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Preface

Until recently, most software applications and technologies were developed without much thought to how they influenced their users. This perspective is changing. Today, industry experts and academics are embracing a purposeful approach to persuasive design. In an industry context, designing for persuasion is becoming essential for success. In academic settings, the study of persuasive technology illuminates the principles that influence and motivate people in different aspects of their lives.

Persuasive technology is rapidly growing into a major discipline, sometimes referred to as captology or the study of computers as persuasive technologies. The previous Persuasive conferences held in Eindhoven (2006) and Stanford (2007) were infused with an energetic spirit and a large attendance, including representatives from both academia and industry.

Persuasive 2008, hosted in Oulu, Finland in early June, was jointly organized by the University of Oulu, Finland and Aalborg University, Denmark. The northern location of Oulu, only some two hours away from the Arctic Circle, offers sunlight 24 hours a day, allowing conference participants to experience the midnight sun.

This three-day conference placed persuasive technology on a firm scientific footing with an emphasis on social, psychological, rhetorical and ethical issues. Featuring full and short papers, posters and panels, Persuasive 2008 highlighted new knowledge in the understanding and design of persuasive technology. The event brought together researchers, practitioners, and industry professionals interested in this important new field. Research themes of the conference included motivational technology, persuasive games, smart environments, Web2.0, mobile persuasion, well-being and health behavior. In addition, attendees and participants explored the theory and ethics of persuasive technology, social and organizational issues, business models for persuasive systems, and conceptual and theoretical approaches.

Persuasive 2008 had three outstanding keynote speakers. Kristina Höök from Stockholm University (Sweden) linked affective computing into persuasive technology; Ian Bogost from Georgia Institute of Technology (USA) criticized the fields focus on technology and ends; and B.J. Fogg from Stanford University (USA) described how online social networks may be used to reach and persuade masses of people.

These conference proceedings contain all three keynote papers as well as the accepted full and short papers. Each of the 63 paper submissions were evaluated through a careful double-blind review process that included three to five reviewers. A total of 17 full papers and 12 short papers were accepted for presentation. We are very thankful for the Scientific Review Committee members as well as the additional reviewers whose insightful work enabled us to select the best papers

for Persuasive 2008. An adjunct poster proceedings volume has been published separately. We considered 38 submissions, of which 25 were accepted for poster presentation at the conference.

For the first time at a Persuasive conference, a doctoral consortium was held in conjunction with conference events. Twenty bright students were selected to attend the consortium based on their research plans and applications.

We would like to thank the University of Oulu and its Faculty of Science, the Department of Information Processing Science, and the Oulu Advanced Research on Software and Information Systems (OASIS) research group, as well as Aalborg University and its Department of Communication for their generous support. The doctoral consortium was kindly funded by the Graduate School of Software Systems and Engineering (University of Oulu) and the Human-Computer Interaction Postgraduate Research School (Aalborg University).

We gratefully acknowledge the City of Oulu for organizing the welcome reception for conference participants, as well as the Federation of Finnish Learned Societies, Nokia, and Polar Electro for sponsoring the conference.

Finally, we would like to extend our warmest thanks to all those volunteers who contributed in so many ways to make this conference a successful and memorable event.

March 2008

Harri Oinas-Kukkonen
Per Hasle

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Affective Loop Experiences – What Are They?

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Abstract. A research agenda for bodily persuasion through a design approach we name affective loops is outlined. Affective loop experiences draw upon physical, emotional interactions between user and system.

Keywords: affective loop, affective interaction, persuasion, bodily interfaces.

1 Affective Loop

In my group, we have for a long time been working with the idea of an *affective loop*, involving both body and mind – inseparably – as a basis for design of embodied interactive affective systems. The idea originally came from performing a user study with an interactive, sensor-enabled, doll named SenToy built by Paiva and colleagues [13].

SenToy is a tangible doll, fitting nicely in your lap, with sensors inside its body allowing users to perform different gestures with it, see Fig. 1. The gestures influence the emotions and actions of a synthetic character in a game. The effort of performing the gestures and their shape resemble six different emotional processes: happiness, sadness, anger, surprise, gloating, and fear. For example, the movement for expressing anger is through energetically shaking the doll back and forth. The experience of doing this gesture resembles the inner experience of anger. In fact, when you perform the angry gesture as part of playing the game, you sometimes become completely immersed, through the gesture, to such an extent that you 'feel' the anger. Obviously, you know that you are playing a game and that you are not angry for real, but nonetheless the experience can be very strong.

But what caught our interest, when performing a user study of SenToy, was not only how different gestures could make you immersed in the game and the emotion processes of your character. We also found that users were influenced by the gestures i avatar performed on the screen. If the avatar, for example, became happy from having successfully attacked some other character, it waved its arms in the air, which was sometimes imitated by our users who waved their arms in the air in response, almost like greeting their avatar or acknowledging their identification with it.

The interaction between how the user gestured with the doll, how the avatar portrayed their input and subsequently responded to the next action in the game, as well as users' imitation of the avatar behavior, going back and forth between user and avatar, became a strong, immersive, interactive loop. It (sometimes) helped the user to transform into being one with their avatar and his emotion processes. It seemed to us

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Fig. 1. From left to right: SenToy doll, user study, and avatar expressing "gloating"

that the gesturing with the doll 'opened up' users body language, making them less inhibited, more willing to play along and be emotionally and physically involved. They became, in a sense, more bodily immersed with the situation.

Some of the gestures with the doll resembled and 'spoke' to users' bodies in such a way that they even experienced the emotional process when they performed the gesture with the doll. For example, to express sadness, they had to bend the doll slowly, forwards. As users were sitting down with the doll on their lap, this meant that their whole bodies also bent over, slowly, forwards. This often made their body and face express sadness. If, on top of that, the avatar expressed sadness in a way that resembled their doll gestures, they would get even more involved in this 'sadness' process.

As the development of SenToy was a research project, the interaction and implementation were not always working perfectly. Sometimes the avatar did not respond quickly enough, the sensors sometimes failed, the avatar's emotional processes were sometimes incomprehensible to the user, and so on. At those points, users would be thrown out of their embodied experience of the game. It seemed to us as if this interaction loop was very sensitive to 'small' interaction issues. To be seduced by the interaction required a very tightly designed, flawless loop – in particular in terms of the physical side of the interaction.

The study of SenToy intrigued us to explore this interactive loop some more. Could we perhaps create various applications, not only games, where physical gestures harmonizing with what was going on in the application would create for similar *affective loops*?

2 A First Definition of the Affective Loop

An important aspect of the SenToy interaction is that users choose which gesture to perform. The doll was not picking up on some automatic, physical, bodily reaction to events. Users actively chose whether to become involved and what to be involved in. This led us to a first definition of the affective loop:

- users first express their emotions through some physical interaction involving their body, for example, through gestures or manipulations of an artifact,
- the system then responds generating affective expressions using, for example, colors, animations, and haptics,

- this in turn affects users making them respond and, step-by-step, feeling more and more involved with the system

The system is not trying to infer users' emotional states, but instead involves users in an emotional, physical interactional process. Users may then choose to be involved or not – it is up to them to make the interaction unfold in ways that make sense to them. The system is only staging the scene for the activity.

This way of describing an interaction design idea is of course quite shallow. To deepen it we needed, and still need, more experience and design knowledge to tell other designers more about how to design for this kind of involvements. The research approach we choose is a practical, design-driven method where we explore the affective loop idea through building several applications. Such a process also shows the limitations of the affective loop idea: will it only be able to generate a few applications, perhaps only within the domain of games, or is this a concept that could be used for many different applications domains?

To this date, we have built four different applications: eMoto [18], Affective Diary [17], Affective Health and FriendSense. The two latter are not yet fully implemented, and so I will focus on the first two here before we come back to a new definition of the affective loop concept.

3 eMoto

As SenToy was a game, we decided that our next application would be in some other application domain. eMoto was created to be a mobile service for communication between friends. Mobile settings are interesting in the way they rely on interaction with a very small device, with a small screen – a 'baby' interface. To us, it seems as if this domain begs for other ways of interacting than touch sensitive screens with bad imitations of the original desk-top metaphor. We therefore decided to extend on traditional text messages by making it possible for users to make emotional gestures that would modify the text messaging using colors, shapes and animations.

From SenToy we had learnt that it was important for the gestures to harmonize with what was shown on the screen in order for users to grasp the interaction. This meant that instead of gesturing with the whole mobile phone and not being able to see the changes on the small screen, we had to find another way for the system to pick up on users' gestures. We decided to work with those mobiles that come with a touch sensitive screen and a stylus. We could then modify the stylus and add some sensors to it, rather than adding sensors to the mobile phone, see Fig. 2.

Similar to SenToy, we extracted a range of gesture inputs that resembled the inner experience of the corresponding emotional processes. The design was built on a so-called Laban-analysis of emotional body language [5]. Laban was a famous choreographer who in the beginning of the last century invented a notation system for transcribing dance and other bodily movements. The two main variables in his notation system, that made sense to our design task, were *effort* and *shape*. Effort describes the inner experience of the energy expenditure of a movement, while its form, in three-dimensional space, is described by the shape-dimension.

We reused our understanding of those two dimensions when we turned to the design task of picking colors, shapes and animations that would correspond to the

gestures. A slow inward movement associated with calmness would render slow, billowing, wavy movements of big, connected, bluish shapes, while an intense, upward directed, happy gesture rendered intense, bubbly, orange animations. The colors and shapes can be seen in Fig. 2. The high-energy expressions with fast animations appear towards the top of the circle, while the low-energy, slow shapes appear at the bottom. To the left, negative emotions are placed, such as anger and depression, and to the right, positive emotions, such as happiness or being calm. The eMoto-circle is based on Russell's circumplex model of affect [16].

It is important to realize that the sensor-extended stylus only picks up on emotions that users choose to express – there is no automatic sensing in the stylus. Movements with the stylus will make them travel in the color circle and they can decide to stop at any time they want. It is also important to point out that the color circle does not have any textual labels explaining which parts of it is supposed to portray happiness, anger or depression. The meaning of the interaction is constructed by the sender and receiver together. It is constructed from the interaction itself – both with the system and between the two friends communicating.

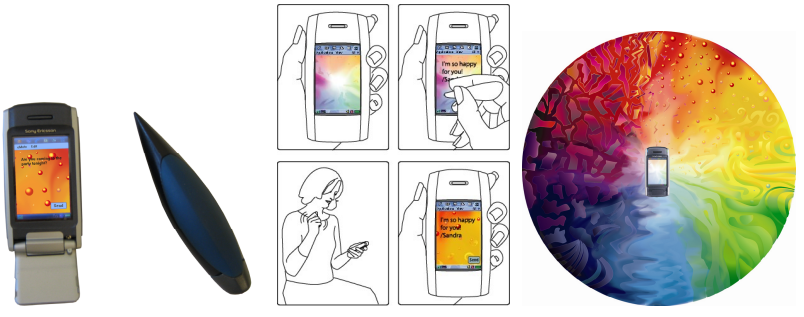

Fig. 2. From left to right: eMoto-pen and mobile interface, eMoto interaction and color circle

The sender of an eMoto-message enters an affective loop experience when they start constructing a message to be sent to a friend. First they write the message, then they gesture with the stylus picking an area from the color circle that best describes what they want to convey, and then, finally, they send the message to their friend. The gesturing reinforces their experience of what they want to convey to their friend. To send an angry eMoto-message, they have to perform angry gestures (using high pressure and a lot of shaking of the stylus) in order to travel to a strong aggressive colorful background.

There is also, in a sense, a 'larger' affective loop going on between the sender and receiver of the message. As the sender is composing the message, she is, in her mind, interacting with the receiver. And when the receiver gets the message, she will realize what emotional gestures the sender has performed in order to arrive at the colorful background of the message.

In hindsight, we could probably have made this 'larger' affective loop experientially even stronger by adding haptics feedback to the message, so that the receiver would not only see the colorful background, but also, through e.g. vibrations, feel it.

3.1 Lessons Learnt on the Affective Loop

When we describe the eMoto system, people worry that the two friends will not be able to understand one-another. Maybe one of them expresses anger through picking a background from the very dark red part around 10 o'clock on the circle, while the other would choose the more energetic animations of smaller shapes higher up in the circle. We purposefully constructed the system with this in mind. We wanted the interaction to develop like a language between the two friends, where meaning would only arise from their knowledge of each other. And, in fact, our 'in the wild'-evaluation of the system with five friends using it over a couple of weeks, showed that users were indeed able to learn how the others expressed themselves and make sense of it. But the 'in the wild'-evaluation study also taught us some other important lessons. Communication of emotions between friends is not simply an information transfer problem; rather it is about physically and intellectually experiencing the whole range of emotions that make up a conversation. Friends will remind each other about their shared past, attempt to share the present, place expectations on the joint future, and attempt to express a whole range of other contextual factors that makes a social relationship. It is impossible to separate the emotion process from the overall social context or from the on-going conversation. Emotions arise from the dialogue; they are constructed, negotiated and experienced by the two friends together.

This casts a different light on designing for affective loop experiences, in particular for communication systems. Friendships can be both strong and fragile. There is a certain rhythm to the communication where we must not forget to be in touch with our friends, answer their messages, returning favors, be careful when we express negative feelings, and make sure that our friendships prosper. Friends also, to a varying degree, need to feel physically close to one-another. In a subsequent study (not yet published) on a group of very close, long-term friends, we could verify that physical closeness is very important to friends. We typically attribute physical intimacy only to romantic relationships, but they also occur between friends, even if they take on slightly different forms, like singing together or giving each other a hug.

Our initial understanding of the affective loop therefore had to be altered to reflect how emotion is inseparable from its social context. Emotion is not a state that can be packaged and sent off to a friend as a separate entity. In fact, the whole notion of broadening the information channel as a means to better emotional communication is missing this point: emotion is an embodied, constructed process – not a state that resides in some particular part of one person's brain.

Physical, bodily interaction is interesting in that it is very hard to distance yourself from it. In language-based interaction we can make use of metaphors, ironies, and in general lie about our real intentions. Such 'lying' is much harder to do in/through your body. The distance that we can create by sitting behind a screen using Facebook or instant messaging is lost.

4 Affective Diary

Reflections on the importance of honesty in bodily processes became the starting point for the next project. This time we wanted to switch domain again and move into the domain of personal emotional reflection. We wanted to create a diary in which

users would be able to reflect on and remember physical/bodily, experiences from their everyday lives. A diary is generally considered to be a book in which one keeps a regular record of events and experiences that have some personal significance. As such, it provides a useful means to privately express inner thoughts or to reflect on daily experiences, helping in either case to put them in perspective. Taking conventional diary keeping as our starting point, we created the Affective Diary system where users can scribble their notes, but where we also record *bodily memorabilia*, constructed from body sensor readings, and *mobile media*, (such as text messages sent/received, photos taken, etc.) collected from our users' mobile phones [17]. A premise that underlies the Affective Diary is one that views our bodily experiences as integral to how we come to interpret and thus make sense of the world.

We had been curious of bio-sensors technology and how it can pick up on various signs and signals that your body transmits when you get agitated, happy, or scared. But it seemed to us that most of the effort in using bio-sensors in the Affective Computing-field is directed at a very hard to reach, and perhaps misguided aim. Their aim is to interpret the low-level signs and signals from the body into different emotion states. In our view, providing *meaning* to emotional processes is a deeply subjective human endeavor, and we wanted to see if we could use the same technology, but involve users in the affective interpretative loop instead.

We started by carrying various available commercial sensors, including the SenseWear bracelet from BodyMedia™. While wearing those sensors, we kept diaries of events in our daily lives that seemed meaningful to us. We scribbled the diary notes and any other time-stamped memorabilia, such as emails or mobile text messages, on print-outs of the sensor-data curves. We could soon see how our own interpretation of our daily lives could be enriched by looking at pedometer data (registering your movements) and GSR (Galvanic Skin Response, measuring the skin's conductivity). While these data could not tell you exactly what you had experienced, they gave interesting indications of events that your body had experienced and most of all, the patterns arising over time revealed aspects of our daily lives to us that we might not always have been aware of.

In short, the system works as follows: as the user starts her day she puts on the body sensor armband on her upper arm and activates the Affective Diary logging system on her phone. During the day, the sensor armband collects sensor data indicating movement from the pedometer, and arousal levels from the GSR-sensor. The mobile phone logging system logs activities on the mobile phone such as SMSs sent and received, photographs taken and Bluetooth presence of other mobile phones in the vicinity.

Once the person is back at home she can transfer the logged data from the armband and the mobile phone into her Affective Diary application on a TabletPC. The armband has a wire that can be used to connect it to the PC and the mobile phone transfers the logged data automatically when docked to the PC. The collected sensor data is presented as, somewhat ambiguously shaped and colored, figures mapped out along a timeline. Above the figures, the materials from the mobile phone are placed according to when in time they arrived (see **Fig. 3**). The window shows about one hour at a time. The representation of the data can be played as a movie, animating the 'body' over time. The body will be more upright standing if the pedometer data shows that the user has been moving around a lot. If the user has been lying down, the 'body' will be lying down. The color of the character will be bright red if the GSR-data

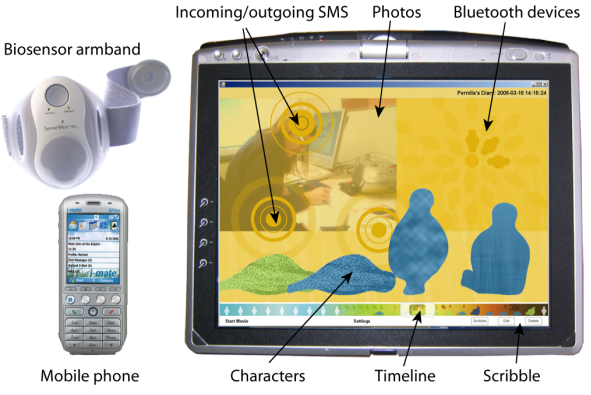

Fig. 3. Affective Diary system design

indicates high arousal and then there is a color scale all the way down to blue that represents very low arousal. What we could not know from the sensor-data was whether users increased GSR-readings because of positive or negative emotions (or simply physical activity). All we could know was that they were aroused. It was therefore important that the character did not look positive or negative.

Users can scribble diary-notes on top of the materials using the TabletPC-pen, thereby connecting events to one another, interpreting the material – providing *meaning* to it.

4.1 Lessons Learnt on the Affective Loop

Similar to the eMoto system, the Affective Diary system does not tell the user what their experience is or should be. The abstract, seal-like, characters that represent their bio-data are purposefully ambiguous, leaving room for interpretation. It becomes an affective loop experience, where users try to remember and re-live everyday events in order to make sense of them.

In a qualitative user study with four users, we could see that to some users this made perfect sense, while some may want much more objective, less ambiguous representations. The data from the user study suggests the Affective Diary's role in a fairly slow cycle of reflection. Perhaps surprisingly, the Diary's sparse detail — displaying time, day, text messages, Bluetooth presence and representations of physiological state—gradually became meaningful, at least at times, for the participants. What appeared to be particularly important in this process of reflection and learning was the ability to see patterns arise between their figures and the situations they found themselves in. For example, one user noted that she was always more stressed those days when she had to work from her workplace rather than working from home. Another subject noted that she was typically very calm when she was in the middle of a quarrel, but then she would typically go jogging 3 – 4 hours after the event, expressing her reactions only to herself. In short, the process built on the long-term use of the Diary and the capacity to visualize patterns and map connections over time.

In different ways, our participants' interpretations of the Affective Diary revealed that measurements read from the body are not necessarily linked to subjective experiences in

any straightforward way. Also, similar to how emotion could not be seen as an individual experience when using the eMoto-system, the Affective Diary study showed how meaning is created from a mixture of physical, emotional, bodily experiences and social context and memory of past events. What we found with the Diary is that its users 'massage' their collected materials into accounts that are meaningful to them.

Affective Diary is quite different from both eMoto and SenToy since it builds on autonomous body reactions rather than conscious gestures, expressing and inducing emotions. Instead users are involved in a slower, reflective affective loop where memories of past events are re-interpreted, re-lived and perhaps experienced in a new way in the light of the displayed memorabilia in the diary.

5 A New Understanding of the Affective Loop

Lacking from the original description of the affective loop above was a description of how our human, physical, bodies can be an arena for embodied experiences where social and bodily practices are intervowen. SenToy allows for a fast, contagious bodily experience where the user is immersed in a virtual world – a magical circle inside which the game rules, game environment and the interaction with the doll, define the experience. eMoto and Affective Diary on the other hand, are placed out in the 'real' world where culture, expectations and social rules determines what we can understand and how we can act. Affective Diary differs from both eMoto and SenToy in that the affective loop experience happens in a reflective process, sometime after the events that are portrayed. The experiences from building these systems have enriched our understanding of the affective loop as a basis for designing for emotional experiences. A new definition of the affective loop should therefore involve the following statements. In an affective loop experience:

- emotions are seen as processes, constructed in the interaction, starting from bodily, cognitive or social experiences
- the user is an active, meaning-making individual – the interpretation responsibility does not lie within the system
- affective loop creates for non-dualistic, non-reductionist experiences

While I have decided to focus on the three systems I have been part of building, there are of course a range of other systems both in academia and in the commercial world that we can draw upon. One very nice example is the BreakAway sculpture [10]. A sensor in the office chair is connected to a sculpture on your desk. When you have been sitting for too long, the sculpture starts slouching and looks more and more tired. If you get up and move around for a while, the status goes back to a more relaxed position. The aim is, of course, to change the behavior of sitting too long at your desk.

In the commercial world, we see a wave of tangible and haptics interaction devices, including the WII, Guitar Hero, mobiles with accelerometers and vibrations, and various sport devices with sensors built into shoes, t-shirts and armbands. This wave of bodily interfaces, in various ways, draws upon emotional involvement.

While persuasion is not the main goal of affective loop interactions, there are some interesting similarities. Fogg's definition of captology [8] is that it *should attempt to change attitudes or behaviors or both*. This rhymes very well with, in particular, the

Affective Diary system. By making users reflect on the connection between their bodily and social experiences, they may bridge the dualism gap and visualize the tight coupling between bodily reactions and life in general. This in turn may change their behaviors. Overall, persuasion that involves our whole being, body and mind, individual and social, is an interesting challenge.

6 Explaining the Affective Loop Experiences?

Above, we have hinted at some issues for the practical design processes in which we may want to make use of affective loops to get users more involved. But this does not explain what is really going on here. Where is the theory that could explain these affective loop experiences? Is it a theory on how cognition works, or can we borrow from some other discipline to explain them?

As a first step towards answering these questions, we need to question one of the fundamental dualistic perspectives in the Western culture: that of separating mind and body. In the work by Damasio [3] that underlies much of the development in the affective computing field [15], he questions whether we can at all separate emotion from thought, and emotion from body – in many cases built on findings in neurology and cognitive science. In the SenToy, eMoto and Affective Diary examples above, the designs are consciously constructed so that emotion is not separated from body nor from the overall social context. Instead, the implementation follows an *interactional* perspective on emotion. Boehner et al. [1] describe emotion as "culturally grounded, dynamically experienced, and to some degree constructed in action and interaction". That is, emotions are created in a co-constructed, co-interpreted fashion. They are *lived*. This is why we avoid talking about emotion states and instead refer to emotions as processes. They are constructed, actively, interactively, together with others, in dialogue with our bodies, our minds and our social context.

Emotion theory draws upon many different scientific disciplines, from such varying perspectives as neurology, medicine, psychology or sociology. There is no way we can cover all these fields here, but let us provide some at least some glimpses related to affective loop experiences.

In neurology, LeDoux goes even further than Damasio and shows how fear-inducing stimuli is short-circuited directly to physical, bodily reactions even before we experience the emotion consciously [12]. In psychology, Parkinson and colleagues [14] discuss the role of emotion in social relations. While most psychologists are focused on individual and intrapsychic processes, their focus is on the social, cultural and interpersonal aspects. Just to bring out one example from their work, they discuss how emotion is contagious in interpersonal processes. One person's tone of voice, body posture or smile, can be contagiously influencing others so that they start experiencing the same emotions. As they point out, this is not a one-shot process, but a mutual contagion. But, of course, there are regulating factors that (most of the time) stop the process from becoming a rising panic or mass hysteria. They also show how emotion is a regulatory process for bringing up children, how emotion is related to culture and how emotions align and realign interpersonal and intergroup relations.

While we agree with the overall characterization that Parkinson and colleagues provide us with, they work very much within the boundaries of traditional psychology

where the actual *subject* is lacking from the interactional process. In ethnography, the work by Katz [11], provides us with a richer account of how people individually and group-wise actively *produce* emotion as part of their social practices. When he, for example, discusses anger among car drivers in Los Angeles, he shows how anger is produced as a consequence of a loss of embodiment with the car (as part of our body), the road and the general experience of traveling. He connects the social situation on the road; the lack of communicative possibilities between cars and their drivers; our prejudice of other's driving skills related to their cultural background or ethnicity; etc. and shows how all of it comes together explaining why anger is produced when, for example, we are cut off by another car. He even sees anger as a graceful way to regain embodiment after, e.g., having been cut off by another car.

A philosophical home that many believe can have a major impact on design of bodily interfaces is that of phenomenology [7]. A phenomenological account of human cognition places us in dialogue with the world around us. Our way of thinking depends on the tools our culture provide us with as well as the social and bodily practices we learn from others. A phenomenological perspective on affective loop experiences offers a way of explaining how we create meaning from our interactions with the world. Our experience of the world depends on our human bodies, not only in a strict physical, biological way, through our *experiential body*, but also through our *cultural bodies* [9]. Physical, bodily practices are learnt in dialogue with others and our culture. Emotions are experienced through the constitution of our experiential body. Primal emotions, such as fear or anger, make our autonomic nervous system react, change the hormonal levels in our body, change our facial expressions and focus our senses and cognition, preparing us for flight or fight behavior [4]. Secondary or social emotions, such as shame or pride, crucial to our ability to maintain social relationships, also have associated corporeal processes affecting our body, facial expressions, body posture, and cognition [19].

But we do not make sense of our emotional reactions as biological processes nor are we predetermined to react in only one way to a particular circumstance. Emotion is a social and dynamic communication mechanism. We learn how and when certain emotions are appropriate, and we learn the appropriate expressions of emotions for different cultures, contexts and situations. The way we make sense of emotions is a combination of the experiential processes in our bodies and how emotions arise and are expressed in specific situations in the world, in interaction with others, colored by cultural practices that we have learnt. Designing for embodied representations of emotional experiences should thus ideally relate to and build upon both the experiential and cultural body.

But what is lacking from the glimpses I have provided here from range of different scientific disciplines is the actual *subjective experience* of interacting with SenToy, eMoto or Affective Diary. In a sense, the perspectives provided by neurology or psychology as discussed above, convey a reductionist idea – that it is possible to understand human thinking and sense-making if we only model enough of the signs and signals our bodies sends in the neuro-system or convey between people through their facial expressions, tone of voice, etc. Designing systems is also an art-form that recognizes human beings as something else than machines built in wet-ware. To get at those aspects, we might have to turn to the humanities or arts to get proper inspiration. Our subjective experience of being involved in affective loops is, in this perspective,

difficult to define and measure, and perhaps should not be in any simplistic sense. Affective loop experience is in that sense similar to concepts such as aesthetic experiences, subjectivity or *gameplay* in games; you know when you experience them, but they cannot be divided into their subparts and analyzed as separate entities that can then be added together as in an equation, calculating its 'experience-value' [6].

7 Questions

Digital products that attempt to set the scene for emotional experiences, bodily interactions, persuasive processes, aesthetic experiences and other experiential qualities, are gaining grounds both in the commercial world and in the so-called "third-wave of HCI"-movement within academia. This movement places some hard questions to us as researchers. Above, I have hinted at questions specifically related to affective loop experiences, such as:

- what kind of knowledge can we gain on how to design for affective loop experiences?
- is the affective loop design concept able to generate a whole class of systems and what are those?
- how can we explain the physical, emotional, social and subjective experience of being inside this kind of involving interaction?

On a meta-level, the whole movement of third-wave HCI is facing a range of very difficult methodological challenges as it is in a way a paradigm shift [2]. By which methods can we capture and discuss subjective experiences? To avoid reductionist ways of accounting for subjective, aesthetic or indeed affective loop experiences, we do believe that it is possible to find a middle ground where we can actually speak about qualities of experiences and knowledge on how to design for them without reducing them to something less than the original. This does not in any way mean that the experiential strands, or qualities, are universal and the same for everyone. Instead they are subjective and experienced in their own way by each user.

A new kind of rigor in research is called for when we start mixing these kinds of design issues with more scientific endeavours of understanding human emotion and persuasiveness. Producing (design) knowledge in this area may feel like a daunting task as the qualities we strive to capture are highly elusive, subjective, context- and application-specific, and relates to values such as aesthetics, fun, meaning-making or being emotionally close to others. But this does not free us from figuring out a way to address this field.

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Fine Processing

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Abstract. This article first presents a series of concerns about the concept and field called persuasive technology, including an overly broad focus on technology instead of computation, and a focus on ends instead of means. As a possible solution, an alternative perspective is offered, dubbed *fine processing*, which is modeled after the concept of *belles lettres*.

1 A Brief History of Technology

I suspect some years hence, we will look back on the term *persuasive technology* with something of a wry smile. Not because the work done under this shingle will appear antiquated, poorly conceived, or ill-argued. Rather, precisely because the dominant technology in culture will have changed. In this future, our assumption about the particular *type* of technology that is our subject today will seem quaint.

Technology is both a very old word and a relatively new one. The first half of the word comes from the Greek τέχνη [technē], originally a reference to a craft or an art, a method used to produce some kind of object. Technical activities in this sense of the word associated more readily with what we would now call the arts, practices such as painting, sculpture, and weaving for example. But the Greeks considered other sorts of human craft to be tekhnē, including practical arts like medicine and barbering. A tekhnē, in other words, was a generic term that referred to many different types of manual crafts.

Ironically from our contemporary perspective, these tekhnē were generally considered lower class activities, since they involved manual labor. The upper classes would have pursued activities of the mind, like philosophy, instead. Such a distinction had its future in concepts like Immanuel Kant's *Conflict of the Faculties* [8]. Kant distinguishes between "higher" and "lower" faculties, where "high" involves practical reason and "low" involves theoretical reason. The higher faculties, of which technology is one, serve interests outside the university, bound to external ends and thereby to the interests of business and government. The lower faculties, by contrast, are autonomous activities, pure and unsullied, separate from the interests of law or business. This is the domain, once again, of philosophy and criticism.

Kant's ideas inspired William Von Humboldt's design for the University of Berlin which, as Mark Taylor has observed [11], forms the foundation of the modern university via the distinction between professional schools and the faculty of arts and sciences. For better or worse, we have built atop that foundation since the 19th

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century. The applied sciences and engineering, with their predictably useful, productive, profitable graduates and research findings, oppose the unpredictably useful, unproductive pure sciences and the arts. In the United States, one artifact of this development are the many institutions established by the Morrill Land-Grant Acts of 1857-1862. Under these statutes, a parcel of federal land was turned over to each state, to be used to establish or fund the creation of universities to teach agriculture and the "mechanical arts."

It is in such institutions that we find the derivation of the second half of *technology*. In Greek a λόγος [logos] is another very general term, meaning a discourse or an account, an explanation, theory, or argument. We usually understand the derived suffix *-ology* as the study or interest in a particular subject. In the case of the study of tekhnē, it has largely been, and largely remains, a project of the "higher" faculties, of professional schools, and of engineers. The apparent origin of the term in Greek, τεχνολογία [technologia], was actually coined not by Greeks but by the Roman orator Cicero, who uses the term (in Greek) to refer to the systematic treatment of a subject [4]. The Greeks, it turns out, had little concept of technology in the sense we mean it today: the general application of scientific knowledge for practical purpose.

Perhaps not coincidentally, *technology* in Cicero's sense entered the lexicon of modern languages around the same time that technical education in von Humboldt's sense became institutionalized in the West, both in the University of Berlin and its followers and in the American land grant institutions.

Traditionally, the "lower" faculties have resisted the instrumentality of the "higher" ones. The impoverishment of the artist or the monasticism of the humanist are archetypes, perhaps even stereotypes of such resistance. In Martin Heidegger's famous critique [7], technology establishes a bad precedent in which nothing is ever good in itself, but only as instruments for other tasks. Despite the supposed disinterest of modern science, Heidegger argues that technology seizes upon all worldly resources and attempts to treat them as the means for another end. *Thinking*, a word at least one philosopher has used to oppose *technology* [5] dissociates itself from productive ends, even embracing wastefulness as a virtue.

There are three lessons we can draw from this partial history of the concepts of technology in the context of persuasion.

1. Using *technology* as a general name for anything, including a particular venue for persuasion, is a naïve and perhaps even a dangerous pursuit.
2. The means of persuasion by some particular technology is as relevant a thing to study as the ends.
3. A focus on one and two allows us to understand something we have not yet done in the field we have been calling persuasive technology, namely the ways computation creates beauty, and the way computational beauty can lead to persuasion.

2 Not Technology but Computation

Technology is a historically contingent term, and when we use it to refer to the type of technological practice currently in vogue, we risk ignoring both the broader cultural complexity of the concept and the specific social, cultural, and material details of a

particular kind of technology. Metallurgy, the alphabet, and computation can all be considered technologies, but despite one can hardly be interchanged with another.

Admittedly, there are many different kinds of technology that have a strong impact on contemporary lives. Some of these are "high-tech," like computation and nanoscience, but others are very "low-tech." At the 2007 Persuasive Technology conference, one keynote speaker presented a plastic clicking device used to train dogs and, hypothetically, people as well. At least one paper in this year's proceedings discusses the ways architecture, urban planning, and the design of public spaces influence what people can and can't do in public and private. One such object is the Mosquito anti-teenager device, a box that emits a very high frequency noise that kids and teens hear as a piercing squeal, but which the older ears of adults often can't hear at all. As a technology, all the device does is emit sound at a specific frequency, but the result is effective enough to inspire its controversial use as an anti-loitering device.

As a general approach, the name *persuasive technology* could easily take on a very general meaning, as the dog clicker and teen buzzer testify. While promising and even compelling, the idea of persuasive technology as a general field, capable of addressing the ways many technologies impact human belief and behavior is a double-edged sword. On the one hand, such an approach would make persuasive technology more historical and comparative as an intellectual domain. On the other hand, this approach would draw us even further away from computation as a persuasive technology.

In my book *Persuasive Games* [2], I issued a set of objections to *persuasive technology* as advanced by B.J. Fogg in his important book *Persuasive Technology* [6]. My first gripe, which relates to lesson one above, relates to *persuasive technology*'s on again, off again relationship with computation as a specific type of persuasive technology. Despite his definition of "captology" as "the study of computers as persuasive technologies," I argued that most the principles Fogg outlines are not native to the computer. The computer, I suggested, takes *procedurality* as its main and unique symbolic property. Procedurality is the computer's ability to model situations and ideas through the use of computational process. It is a type of representation that differs from other, more familiar forms, such as speech, writing, or images. The main tools Fogg outlines for persuasive technology (reduction, tunneling, tailoring, suggestion, self-monitoring, surveillance, and conditioning) may all be made more facile thanks to computation, but none are a means entirely native to it. Consider an example: in the case of architectural technology, one can safely assume that today's buildings and benches are probably designed on computers, but that hardly makes the objects themselves computational. The broader question of persuasive technolog*ies*, in the plural, may well be an interesting one worthy of pursuit. But the fact that architectural and structural design influence behavior *technologically* may be too great a temptation for a field that has not yet mastered computational persuasion, the primary medium in which the field has located its research.

In other words, there seems to be a gap, even a broken promise, in the connection between persuasive technology and computation. One way to begin closing this gap is to ask how persuasion is changed fundamentally by computational inscription.

3 Means and Ends

Technology has a complicated relationship with progress; indeed its very capacity for progress remains so controversial that it can serve as a sort of nickname for the most fundamental of conflicts within the academy, that of the so-called "two cultures problem" [10] that evolved from Kant's model of the university. Today still, *technology* is a bad word to many minds.

My second gripe, which relates to lesson two above, argued that the tools of persuasive technology are often used exclusively in the support of ends rather than means. A website "tunnels" a user from browsing to purchase. A heart-rate device allows a user to self-monitor and adjust behavior based on digital output. An exercise bike conditions a rider by rewarding him with a television image when a target speed is reached. A surveillance system dissuades a knowing subject from taking the wrong action, as defined by his surveyors, through implicit threat. These techniques might produce desirable *ends*, from the perspective of the creator or sponsor of a persuasive technology. But they do not necessarily produce desirable *means*.

In *Persuasive Games*, I suggested that the gap between means and ends tore open into a chasm of method. *Persuasive technology* understands persuasion as social influence, with success measured by reaching ends as defined by the persuaders. In such a domain, empirical methods rule, and persuasion involves creating relationships of trust and then action between the technology and some external goal that can be quantitatively monitored. The intended result of such persuasion is a change in *action*, which in turn might be scientifically measured and accounted for. I contrasted this type of persuasion with *rhetoric*, the use of arguments to make claims about the world and, in so doing, to change people's opinions about that world. The intended result of rhetorical persuasion is a change in *thinking*, which may or may not have a direct relationship to measurable action—indeed, even if it does, that change of thinking might take place in complicated and longitudinal ways, such that neither creator nor interactor might be able to put a finger on exactly when and how the persuasion took place, or indeed if "persuasion" is even the correct word for this kind of complicated relationship.

I suggested a different theoretical framework, which I have called *procedural rhetoric*—the practice of using processes persuasively, especially computational processes. The difference between rhetorical and psychological persuasion, I suggested, mirrors the difference between deliberation and action. The problem with action is not that it is concrete or measurable—certainly the result of any media experience throughout history has been a change in the reader, viewer, or interactor's ideas and actions in the world, even if in subtle ways. Rather, the problem lies in taking the result as the sole bearer of value in the persuasive relationship between computer artifact and human being.

One way of understanding this objection is as an instance of the conflict of the faculties. Indeed, both objections trace the distinction between Kant's higher and lower faculties—they sport a distinction between means and ends. Rhetoric offers an attractive alternative or supplementary as a model for computational persuasion thanks to its addition of deliberation as a primary outcome of interaction with a computational artifact. But we can take the matter even further.

4 Fine Processing

For Kant and his progeny, there is always something economic about the conflict of the faculties. One way of valuing the outcomes of the high faculties is through material benefit, activities that take place today primarily in capital markets. Another way of characterizing the value of outcomes is through control, either at the hands of governments, corporations, or other institutions of power. Once the acquisition of money or power is involved, some argue that the latter sort of of persuasion always risks abuse. Such attitudes lead away from persuasion and toward coercion, the deliberate pursuit of outcomes irrespective of the wishes of the agents involved in the process. This is one of the concerns I voiced in my objections to persuasive technology in *Persuasive Games*, that "captology" risked becoming manipulative rather than persuasive. This issue remains valid and should serve as a strong warning to persuasive computing projects. But it's not the whole story.

There is another reason to pay closer attention to the means by which computational persuasion takes place. A downside of an overzealous focus on outcomes is that we tend to lose all the richness and wonder of experiences in our chase for them. Encounters with computer artifacts are experiences as frequently as they are tools. And understanding experiences requires a different focus.

In rhetoric, we are fortunate to have a long and rich history of widely varying approaches to persuasive expression. A very quick, incomplete history lesson is in order.

4.1 Belles Lettres

Although the Renaissance took great interest in classical antiquity as a subject of scholarly study, it also revisited craft as an activity worthy of respect rather than disfavor. Thanks to the movement known as *humanism*, the works of human creativity took center stage not just as powerful instrument but as disinterested delight. Arguing that language was a tool humans uniquely used to access and communicate the world, poetry took philosophy's place as the dominant medium for worldly transformation. While this trend shifted back toward rationalism and empiricism in the Enlightenment, the Renaissance set a permanent place for artistic productivity as a type of rhetoric.

Attempts to combine art and logic were common to the enlightenment, including George Campbell's effort [3] to define "faculties" of the human mind such as pleasing the imagination and moving the passions. Another trend focused less on merging art and reason and more on celebrating the former's qualities as form rather than truth.

B*elles lettres*, or "fine letters," was one name given to this second trend. The term can refer generally to the aesthetic qualities of art of all kinds, including tone, style, and other formal properties. But more specifically, *belles lettres* also implies the craft of constructing and critiquing discourse itself. Among the innovations in belletristic rhetoric were Hugh Blair's insistence [1] that taste and sensory pleasure take a part in rhetorical study. The importance of *belles lettres* centers around the construction and form of artistic artifacts of all types, in addition to or rather than their meaning.

In more modern times, *belles lettres* has evolved to account for those works that possess aesthetic and expressive merit but which fall outside the normal purview of

more established genres of expression. For example, expository, extemporaneous, critical, and epistolary writings fall into this category. Of these types of work, it is perhaps no accident that many focus on personal accounts, subjective claims, and expository styles. This is the domain of memoir and literary criticism, of journal and essay, of travelogue and public address.

4.2 Computational Bellettrism

The *lettres* in *belle lettres* originally referred specifically to literary creativity, but history has extended the term's meaning to inscription beyond writing. The photographic essay is one example, a series of images meant to convey a set of ideas, an argument, or just a sensation of a place, time, or subject. Whereas the written essay or critique uses language to express its ideas, the photo essay uses images.

A question worth asking is this: what would be the computational equivalent of the essay, the critique, the journal? It would have the same goals as those genres do when crafted in other forms, but just as the photograph inscribes with images—its native means of inscription—rather than words, so the software would inscribe with something native to the medium of computation.

As I suggested above, that means of inscription is *procedurality*, the crafting of computational processes that represent worldly processes. A computer artifact like a videogame, a work of interactive fiction, or any other type of software constructs a procedural model of something in the world, making claims about how that system works, or how it might work differently. This is a topic I've discussed in detail before, mostly in relation to the topic of persuasion. One of the observations I've often made is that creative software artifacts can make arguments by modeling ideas about the world that are different from the ones in the minds of players, at least some of the players some of the time. This experience of dissonance between expectations of the world and its reality creates opportunities for persuasion. When we put the two models together, we see where they converge and diverge—this is what we do when we play videogames or use software critically.

But like approaches that focus solely on outcomes, this approach too lends most of its attention to the experience someone takes away from a computational artifact. What about the experience of using it? Clearly the way a videogame or software system is constructed and the ways it behaves exert a non-trivial effect on the experience the user takes away from it, including whether or not that experience leads to deliberation *or* more explicit, measurable outcomes. Unlike the usual questions asked in the field of Human Computer Interaction (HCI), the present one is not concerned with efficiency of accomplishment, completion of tasks, or measurement of external success. This is a question of aesthetics, not effects.

Although the term *belles lettres* is largely historical and medium-dependent—no one suggests *beaux images* as a description for essayistic photography—it is nevertheless useful to understand the spirit of my suggestion by borrowing the name. What we need is a practice and a theory of "fine process," of *beaux traitements*, if you wish to render it in parallel French. From the perspective of theory, such an approach would focus on the aesthetic fineries of crafting representation through process rather than language or image, From the perspective of practice, such an approach would focus on the methods and techniques for practicing fine processing.

4.3 An Example, *Passage*

This article is not intended to lay out a detailed first pass at a theory of fine processes, but rather as a provocation for such future work. That said, I do want to offer an example as a compass bearing.

Passage is an unusual videogame created by U.S. artist Jason Rohrer. It was originally conceived for and released in the game art exhibit Gamma256, which took place on 28 November 2007 in Montréal. The exhibition specified only two rules: games must use the XBox 360 controller as an input device, and they must have a resolution of no more than 256x256 pixels. Smaller resolutions, including non-standard ones, would fall within the constraint. *Passage* has the latter footprint, a narrow window of 100 x 12 pixels (plus another 4 on top to display a "score"), as shown in figure 1.

The player controls a young adult man, abstracted through the pixelization of the resolution constraint. As the game begins, the player can move in any direction along a strange path of shapes that seem naturalistic on the one hand, but distorted on the other. For example, when the game starts, the player can see a strange thin form within reach. As he moves toward it, to the right side of the screen, the image resolves into a female character. The player can choose to couple with this character, in which case the two move together as one for the rest of the game. He can also steer around her and go it alone. Then the player steers a straight path across the game's abstract landscape, which is procedurally generated at runtime from a small number of constituent tiles. Moving down past the thin window of a screen scrolls the world, revealing a rich maze-like topology. Throughout this maze, treasure chests are scattered, some of which open to reveal stars, others dust. Moving in a straight line insures no encounter with obstacles of any kind, but also none of the treasure chests scattered throughout the environment. Capturing stars from chests constructs memories that can be seen later.

Over time, the characters age and change appearance, their hair color, clothing, gait, and speed of movement reflecting their progression through life. A player who pursues the treasures in the environment will quickly note that some which appear close and accessible quickly reveal their true inaccessibility. Others are accessible only by the lone man, impossible to reach when traversing time as a couple. Subtle visual patterns on the chests indicate whether not they will yield a treasure, another pattern the player can learn with experience.

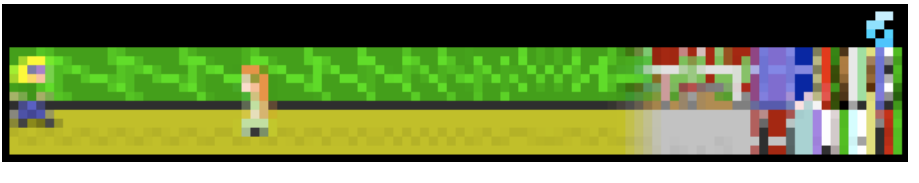

Fig. 1. A screenshot of *Passage* during play. Here the player is about to encounter the woman with whom he can choose to couple. Note the compressed future time, representing opportunity, on the right side of the screen.

The game always runs for exactly five minutes. Near the end, if he has taken a spouse, the woman will die, her form transforming into a tombstone. The player crouches still further at this point and lumbers even more laboriously under the pain of mourning. Soon after he too dies, his tombstone created at that spot, and the game ends. It is up to the player to decide if the man will go on without her, pressing further on into life, or wait by his beloved's grave such that his might find its eternal place next to hers, as shown in figure 2.

In his creators statement, Rohrer calls *Passage* a *memento mori*, a reminder of mortality. The game represents life as a passage through space, with some decisions opening new avenues or new experiences, others precluding future ones. Wisdom and experience are simulated through the placement and logic of treasure chests. Opportunity and sacrifice are represented through the coupling with a partner, and aging and loss also find their place in the game.

The richness of representation in *Passage* is surprising given its visual and experiential simplicity. The game doesn't look like much compared with today's verisimilitudinous, high-gloss commercial titles. The player of *Passage* can't do very much, in fact he can only move around. The game pad buttons yield no satisfaction. Yet, it would be insufficient to suggest that the game's power comes simply from simplicity; in fact, its visual simplicity derives from a much more complex set of procedural representations. It is in the crafting of these rules of behavior that produce the representation that we can see how *Passage* exhibits fine processing.

Let's consider one such process in a little more detail. In order to support *Passage*'s translation of time into space, Rohrer devised a way to render space as visible, yet distorted. He explains in the game's creators statement [9]:

> The early stages of life seem to be all about the future: what you're going to do when you grow up, who you're going to marry, and all the things you're going to do someday. At the beginning of the game, you can see your entire life out in front of you, albeit in rather hazy form, but you can't see anything that's behind you, because you have no past to speak of. As you approach middle age, you can still see quite a bit out in front of you, but you can also see what you've left behind---a kind of store of memories that builds up. At its midpoint, life is really about both the future (what you're going to do when you retire) and the past (telling stories about your youth). Toward the end of life, there really is no future left, so life is more about the past, and you can see a lifetime of memories behind you.

The topology through which the player progresses is visible in a rough way, such that the player can regard the colors and patterns at the right of the screen and imagine what their corresponding scenes might look like when reached. When he finally arrives at them, however, the reality is sure to be different than the expectation—not better or worse, necessarily, but different. Likewise, as those experience recede into memory, the game renders them again as compressed lines, this time on the left side of the screen, in the past. Here again the player can regard them and remember the space they represented in the lives of his characters as that time was rendered in space. But even in the course of a five minute game, short-term memory makes the details of those topologies evanescent, along with the specific actions the player took

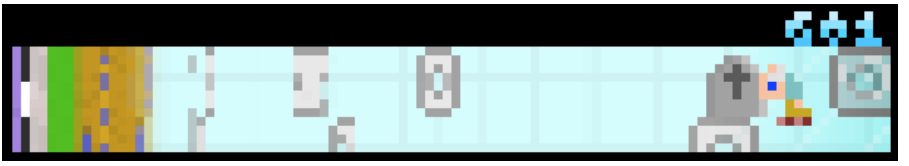

Fig. 2. A more detailed look at the game's rendering of unseen time. Note the construction of "memories" as compressed graphical renditions of areas and experiences the player has undertaken during play, compared to the "opportunities" depicted in figure 1.

to accomplish them—whether he pursued a particular treasure with resolve, or meandered willy-nilly through the maze, or cut a straight course, pressing forward for another, unseen terrain.

It's hard to get across in description and screenshots, but this terrain evolves dynamically as game time passes, the whole screen adjusting slightly as different views on time, as it is represented through space, are distorted by the algorithm used to render the landscape. These transitions blend seamlessly one to the next, offering visual interest, but more importantly allowing the underlying procedural representation of space as distorted expectation and memory of time to come through.

4.4 Fine Processing and Persuasion

The result of *Passage* is not persuasive in the usual sense. This is not a game about fidelity, or wisdom, or mourning, although it suggests all of those themes and many more. The game does not hope for any particular action or reaction from the player, but it does trace a set of ideas upon which he might deliberate.

Passage is both autobiographical and universal. For one part, Rohrer embedded aspects of his own life experience into the game. In his words again:

> And if you're wondering, I do have light hair and blue eyes, and my spouse does have red hair and green eyes. When I was younger, I wore a green shirt, blue pants, and black shoes. Now my favorite outfit involves white shoes, brown pants, and a black shirt. My spouse used to have a light-green dress that was her favorite. And yes, my hair line is starting to creep back. That's me and my spouse in there, distilled down to 8x8 pixels each.

For another part, Rohrer's own experience of the themes he presents in *Passage* apply equally well to anyone's life. No matter if we consider the game autobiography or morality play, the aspects of the game that make it meaningful are both aesthetic and representational. During and after an experience with *Passage*, the player reflects *both* on the game's theme (the passage of a life, the fragility of decisions) *and* on the aesthetics that relate that theme (the compression of time as space, the distortion of memory and opportunity). The one is a window to the other. And a reflection on the themes of *Passage* encourages, indeed requires a reflection on the processes used to construct them. Just as an appreciation of the craftsmanship of language and form in a travelogue, or of composition and exposure in the photographic essay, or of cinematography and production design in the short film lend context, credence, and

support to the claims of an artifact, so an appreciation of the craftsmanship of process lends such support to this game's claims.

5 Conclusion

In *Persuasive Technology,* Fogg writes about professionalism of design and execution as a factor in building trust between people and machines. For example, a well-crafted website that completely and clearly explains the tasks required to complete an online purchase is likely to build more trust within the human actor, leading to stronger persuasion toward a purchase. But there is a difference between professionalism of craftsmanship and what I am calling fine processing. *Passage* certainly exhibits polish and thoughtfulness of construction, but it does not do so in the way that other contemporary professional titles do; in fact, the value of its procedural aesthetic comes partly from a distinct sense of hand-craftedness. Rather, *Passage* breeds deliberation through a tight coupling of procedure, image, and expression. The player's experience is less one of reaching a goal than one of considering the processes elegantly presented by the game.

While it does not fully describe every approach to persuasive technology, fine processing offers an example of one approach that addresses the problems I suggested earlier: it focuses on computational expression as a unique and distinct kind of inscription, and therefore of persuasion; and it distances itself from more strongly outcome-based approaches to persuasion, dealing more with means than with ends. The result offers a new perspective on how creativity and form in software participate in persuasion, through beauty rather than duress.

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Mass Interpersonal Persuasion: An Early View of a New Phenomenon

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Abstract: In 2007 a new form of persuasion emerged: mass interpersonal persuasion (MIP). The advances in online social networks now allow individuals to change attitudes and behaviors on a mass scale. MIP has six components: persuasive experience, automated structure, social distribution, rapid cycle, huge social graph, and measured impact. Before the launch of Facebook Platform, these six components had never come together in one system. As tools for creating MIP become available to ordinary people, individuals and small groups can better reach and persuade masses. This new phenomenon will change the future of persuasion.

Keywords: persuasive technology, captology, social networking, persuasion, Facebook, mass interpersonal persuasion, MIP.

1 Introduction

A new form of persuasion emerged in 2007: I call it "mass interpersonal persuasion" (MIP). This phenomenon brings together the power of interpersonal persuasion with the reach of mass media. I believe this new way to change attitudes and behavior is the most significant advance in persuasion since radio was invented in the 1890s.

Before describing MIP in more detail, I want to set expectations. This paper is the print version of my keynote address for the Persuasive Technology 2008 Conference. I have three goals in speaking: to highlight an important new trend in captology, to provoke new ways of thinking, and to share my opinions and experiences. It's a relief that my work here need not be perfect to achieve those goals. These ideas are sure to evolve. To account for this reality, I will post on my website updates to this paper, citations to related work, and comments from other people. In this way, we all learn more about MIP.

2 Facebook Makes a New Form of Persuasion Possible

The emergence of MIP became possible recently because Facebook, a social networking service, created a new way for third parties to create and distribute

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interactive applications (web apps) to the millions of people linked in an online social network. Facebook made this possible on May 24th, 2007, when they launched Facebook Platform (their API and related tools).

Before the launch, I was under a nondisclosure agreement with Facebook. I was invited to be a Developer Partner and would demonstrate what a third-party developer could do with the Facebook Platform. After learning about the confidential plans for Platform, I knew that Facebook's innovation would have big implications for the tech industry, but I didn't know for sure how users would respond; no one did.

On the designated day, I gathered with other Facebook Developer Partners for the Platform launch event in San Francisco. After the ceremonial announcement, the audience was turned loose to roam the exhibit hall and see what the Developer Partners had created. My team had built two applications that allowed voice interactions online. Other Developer Partners created apps that allowed Facebook users to share music or photos. A few companies created social games that people could play online. Overall, about 60 third-party apps were on display.

Within a few days after Facebook Platform launch, public metrics showed how quickly some of the third-party applications grew. Day after day, I saw how Facebook's innovation would allow persuasion to take place, from one friend to another, on a massive scale never before possible. Most Facebook app developers were acquiring thousands of users each day. This was exciting. But the real story involved millions, not thousands.

One company named iLike acquired over one million new users in the first week[1]. Their Facebook application quickly persuaded millions of people to give up personal information about their music preferences[2]. Some of these people were later persuaded to buy concert tickets with friends. As the weeks progressed, I saw how a handful of small companies had tapped into a new phenomenon in persuasion.

As more third-party developers were learning to leverage MIP, Facebook grew quickly over the next few months. In the 16 weeks following Platform launch, Facebook added over 18 million new members. At the end of 2007, Facebook had well over 50 million users, doubling the 24 million they had in late May.

In response to Facebook's surge, other social networking services announced they would also open their platforms to third-party developers. To me, this signaled that MIP wouldn't be just a Facebook phenomenon. This new form of persuasion would become mainstream. The path ahead seemed clear: With the emerging platforms and development tools, ordinary people would be able to create apps and distribute them through social networks online. A small percentage of the creations would reach millions, persuading people in ways that are sometimes trivial and sometimes important.

3 A Stanford Course Leverages Mass Interpersonal Persuasion

To understand MIP better, I decided to teach a course on the psychology and metrics of Facebook applications. A few weeks after the launch of Facebook Platform, I got approval from Stanford's Computer Science Department for the new course. I recruited

[1] http://money.cnn.com/2007/06/01/technology/facebookplatform.fortune/index.htm
[2] http://venturebeat.com/2007/05/26/facebook-users-vote-for-ilike-but-what-happened-to-audio/

a teaching team to bring more skills and perspectives[3]. We planned to have students create applications for Facebook.

However, our course wouldn't just be about writing code. Instead, we wanted students to focus on using psychology in their creations, especially the psychology of persuasion. In addition, we wanted students to use metrics to guide decisions about their applications[4]. For example, rather than having students guess about what name to give their new Facebook app, we wanted them to test various options and use data to support their decision. We encouraged a metrics-driven approach to designing the user experience, including details like creating an interface button: What should the button look like? Where should the button be located in the UI? What text should be on the button?

We also used metrics in our grading plan. The hard numbers, not our opinions, would largely determine a student's grade. For their first app, students would aim for distribution. In the second app, students would aim for user engagement. Both were measurable through Facebook statistics in combination with Google Analytics[5].

We held our first class in late September 2007, four months after Facebook launched Platform. At that point in time, third-party developers had already created over 6,000 applications. Each day over 50 new apps would appear on Facebook. This meant that our students' projects would have lots of competition.

Some wondered if we were too late to the game to get any traction on Facebook. The students worried about competing against big companies and professional development teams backed by deep pockets. Most students had no experience with web apps. And none of our students could use their own money to develop or distribute their applications. Some students wondered if our grading plan was fair. They would be matched against full-time professionals.

In the coming weeks, our class surprised everyone.

When the 10-week course ended in December 2007, our students had persuaded over 16 million people to install their applications. At that point, about one million people each day used an application our students created. As teachers, our response was similar to many in Silicon Valley[6]: We were amazed by the impact of our students' work.

I believe that student projects have never produced such big numbers before: 16 million adopters and 1 million daily users[7]. I wish I could say this was the result of excellent teaching and coaching. But that wouldn't be quite right. These dramatic numbers happened for the first time because MIP was possible for the first time. In other words, our course leveraged a new opportunity in reaching and engaging people

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[3] Dave McClure joined me at the co-instructor. My head TA was Dan Ackerman-Greenberg. Also part of the teaching team were Yee Lee, Rob Fan, Greg Schwartz, and Jia Shen.

[4] The standard metrics tools were limited, so not all teams used metrics as much as we hoped. But many did. In fact, some teams created their own metrics tools.

[5] Though limited, Facebook shares public statistics about each app, which are mostly useful for measuring reach. Google Analytics gives better statistics for user engagement.

[6] The final for our course was a public presentation of student work. Over 500 people attended.

[7] After the course ended, we learned about additional student successes. It seems that by March 2008 the students' creations had generated over 25 million Facebook app installations. In addition, some students also made money. Our head TA believes that Stanford students earned over $500,000 in advertising revenue within a few months.

using technology. In this case, the platform for MIP was Facebook. In the future, we'll see many channels through which MIP can take place, including solutions designed for virtual worlds and for mobile phones.

Some might wonder, "Isn't the Stanford experience a classic example of viral adoption?" The short answer is "no." I'll return to this question after I describe the components in MIP.

4 Six Components in Mass Interpersonal Persuasion

MIP has six components, described below. All of them existed before Facebook launched Platform. But the six components had never been bundled together in one place:

1. **Persuasive Experience:** An experience that is created to change attitudes, behaviors, or both.
2. **Automated Structure:** Digital technology structures the persuasive experience.
3. **Social Distribution:** The persuasive experience is shared from one friend to another.
4. **Rapid Cycle:** The persuasive experience can be distributed quickly from one person to another.
5. **Huge Social Graph:** The persuasive experience can potentially reach millions of people connected through social ties or structured interactions.
6. **Measured Impact:** The effect of the persuasive experience is observable by users and creators.

4.1 Persuasive Experience

First of all, MIP builds on an experience designed to change attitudes, behaviors, or both. This implies that the creator of the experience intends to make impact on people's lives. For example, a political party could design an experience to win support for their candidate by asking people to watch a video online and then to add their name to a public petition. Or, in the health arena, an insurance company might reduce rates each time a person reports his or her exercise behavior to a group of peers online. These are both persuasive experiences; the creators intend to change people's behavior.

MIP focuses on *changing* people's thoughts and behaviors, not simply amusing or informing them. So this is point number one: Success with MIP hinges on a persuasive experience.

The persuasive experiences in MIP gain power by tapping into social influence dynamics. As I see it, social influence is a broad area, with flexible boundaries and competing ways to categorize influence strategies. To simplify things for the purpose of this paper, let me say that MIP often uses these social influence strategies: compliance of many types (direct request, moral appeal, deceit, etc.), ingratiation as outlined by E. E. Jones (giving compliments, conforming to others, presenting self, and rendering favors), and group-level intrinsic motivators as defined by Lepper and Malone (recognition, competition, and cooperation).

To understand specific cases of social influence in MIP, consider how invitations work in Facebook. When a friend of mine on Facebook invites me to use a third-party application, the Facebook system sends me a request. The app creators decide what the text will say. Usually the message is simple. But the psychology is sometimes sophisticated. For example, when a friend invited me to use the app called Lil Green Patch on Facebook, I received the message below.

```
Here is a Strawberry plant for your Green Patch. Could you help me
by sending a plant back? Together we can fight Global Warming!
```

The three short sentences in the invitation text use the persuasive strategies of pregiving, reciprocity, direct request, cooperation, altruism, and more.

Another successful application, Top Friends, used this invitation text:

```
Amber Phillips has added you as a Top Friend! Does Amber Phillips
make your Top Friends?
```

Again, a few words can put powerful persuasion dynamics into play, leveraging the fact that this request usually comes from someone I know and trust.

On Facebook, users select the friends they want to invite, but the creators of successful apps do not leave the persuasive experience to chance, even if it means putting words in people's mouths. That's not a surprise. Without a successful persuasive experience creators cannot achieve MIP.

In the future, persuasive experiences will become easier to create. Right now, options are limited for people who can't write code. However, any Facebook user today can create a group, such as a war protest group, and set MIP into motion. When it comes to third-party applications, the barriers are getting lower. With templates and wizards to simplify things, we will soon have tools that allow ordinary people – not just political parties and big insurance companies – to create and distribute persuasive experiences to the masses. Automating the experience is the focus of the next section.

4.2 Automated Structure

Next, MIP relies on computers to automate the persuasive experience. The automation serves two functions. First, software can deliver a persuasive experience over and over. Computer code doesn't take a vacation or go on coffee breaks; the machine keeps working. And it delivers the persuasive experience with fidelity. It doesn't do a crummy job if distracted or improvise if unprepared. So once someone creates a persuasive experience that works in digital form, code can replicate this precise experience over and over.

The second point is that the automation makes it easier for people to share the experience with others. For example, suppose Sarah Politico wants to motivate friends to join a rally to support Candidate X. An automated experience makes this easy for Sarah. She doesn't have to invent all the pieces of getting friends to commit to the rally. In Facebook and other platforms, people need only to click a few buttons and they are finished; the automation makes it simple for people to both extend and accept invitations.

Simplicity is important in persuasion. As humans we have a natural human drive to conserve resources (in other words, we are lazy). If a task seems simple to us – like clicking the mouse once or twice – we are likely to do the task right away. When

tasks are complex or have multiple steps, we are more likely to avoid the task or procrastinate.

To reiterate, software code structures and automates the experience, which delivers an experience with fidelity; it also simplifies the work for people promoting the experience.

4.3 Social Distribution

The first two components – persuasive experience and automated structure – have come together before. This combination is the basis of my early work at Stanford in captology, where I demonstrated that computers could reliably change beliefs and behaviors. So this combination is not new. What became new in 2007 was the combination of the six components for MIP, including making it easy for friends to involve other friends in an automated persuasive experience. With social networks in place, one friend can invite another friend to join the persuasive experience. The process then repeats, with the new friends involving their friends.

For example, suppose my friend Jeannine invites me to use a Facebook application that will inspire me to practice golf every week. By using this app, I can also invite my own Facebook friends to be part of my golf practice team. So I invite 10 people to use the app. Then some of my friends invite their Facebook friends. In this way, the application gets distributed through social channels.

Social distribution online was possible before Facebook Platform. For example, I could forward an email to a list of friends. But for MIP, distribution within a structured social network, like Facebook or Bebo, seems important and perhaps vital.

First of all, the persuasive experience gains credibility by being inside the walled garden of a high-trust culture like Facebook. Users assume that inside the walled garden any shady persuasive efforts are quickly squashed. Credibility is also boosted by the fact that every action inside Facebook is attached to real user who will get ousted for bad behavior.

Next, social distribution inside a social network makes inviting friends and accepting invitations easier. For example, Facebook users perform familiar behaviors to join a group or add an application. Users don't need to navigate to a new web site, register for a new service, or solve any new technical issue. It's simple.

To reiterate, social networks are important for MIP because they make the persuasive experience more credible and the distribution task simpler than what happens on the open Internet.

4.4 Rapid Cycle

A rapid cycle is another key component in MIP. What this means is that the time between invitation, acceptance, and a subsequent invitation needs to be small. MIP is greatest when the cycle time for getting involved and involving others is shortest.

Rapid cycle time builds momentum and enthusiasm. Not only does the level of involvement grow quickly with a rapid cycle, but the rate of involvement also goes up. Momentum sweeps many people into a movement who may otherwise not get involved.

Consider this example: One day in September 2007, my Facebook Newsfeed showed that seven friends had just joined a Facebook group to support the monks in Burma. I respected these friends so I clicked to learn about the group they joined. I saw the group was growing quickly – 3,000 new people each hour, one blogger later reported[8]. After a few more days, awareness of the Facebook group – and the monks' protests in Burma – seemed to sweep through Facebook. At one point I wondered, "Is there any active Facebook user who doesn't know about this group?"

The rapid growth of the Burmese monk group was directly tied to the rapid cycle Facebook allows. In this case, I became aware of my friends' actions – joining a new group – within hours. Facebook notified me automatically via the Newsfeed; my friends didn't even need to invite me. Facebook also allows a more active role: anyone could invite friends to join the Burmese monk group immediately. This process takes less than five minutes. Either option is a rapid cycle.

In a similar way, the rapid cycle for sharing apps in the Facebook context allowed our students to reach millions of people within a few weeks. Student teams who designed their apps to have a rapid cycle for invitations often saw their user stats rise quickly. Once rapid growth was underway, the student apps then benefited from the momentum created – buzz from bloggers and listing on leader boards.

A slow cycle may lead to growth but it will fail to benefit from momentum. A good case in point is Tivo. Launched in 1999, Tivo offered people a much better way to watch TV. But adoption was slow, in part because the cycle for adoption and social distribution was slow. The more people used Tivo, the more they loved the service. But the process of falling in love and then evangelizing Tivo to friends could take months or years. As a result, Tivo has grown steadily but has never created a wave of momentum that would sweep eager new buyers into stores to demand Tivo. That's possible only with a rapid cycle.

4.5 Huge Social Graph

The previous four components would not lead to MIP if only 100 people belonged to the social network. Yes, you could reach all 100 people within a day, but 100 people is not "mass." An important component of MIP is having a huge social graph—a network of millions of people connected to one another.

Facebook offers a huge social graph, about sixty million at the time of this writing. The network for MySpace is more than twice the size. Both of these social graphs are huge. In the future we can expect bigger playing fields as Facebook and MySpace continue to grow. Even more significant could be new initiatives like OpenSocial and DataPortability, which could soon bring together almost 500 million people in affiliated social graphs[9].

Persuasive experiences of the future will almost certainly be able to jump from one social graph to another. For example, a movement supporting Burmese monks may start in Facebook but then be ported to other social networks such as Bebo and Hi5.

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[8] http://www.allfacebook.com/2007/09/3000-users-per-hour-join-burma-protest-group/

[9] Yahoo currently has the most users of any web service, but they have yet to outline their social networking strategy in a convincing way. If they join the OpenSocial coalition, for example, they would add over 250 million potential users to that network.

The specific companies don't matter much in MIP. What matters is that millions of people are now linked to other people online. These ties are all potential distribution paths. The larger the social graph, the greater the potential reach for MIP.

4.6 Measured Impact

The final component of MIP is measured impact. In other words, people must be able to observe the effects of the intervention. For example, people need to see how many people have joined the group in the last 24 hours, or how many people have installed the app today, or how much money has been raised in the last month. To be clear, I'm not talking about impacts that are *potentially* measurable. This sixth component refers to measurements that are actually reported.

Facebook Platform allows both creators and adopters to see basic statistics on an app's distribution and use. For example, anyone can go to Facebook and see how many people used AppABC yesterday and how many new people installed the app.

Making the statistics available to everyone facilitates MIP in three ways. First of all, those who share the persuasive experience with their friends can get feedback on the success of their efforts. This feedback likely increases the motivation for people sharing the experience. On the receiving side, visibility creates more pressure for the person who is invited. They may want to avoid an awkward situation like this: "Hey, I invited you to support the Burmese monks. You never joined the group. Don't you care about what's going on?"

Social proof is the second way measured impact facilitates MIP. Consider this scenario: When I see that 3 million people use AppABC each day, I have evidence that the app is worth trying. If I don't try the app, I may be missing something important. That's a natural response. The point here is much like I stated earlier: when an experience gains momentum, people take notice and are more likely to join in, even without an explicit invitation from friends.

The third way measured impact facilitates MIP is by helping creators improve their persuasive experience. The creators can test various approaches to the persuasive experience and see which option works best. For example, the leading Facebook app developers today are in a constant cycle of testing and improving. Each hour brings them new information about impact: Which "call to action" gives the highest conversion? What image works best? Which invitation text is most effective? The leading developers improve their applications continuously.

Consider invitation text as an example of testing different approaches. In my own experience of being invited to Top Friends, a leading Facebook app, I saved three different wordings for their invitation.

```
Amber Phillips has added you as a Top Friend! Does Amber Phillips
make your Top Friends?

Amber Phillips thinks you are BFFs and would love to be added to
your Top Friends. You should add Amber Phillips as your Top
Friend! ;)

Amber Phillips thinks you are BFFs and would love to be added to
your Top Friends. Please add Amber Phillips today :)
```

Which invitation text works best? I don't know. But the app creators know the answer. Of course, it's unlikely they will share this valuable piece of information. Because the competition is intense, the cycle for improvement is not weeks or days but hours—as fast as they can test options and get data back on user response.

One of the leading apps on Facebook has over 200 measurement points built into the code[10]. They know how long people spend on each screen, what buttons get clicked, how many invitations get sent by new users, and so on. This gives creators a clear view of how people use their app and how modifications affect adoption and use. The two leading app creators for Facebook, companies named Slide and RockYou, have built their own metrics tools because the current Facebook statistics aren't sufficient for their careful testing and observation. In the future, better measurement tools will likely be commonplace, giving all developers more insight into how to improve their creations.

5 Viral Adoption and Mass Interpersonal Persuasion

Now I return to the question I posed earlier: "Is MIP just a fancy way to describe viral adoption?" To answer this question to everyone's satisfaction, we would first need to agree on the meaning of "viral adoption" and related terms like "virality." The fact is that people don't agree on the definitions; the meaning has been debated since the phrase "viral marketing" first appeared in 1996. As a result, no answer to this question will satisfy everyone. With that caveat, I will offer an answer that I hope satisfies most people.

First of all, most people would probably agree that viral adoption involves distribution through social ties. Next, an experience that leads to successful viral adoption will have some persuasive elements. So in these two areas – social distribution and persuasive experience – virality and MIP share common ground. But the other four components of MIP are not necessarily required for how most people define viral adoption. In other words, viral adoption can happen without an automated structure, a huge social graph, a rapid cycle, or measured impact. In contrast, MIP requires these four components.

6 Comparisons to Mass Interpersonal Persuasion

As I explained above, MIP emerged because six components came together for the first time in a single system. The individual components are not new. In fact, some of the most successful persuasion modes have combined some of the components. Table 1 shows how familiar genres use some of the six components.

Gossip and urban legends are genres of communication that usually have persuasive intent. While gossip and urban legends are socially distributed – shared from one friend to another – at least two components of MIP are lacking: no automated structure and no measured impact.

[10] The lead developer for this popular app said I could share this information, but he didn't want me to name the app or the company.

Table 1. Various genres include components of MIP

	Persuasive Experience	Automated Structure	Social Distribution	Rapid Cycle	Huge Social Graph	Measured Impact
Gossip & Urban Legends	Yes	No	Yes	Yes, sometimes	Sometimes	No
Chain Letters via Postal Mail	Sometimes	No. But prescribed steps give structure.	Yes	No	Yes	No
Networking Marketing	Yes	No. But prescribed steps give structure.	Yes	Sometimes	Yes	Partially
Forwarding to Email Lists	Often yes	No	Yes	Yes	Yes	No
Software Virus	Usually no	Yes	Yes, but not intentionally	Sometimes	Yes	Not typically

Chain letters sometimes have a persuasive intent. If nothing else, the letter is designed to motivate people to continue the chain. The letters are distributed socially and they could reach everyone in a country or the world, giving them a huge social graph as the audience. Chain letters usually include careful instructions, giving the experience structure. But the experience is not automated. It requires effort. Chain letters do not have a rapid cycle and no measured impact.

Network marketing is a term I'll use to describe the process of selling to friends and, even more important, recruiting friends to be part of your sales organization. Successful network marketing efforts are much like chain letters: The experience is structured, distributed socially, and could ostensibly reach millions of people. For example, my sister once learned about a new vitamin from her friend. These vitamins weren't available in stores. My sister could buy vitamins only from her friend. But her friend had a better offer: By becoming a distributor, my sister could get a discount on vitamins and potentially make money. She signed up. She became part of her friend's sales organization. Then the cycle began again. As one might expected, my sister shared the vitamins with me. (By the way, I did not sign up to sell vitamins.)

Note that recruiting new people into networking marketing usually takes days or weeks, which is not a rapid cycle. Also note that the impact is not observable by everyone, only a handful with access to the data (which leaders carefully filter and share). Even so, network marketing has many components of MIP so it's not surprising that many such companies have succeeded.

Finally, the persuasion genre that is closest to having all six components in MIP is forwarding to email lists. We've all experienced this. A friend sends us an email and urges us to pass it along to all our friends. Many ideas and causes have been promoted in this way. Forwarding email campaigns have most components of MIP except the

structure is not automated and the impact is not measured. One could also argue that this genre lacks an important quality of social distribution that I explained earlier: credibility.

7 What's *not* Important in Mass Interpersonal Persuasion

So far I've explained the new phenomenon of MIP by providing brief examples, explaining the six components, and comparing MIP to familiar persuasion genres. In this section I hope to further clarify MIP by pointing out what does *not* matter in this new phenomenon.

First, the **technology** used does not determine what is, or is not, MIP. Today, Facebook is the most likely technology platform, but in the future, we can expect MIP to play out on mobile devices or on the screen in our living rooms. Looking to the future, there may be a way that MIP occurs without even using computing technology.

Could a biological virus be created and distributed with an intent to change attitudes or behaviors? Right now this seems a chilling scenario involving terrorism, but it's not impossible that at some future point, spreading a biological agent would be a responsible act of public health.

The second point is that the **topic** doesn't determine if something is or is not MIP. In my work and my lab, we focus on topics that benefit people, motivating them toward better health, more responsible environmental behavior, and so on. But the persuasive intent could be frivolous or it could be downright evil.

The last point is that the **initial intent** of the creator may not matter much when it comes to MIP. In my previous work in captology, I've argued that a "persuasive technology" is defined largely by the creator's intent. At the time I also said that distributors can also have intent, but this was a minor point. Now, with the emergence of MIP, the intent of the distributors can be important, especially when the creator did not intend to persuade in the same way. As an analogy, consider how a video on YouTube can take on a life of its own, different than what the creator intended.

8 The Future of Mass Interpersonal Persuasion

Mass interpersonal persuasion matters because this new phenomenon gives ordinary individuals the ability to reach and influence millions of people. This is new. Over the past century, mass media has been the primary channel for persuasion. These channels were controlled by powerful people and organizations. They used mass media largely to achieve their own goals. Now, the landscape is changing.

I believe the power to persuade will continue to become less centralized, thanks to MIP. For early evidence of decentralization, we can see how much impact ordinary individuals have had with blogs and online videos. This is just the beginning. Individuals will have even more impact in the world as we continue creating tools that enable MIP. We are at the start of a revolution in how individuals and cultures make decisions and take action.

If human nature were fundamentally bad, I would be worried about MIP. Certainly, this new power could have a dark side. But I believe we humans are fundamentally good. I believe that, for the most part, we will create vehicles for MIP that will benefit society—that will enhance education, improve health, and help to bridge national and cultural divides. This democratization of persuasion will lead to far better outcomes than those achieved when persuasion is controlled by a few powerful groups. The power and potential of mass interpersonal persuasion give me hope for the future.

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Online Persuasion in Facebook and Mixi: A Cross-Cultural Comparison

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Abstract. Social networking sites persuade millions of users each day to adopt specific behaviors. To understand this phenomenon in the context of persuasive technology, we analyzed how persuasion takes place in leading social networking sites from two different countries: Facebook in the U.S. and Mixi in Japan. We compared the two services on four persuasion goals: creating profile pages, inviting friends, responding to content by friends, and returning to the site often. Our analysis reveals the differences and similarities in how Facebook and Mixi are designed to influence users toward the achievement of these four goals. In general, Facebook's persuasive design is more assertive and mechanistic, while Mixi's approach, by comparison, is subtle and indirect. These persuasion styles seem to map generally to cultural differences between the U.S. and Japan.

Keywords: persuasion, captology, social networking, persuasive technology, behavior chain, persuasive design, cultural comparison, Mixi, Facebook.

1 Introduction

Social networking services are among the most popular sites on today's Internet. They are also among the most persuasive. For a social networking service (SNS) to succeed, the service must motivate users to adopt specific target behaviors: register, upload a photo, connect to friends, share content with friends, and so on. The study of social networking sites can provide insight into how persuasion occurs online, an increasingly important topic in captology, the study of persuasive technology [1].

Facebook is the fastest growing SNS in the U.S., ranking #5 in traffic[1] for all U.S. websites. However, in Japan Facebook is not popular, failing to rank in the top 100 sites. Instead, Mixi is the leading SNS, ranked as the #5 website overall in Japan[2].

Despite the profound cultural differences between the U.S. and Japan, people in both countries are being motivated and persuaded on a daily basis by these social networking services. As a research team from the U.S. and Japan, we set out to compare how persuasion occurs in Facebook and Mixi by analyzing the user

[1] Data from Alexa.com on January 1, 2008.
[2] Data from Alexa.com on January 1, 2008.

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experiences from the perspective of persuasive technology. To our knowledge, our research is the first collaborative effort between countries to compare the persuasive design of social networking services that appeal to two different cultures.

Our comparison is a case study. As such, we do not attempt to test hypotheses. Instead, our goal is to illuminate which issues deserve deeper investigation and which could later become independent variables in a controlled experiment.

Our work makes an original contribution by specifying persuasive goals in SNSs and describing how two services achieve these goals; comparing influence strategies used in online settings from two different cultures; and analyzing the success of SNSs in terms of persuasive technology principles.

1.1 Background

Fogg & Eckles [2] investigated over 50 successful "Web 2.0" services and identified a pattern that all leading services followed, which they called the "Behavior Chain for Online Participation." This framework, illustrated in Fig. 1, was a useful lens through which to compare persuasion on Facebook and Mixi. The Behavior Chain outlines three Phases: Discovery, Superficial Involvement, and True Commitment. Our comparison of Facebook and Mixi focuses on Phase 3: True Commitment.

Our analysis revealed that both Facebook and Mixi are designed to persuade users toward the behaviors listed in Phase 3: creating value and content, involving others, and staying active and loyal. To focus our research, we extracted four SNS persuasion

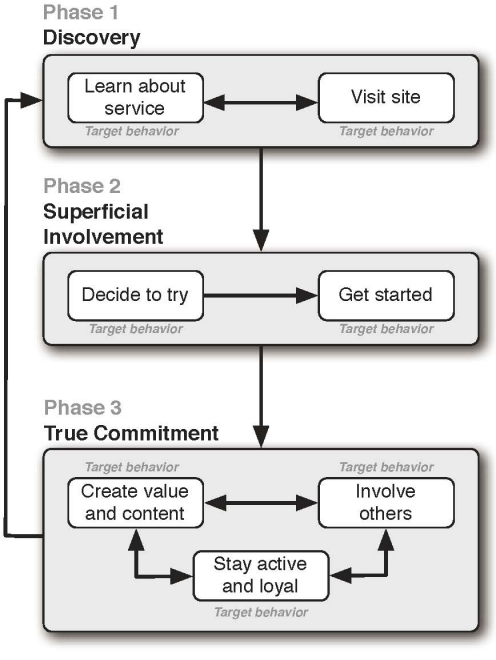

Fig. 1. Our cross-cultural analysis focuses on Phase 3 of the Behavior Chain [2]

goals that map onto the Target Behaviors listed in Figure 1. These persuasion goals are generally accepted objectives for a commercial site. Below we list our SNS persuasion goals and show how each corresponds with a Target Behaviors from the Behavior Chain.

Persuasion Goals for SNS		**Target Behaviors in Behavior Chain**
#1 Create Personal Profile Page	-->	"Create Value and Content"
#2 Invite Friends	-->	"Involve Others"
#3 Respond to Others' Contributions	-->	"Create Value and Content"
#4 Return to Site Often	-->	"Stay Active and Loyal"

In this paper we examine how Facebook and Mixi are designed to achieve the four persuasion goals listed above. In the sections that follow, we explain each goal and the persuasive design in Facebook and Mixi to achieve that goal. Then we briefly compare and contrast the persuasion strategies. We conclude our paper with a summary and an overview of issues for future investigation.

2 Comparison of Persuasive Design Elements

The commercial success of Social Networking Services depends on persuading users to perform specific behaviors. The persuasion goals we discuss in this paper are among the most important goals for commercial viability. If a SNS fails to achieve any one of these four goals, the company will likely fail. For this reason, these four goals are the focus as we compare Facebook and Mixi.

2.1 Persuasion Goal #1 – Create Personal Profile Pages

Profile pages form the core of social networking sites. The quality of experience on these sites is tied to the quality of the profile pages. We found that both Facebook and Mixi are designed to motivate users to create engaging profile pages, though each service takes a different approach.

On Facebook, the "edit" command for the profile page is always visible to the user. This visual prominence serves two functions. First, the interface reduces the barrier [3] for adding information. Next, the design implies that a profile page can and should be updated frequently.

As shown in Figure 2, the Facebook interface provides users with a series of labeled tabs, each with drop-down boxes or free-response spaces. To induce people to create interesting profile pages, the Facebook interface prompts users for highly personal information, such as religious views, mobile phone number, sexual orientation, and relationship status. Facebook does not indicate that such responses are optional.

Mixi also prompts users to share and update personal information. However, Mixi divides the initial profile creation experience into two stages. In addition to verifying the user's email address, this two-stage model serves two persuasive purposes: It builds self-efficacy [4] for using Mixi, and it leverages a "foot in the door" approach

Fig. 2. The Facebook user interface prompts users for highly personal information such as political, religious, and sexual orientation

to persuading the user to offer future disclosures [5, 6]. In the first stage, the user enters a name and a "self-introduction." The Mixi interface models friendly behavior [7] by offering users a sample self-introduction, which we've translated as follows:

> *"Hello, my name is Mixi Tanaka. I am a college student. I would like to be a counselor to help people. I am wondering if I can communicate with your friends in Mixi. I'm looking forward to meeting you on Mixi."*

The design of the Mixi interface, shown in Figure 2, visually suggests the length and tenor of the new user's self-introduction. In this way, Mixi likely influences users toward friendly and concise self-introductions.

After submitting the self-introduction, Mixi users have completed the first stage of profile creation, likely giving new users a sense of success and, equally important, setting a precedent for further disclosures in the second stage. Users will share the bulk of their profile information in the second stage. This includes hobbies and personal interests. Mixi does not prompt for highly personal information.

While both Facebook and Mixi are designed to elicit personal information, the services differ in two ways. First of all, Mixi's two-stage model allows users to build confidence and begin slowly to disclose information. If the first stage of the model can establish trust, users will likely reveal more information in the second stage [8].

Fig. 3. The Mixi UI models behavior for creating a friendly self-introduction

In contrast, the Facebook profile creation process is one long stage, with no initial trust-building period. The Facebook interface prompts users for highly revealing information, while Mixi's interface does not.

In both services, users are encouraged to change and update their profile by an interface design that makes such behavior simple.

2.2 Persuasion Goal #2 – Invite Friends

Inviting and connecting to friends is an essential behavior for making a SNS successful. Without these connections, the service would have little value. The design of Facebook and Mixi both persuade people toward achieving this key outcome.

Facebook takes bold measures to motivate users to invite others to the service. Users can click on the always-present "Friends" interface element to invite individuals by typing in their email addresses. But the persuasion tactics of Facebook do not stop with visual prominence and simplicity. Facebook also offers tools that allow users to invite friends in bulk.

One such invitation tool, shown in Figure 4, gives Facebook access to the user's password-protected contact list on other services, such as Yahoo, AOL, or Gmail. The Facebook interface conveys simplicity and credibility to gain user compliance (The UI says, "Facebook will not store your email login or password."). After the user enters confidential information, the Facebook technology logs in to the competing service such as Yahoo, extracts the user's contacts, and sends invitations to everyone the user designates. The bulk invitation tool allows new users to have hundreds of Facebook friends quickly – a strong incentive in Facebook's culture where having friends is a mark of status [8]. The bulk invitation process takes about two minutes.

Compared to Facebook, Mixi takes a less aggressive approach to motivating invitations. Like Facebook, the invitation tool is easy to access, reducing barriers to achieving this persuasive goal. However, in contrast to Facebook's automation, Mixi users must type in the email address for each friend they wish to invite. There is no tool for bulk invitations. As a result, connecting with friends in Mixi requires effort for each individual invited.

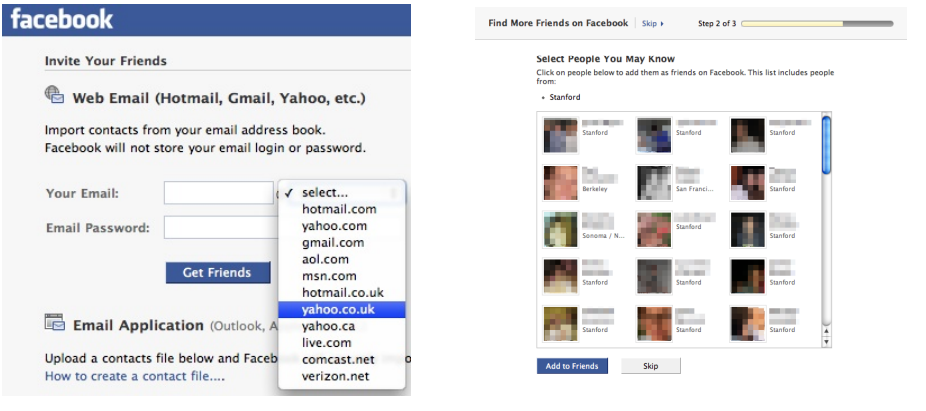

Fig. 4. Facebook encourages users to invite friends in bulk, often hundreds of people at once

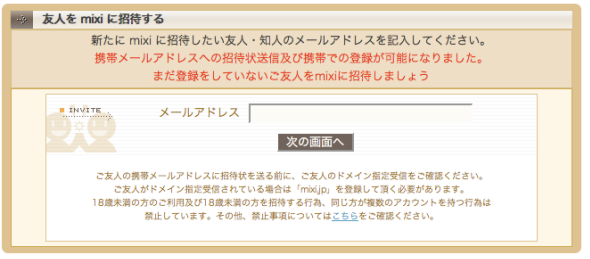

Fig. 5. Mixi users are encouraged to invite friends, but users cannot invite in bulk – only one person at a time

Both Facebook and Mixi motivate users to connect to more friends by publicizing the number of friendship connections for each user.Both services allow other people to see if a user has one friend or 500. Having only a few friends seems to be a marker of low status in both Mixi and Facebook. So users naturally have a drive to add friends in order to be seen as more socially desirable.

In Mixi, the number of friendship connections is linked to each user's name on the Friends List, as shown in Figure 6. The social connectedness of friends is easily compared. For example, Figure 6 shows one Mixi user with 200 friends, while other people have only one friend. Social comparison and social desirability factors naturally motivate users to build their friendship network.

In contrast with Mixi, Facebook doesn't offer an interface that shows all the friendship numbers in one place. Rather, the number of friends is found on each person's profile page. As shown in Figure 7, Facebook organizes friendships by "Network," which is an artifact from Facebook's early days as a series of college directories or networks. (The early design did not allow networks to exchange data.)

To this point in our analysis, we noted that Facebook has consistently motivated users with persuasive design that is more assertive and direct than Mixi's design. However, in this single instance—the way services convey social statistics—Mixi's design is more assertive. Mixi connects the friendship numbers directly to the user's

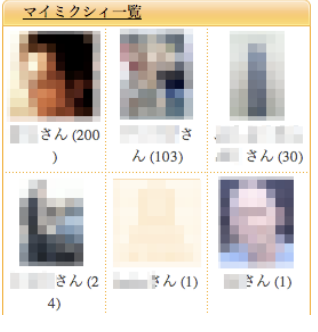

Fig. 6. Mixi publicizes the number of friends for each user, which creates motivation for connections. In this example, one user has 200 connections while others have just one.

Fig. 7. Facebook publicizes the quantity of connection for each user, organized by Network

name, making this data part of the user's online identity. In addition, Mixi makes it easy to see which friends have the most connections. In contrast, to compare friends in this way on Facebook would take significant work.

In our research comparing Mixi and Facebook we speculated that the motivation to acquire many online friends may be stronger in the U.S. than in Japan. More specifically, on Facebook the drive to have many friends is an accepted part of the online experience [9]. We could find no prior research on this point so we set out to gather data as a pilot test of our hypothesis about the desirable number of social connections.

We performed a small online survey in Japan and the U.S., using a convenience sample of users from Mixi (n=34) and Facebook (n=30). The results, while not definitive, suggest that each culture has a different view of how many social connections online is ideal, at least on Facebook and Mixi.

The survey summary in Table 1 shows that Mixi users in our sample had substantially fewer online connections, with an average of 58 friends compared to an average of 281 friends for Facebook users.

Table 1. Facebook users are motivated to connect with more friends than Mixi users

Question in Survey	Facebook Users	Mixi Users
Current number of friends in SNS (average)	281	58
Hoping to add more friends online	23%	9%
"Ideal" number of friends in SNS (average)	317	49

The survey showed that users of the two services also perceived the "ideal" number of SNS friends differently, with Mixi users choosing 49 connections on average as ideal, while Facebook users reported an average of 317 connections as ideal. Similarly, when asked if they wanted to add more friends online, 23% of Facebook users said "yes," while only 9% of Mixi users hoped to add more friends.

Figure 8 maps the survey data to highlight the differing views (and therefore motivation strength) regarding the quantity of online social connectedness. The plot

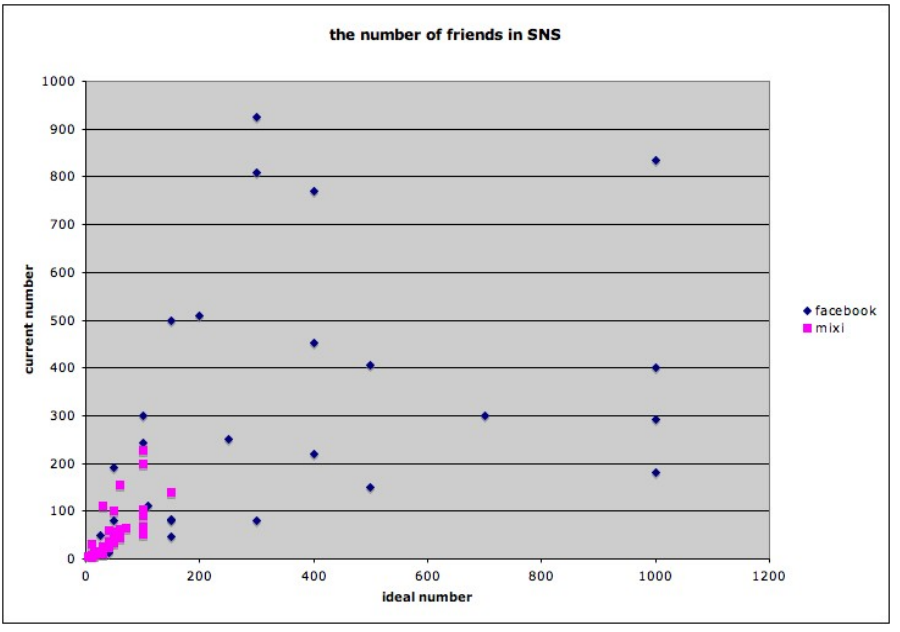

Fig. 8. Mixi users are connected to fewer friends than Facebook users. Compared to Mixi users, Facebook users aspire to have more connections, sometimes up to 1000.

shows a tight cluster for Mixi users in the lower left-hand quadrant of the graph. Compared to Facebook users, Mixi users generally have fewer connections in Mixi, and they seek fewer connections.

The apparent difference in how Mixi and Facebook users perceive the quantity of social connections suggests that Facebook can leverage the motivation to make more connections than can Mixi in designing for persuasion. Some might propose that Mixi should copy Facebook's approach. This could be a mistake. For Japanese users, Facebook's "mass invitation" tool may seem crass and insincere. In contrast, for a U.S. user of Facebook, mass invitations may appear to be a smart way to save time.

This difference in quantity of relationships also seems to match the cultural differences in how people manage social relationships in the U.S. and Japan [10, 11]. The persuasive design in Mixi and Facebook reflect (and perhaps reinforce) those differences. Our specific conclusion matches a larger pattern of persuasive technology tailored to the motivational characteristics of various cultures [12].

2.3 Persuasion Goal #3 – Respond to Others' Contributions

People gain satisfaction from posting content online, but they likely get more satisfaction from seeing others responding positively to what they have posted. Because social interaction over user-generated content is what sets SNSs apart from traditional media and web sites, our third comparison between Facebook and Mixi examines how these services motivate users to view and comment on their friends' content.

Facebook and Mixi allow users to post content in video, text, links, and photos, and both services notify users about new content posted by friends. This serves as the first step toward initiating a response to other people's content.

Facebook notifies friends about new content in two ways. First, the Facebook News Feed, which occupies the central part of each user's "Home" page, shows friends' recent activities, including newly posted content. Users can see the content with one click, a barrier reduction strategy that motivates this behavior.

Next, in Facebook any posting of new comments also generates an email to the user's email address outside of Facebook. This again makes the content one click away, but this time the notification is pushed to the user's email, expanding Facebook's reach beyond the web site. Similarly, Mixi notifies users about new content via email. For both services, the email notification is a first step in getting people to engage with user-generated content.

Both Facebook and Mixi encourage people to comment on what friends have posted online. The services make this easy to do by placing a prominent comment box near the posted item. The interfaces are similar, as shown in Figure 9. The design in both cases conveys to users that posting a comment is simple: an open field for entry plus a simple submit button. The size of the comment box implies brevity, which makes it easier for others to read the comment later. Indeed, the design of the commenting interfaces likely influences the desired behavior among friends.

Fig. 9. The UIs for Facebook (left) and Mixi (right) encourage commenting about user content

The user experiences for commenting are similar in Facebook and Mixi. In both services, multiple comments on one piece of content become a sort of dialogue, allowing a variety of friends to react and discuss together.

In terms of persuading users to respond to the content friends have posted, Facebook and Mixi are identical from a psychological perspective. Both services trigger user behavior by sending an email notification, and both reduce barriers by including links in email and then making the commenting box prominent. This similarity is not surprising. Motivating friends to interact online about shared content is the "holy grail" of social networking. In our view, more than any other activity, the experience of interacting with shared content motivates people to continue using Facebook and Mixi.

2.4 Persuasion Goal #4 – Return to Site Often

A goal of all social networking services is to persuade users to return often. Active users make the service more engaging for others in their online social network. In our research, we identified and compared three ways that Facebook and Mixi motivate

users to return to the site often: through email updates, digests of friends' activities, and "pokes" (Facebook) or "ashiato" (Mixi).

Persuading Returns via Email Updates. Both Mixi and Facebook send notices to users' email accounts to update them on new happenings with their friends in the SNS. Mixi sends a daily update, which has only the titles of the newly posted content. To see more than the titles, users must click on a link and log into the service.

Facebook's notification system is similar but more assertive. Facebook sends users an email notification when any of the following happens: when users are tagged in a posted content item, have comments posted about them, have comments posted subsequent to their own, receive a message on Facebook, are added as a friend, or are requested to join a group. As a result, a Facebook user could receive dozens of emails a day from the SNS. Each email is designed to motivate users to return to the site.

In comparing these two approaches, we find the Mixi solution to be less direct and, in some ways, more graceful. The Facebook notifications are direct and, thanks to the volume, potentially more annoying.

Persuading Returns with Digest of Friends' Activities. The second way to compare how these services motivate return visits is to examine how users stay updated on their friends' activities. In this regard, the sites are psychologically similar. Users of both systems can view friends' activities in one place on each site. In Facebook, the News Feed recounts who has posted a new link, who has signed up for an event, who is in a new relationship, and so on. On Mixi, the content is less diverse but the function is the same. Mixi shows updates on the Diary, on photos, and more. The drive to stay up-to-date with friends' activities [13] likely prompts frequent return visits.

Persuading Returns with Pokes and Ashiato. The third way we compare the persuasive design for return visits is identifying how users are socially present in each others' online spaces. On Facebook, users can visit a friend's profile page and then send that friend a "poke." The ambiguous "poke" is sent via email and SMS to the friend. Poking can prompt a user to log in and "poke" back – or to send a message, write on their Wall, or respond in other ways. By design, "poking" is a provocation.

In contrast, Mixi doesn't offer "poking." Instead, one user becomes aware of another's presence on his or her profile page by "ashiato," which is translated as "footprints." When a user logs into Mixi, she can see evidence that other users have visited her profile page by viewing the Access Log and the accompanying footprints, as shown in Figure 11.

Fig. 10. Facebook users can "poke" friends when visiting their profile pages

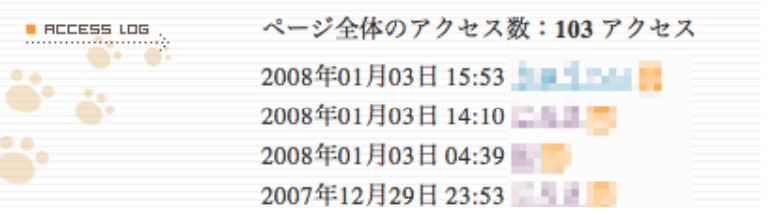

Fig. 11. Mixi shows who has visited a friend's profile page by leaving "Footprints"

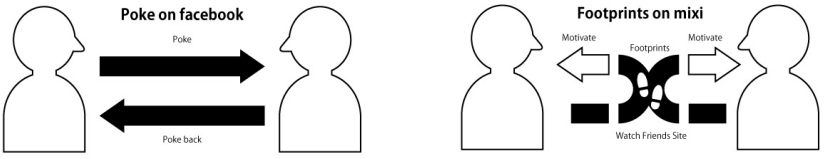

Fig. 12. Facebook and Mixi offer different ways to show a Friend's attention, as shown conceptually above. Facebook is direct with "poke." Mixi is subtle with "footprints".

Once again we see differences in persuasive design of the two SNS's. Facebook's "poking" is deliberate and direct. The system is designed to provoke users to return to Facebook and respond. Mixi has the same goal but it achieves return visits by enticement: the allure of seeing "footprints" evokes the target behavior.

3 Conclusion and Implications

In this paper we have compared how two social networking sites in different cultures motivate users toward the same four persuasive goals by using persuasion tactics. In general, the motivation elements in Facebook are bold and assertive. The Facebook service is designed to persuade users to take quick action with pointed outcomes. The Facebook system provides for direct and perhaps annoying notifications that serve as prompts to take action. By comparison, Mixi's approach to persuasion is subtle. The influence tactics are less direct and require more time to achieve results than those on Facebook. In general, Mixi users must invest more energy to start and maintain relationships through the service.

As researchers from the U.S. and Japan, each of us has experience working professionally in the other's culture. We bring that expertise to this comparative analysis. That said, in starting this research, we didn't expect – or want – to reach stereotypical conclusions about our cultures. As researchers we were open to finding that the Internet creates a new world, and that behaviors online may not reflect respective cultures. However, the evidence in our analysis clearly suggests that Facebook better reflects the persuasion dynamics that are common to US culture, while Mixi conveys a stronger Japanese sensibility.

Facebook and Mixi are among the first successful social networking services in any country. No matter what culture, we are at the beginning of learning how such services motivate and persuade people. The future will bring social networking

services we can't imagine today. In this uncertainty, we believe that one constant remains: When new social networking services arrive, they will undoubtedly be designed to motivate and persuade users.

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Website Credibility, Active Trust and Behavioural Intent

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Abstract. This paper evaluates data from an international anti-poverty campaign to assess if common principles from e-marketing and persuasive technology apply to online social marketing. It focuses on the relationships between website credibility, users' active trust attitudes and behavioural intent. Using structural equation modelling, the evaluation found a significant relationship between these variables and suggests strategies for online behavioural change interventions.

Keywords: social marketing, advocacy, website credibility, trust, behaviour, Internet, online, captology.

1 Introduction

Social marketing is an approach to social change that applies commercial marketing principles to behavioural change interventions, such as environmental protection, public health, safety or community development [1]. What distinguishes social marketing from other social change practices is its focus on behaviour change as the 'bottom line', its customer-driven approach and its typical use of appealing interactions that encourage behaviour change [2].

Social marketers are increasingly using the Internet to engage their audiences. For example, campaigns that have benefited from the Internet include *Verb*, *Above the Influence* and the *National Day to Prevent Teen Pregnancy* [3]. Conducting behavioural change online is not only cost effective, but it is also backed by strong evidence that online interventions can influence health and social behaviours. One meta-analysis of 22 papers—comparing web-based versus non-web-based health interventions—showed that online interventions significantly increased participants' knowledge and health related behaviours [4].

Given that traditional social marketing is based on commercial marketing principles, it makes sense to ask if e-marketing principles are relevant to online social marketing. A substantial body of e-marketing research has focused on modifying web users' behaviour, with a view to increasing sales. Within this body of research, credibility and trust have frequently emerged as key concepts related to customer behaviour. For example, it has been suggested that by increasing trust, businesses can increase the willingness of prospective customers to shop online [5]. Conversely, mistrust in an online company has been shown to be a primary fear of prospective buyers on e-commerce sites [6].

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The fields of social marketing and persuasive technology share a number of common approaches and goals. While social marketing aims to influence beliefs, attitudes and behaviours through marketing interventions [7], persuasive technology aims to modify attitudes and behaviours through technology interaction [8]. Both fields share common behavioural change goals and exist within ethically similar domains, aiming to improve the lives of individuals and society at large. Within the filed of persuasive technology, website credibility has received considerable attention, playing a prominent role across numerous publications.

Across the literature, researchers frequently focus on linkages between credibility and behaviour, and between trust and behaviour. However, there is little research about the relationship between all three in an online social campaigning context. Given the common ground between commercial marketing, social marketing and persuasive technology research, it is reasonable to ask if credibility and trust can also be applied to online social marketing, where selling socially benevolent behaviour is the bottom line.

2 Background

2.1 Behavioural Intent

Behavioural intent has been shown to be a strong predictor of behaviour across numerous studies. This association is well established within the theory of reasoned action [9] and the revised theory of planned behaviour [10]. Both theories have been shown to predict condom use across a large number of public health interventions and empirical studies [11].

According to stages of change research, behavioural intention takes place along a continuum where a person first has no intention to act; then contemplates the value of acting; and finally, prepares to act. Following these three phases, they may take action; and possibly move on to maintenance where the action becomes an established habit [12]. Across numerous studies, it has been demonstrated that people who are in the preparation phase, who are planning to act on their good intentions, are more likely to successfully adopt or drop a particular behavioural pattern [13]. Across both theoretical fields, there is strong empirical support for the link between intentions and actual behaviour.

2.2 Credibility

When target audiences experience traditional offline social marketing interventions, the credibility of the campaign, organization or individual making the request impacts on the degree to which audiences are likely to adopt new behaviours [7]. Celebrity endorsements are frequently used to establish the credibility of commercial and non-profit campaigns. While developing a scale to measure celebrity endorsers' credibility, Ohanian showed a significant association between an endorsers' perceived credibility and subjects' behavioural intentions to make purchases [14].

To define credibility, Ohanian's scale to measure celebrity endorsers' credibility asserted that credibility was composed of trustworthiness, expertise and attractiveness

[14]. While computers credibility has been defined as believability; and is composed of trustworthiness and expertise [16].

Online, there are good reasons to consider websites as credible sources, where websites serve as a sort of 'sales person' or 'product endorser'. In one experiment, it was shown that Ohanian's celebrity endorser credibility factors also applied to photographs and text, with written words seeming more believable when next to high credibility photographs [17]. It has also been shown that users' attitudes towards non-profit websites are heavily associated with perceived credibility and a website's design and usability [15].

Given the four types of computer credibility—*presumed*, *reputed*, *surface*, and *experienced* [16]—these credibility formations take place at different points in time: before, during and after interaction. For example, before interacting with a website, *presumed credibility* describes the prejudices a user may hold; while *reputed credibility* describes users' views that were shaped by third parties. During interaction, *surface credibility* is formed from superficial contact; and *experienced credibility* forms on the basis of deeper first-hand experience that may require repeat interaction.

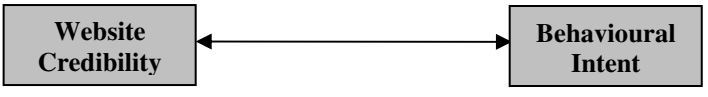

Fig. 1. Website credibility and behavioural intent bi-directional model (H1)

When considering directional relationship between website credibility and behavioural intent, there are reasons to suspect that it operates bi-directionally. In one direction, presumed, reputed and surface credibility formations can occur before and during interaction. Thus credibility judgements precede behavioural intentions.

However, to understand this bi-directional relationship, consider an example that runs in the opposite direction, where behavioural intent precedes or reshapes credibility judgements. Assume a person is initially sceptical about the credibility of a public health website which suggests that action A produces benefits B (for example, exercising 20 minutes per day will improve your mood and energy levels). Suppose this person's friend encourages them to act out A; and after much hesitation, they act out A and realize the benefits B. In this case, the firsthand experience of seeing how action A produces benefits B created a basis for reassessing the credibility of this website. In other words, after experiencing the A/B link firsthand, the sceptical user is more likely to reassess the credibility of the public health website they initially disregarded. In this case, behaviour precedes or modifies credibility judgements. This A/B belief can also occur prior to actual behaviour. For example, in the stages of change process, a person believes that A and B are related in the contemplation and preparation phases, just before the action takes place.

Given that credibility, behaviour and behavioural intent can flow in two directions, the following hypothesis is put forward and presented in Figure 1.

H1: Website credibility and users' behavioural intent are bi-directionally related

2.3 Trust

People who trust their fellow citizens are more likely to volunteer, contribute to charities, participate in politics, give blood, fulfil their tax obligations and hold more tolerant views of minorities [18]. In an online context, trust has been deemed the primary intermediary between perceptions and customers' willingness to make online purchases [5]. There are three categories of online transaction risks: *financial*, *product* and *time/convenience*. Within the financial risk category, the top specific fear is mistrusting an online company [6]. Online trust plays an intermediary role between a website's physical characteristics and users' behavioural intentions. The mediating role of trust varies across different types of websites depending on the risks and costs associated them [19]. Trust has also been associated with users' loyalty towards a website [20].

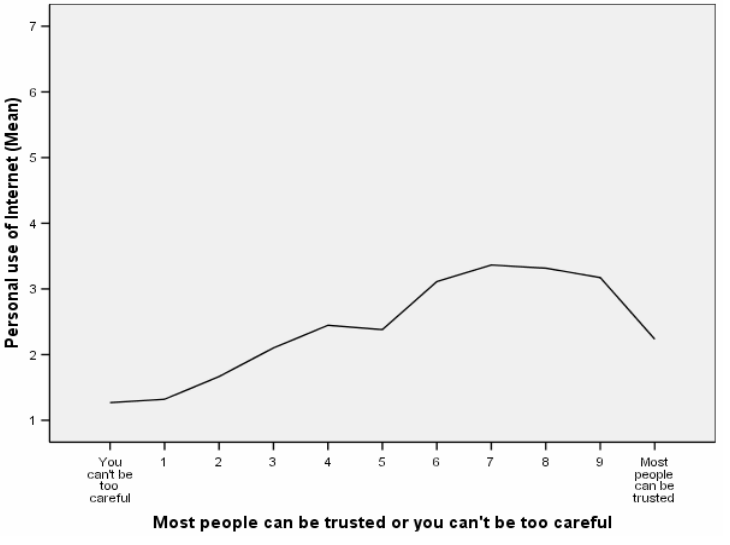

Fig. 2. Association between generalized trust and Internet use (ESS 2004 data)

The link between trust and behaviour is not just manifest within specific online behavioural acts, but shows an association with widespread Internet adoption. An analysis of the data from the UK's 2005 Oxford Internet Survey defined cyber-trust as a *confident expectation*—the belief that online actions can frequently be taken without additional safeguards. In general, the authors showed that the more years a person spent on the Internet, the more their cyber-trust grew. They concluded that the Internet was an *experience technology* where cyber-trust increased in relation to the number of years a person spent online and their proximity to Internet technology. Education was also shown to be associated [21]. Given this association, an exploratory analysis was undertaken to see if this same relationship between Internet use and trust existed in other nations. The European Social Survey (ESS) is a European wide survey being coordinated by a number of academic institutions. Using

data from their 2004 study, a comparison was made between generalized trust and personal use of the Internet, web and email. The results, presented in Figure 2, showed a significant association (r=.232, N=45,414, p<0.01, one-tailed). Together, these findings suggest that trust is not just associated with specific online behaviours, but also, broader Internet use in general.

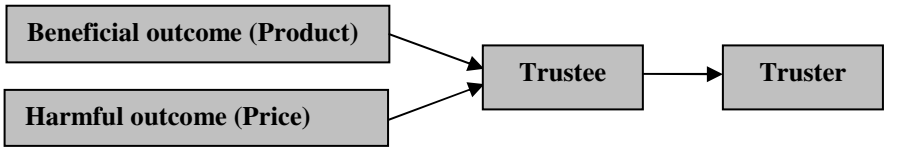

Fig. 3. Visualization of Deutsch's (1962) trust model

One classic model of trust, by Deutsch (1962), is shown in Figure 3. This model has been used as a basis for trust in mathematically exact social networks models [22] and as a core concept to define online trust [23]. To follow this model, first, start with an actor (the truster) who encounters an ambiguous path with two possible outcomes: one is beneficial and the other is harmful; moreover, this harmful outcome is worse then the beneficial outcome is good. Second, to achieve the beneficial outcome—and avoid the harmful outcome—the truster must depend on another person or event (called the trustee). Third, when the truster embarks on this ambiguous path, they have acted out a trusting choice which empowers the trustee to determine the outcome. If they do not embark on this path, they have made a mistrustful choice. However, if they embark on a path with much to gain and little to loose, this is called gambling and would not qualify as a trusting choice [24]. This model fits well with the saying: 'If there is no risk, there is no need to trust.' An earlier work by this author stressed that trusting relationships are built on an object of *motivational relevance*, so that the basis for a trusting relationship is the truster's motivation to achieve a particular outcome, and second, the truster's confidence that they can predict the behaviour of the trustee, and thus confidently predict the outcome of the trusting venture [25].

Applied to an online social campaigning context, a site user would enter into a trusting relationship when they act on the advice or request of a website. The degree of trust required depends on the ratio of potential benefits to harm. The moment that trust emerges is the moment that the person takes action.

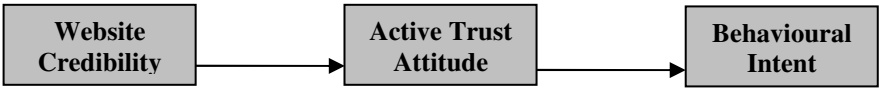

Fig. 4. Active trust mediation model (H2)

Across academic and professional literature, the terms credibility and trust are sometimes used synonymously. This confusion may be due to the fact that these terms hold related, but different meanings [8]. There is also a lack of distinction between *passive trust* which requires psychological believability and *active trust* which

requires physical action. For example, take a website user who perceives a particular website to be trustworthy and credible for a particular purpose. Given *passive trust*, they may feel confident that website staff will deliver on promises or that the outcomes of the website's advice will be positive. Given *active trust*, the website user would be confident enough to commit a physical action such as purchasing a product or taking a recommended health supplements. This action places the website user in a dependency relationship with some level of risk that the order will not be fulfilled or the recommended health supplement is actually harmful. While passive trust requires psychological credibility judgements that carry no risk; active trust requires a physical act that implies dependence and risk. In this sense, trust starts passively with confidence and ends actively with action. Active trust moves safe psychological judgements into risky physical acts, and by doing so, it bridges psychology and behaviour. The following hypothesis is put forward and presented in Figure 4.

H2: Active trust mediates the effect of website credibility on behavioural intent

3 Methodology

To evaluate these two hypotheses, a research study was conducted on the 2007 Global Call to Action against Poverty campaign. Also called the White Band Campaign, this international activist movement mobilized millions of persons around the world to undertake numerous activities to address global poverty. By October 2007, the campaign's global network included 74 websites with a common mandate, identity and mobilization goals. Given the common objectives, yet wide variety of websites, this online network offered an opportunity for real world research.

Following a previous pilot investigation [26], the current study used a self administered online survey that was developed and advertised on campaign websites in English, Spanish, French and Portuguese. It ran from 6 November 2007 to 7 January 2008. Campaign webmasters were first engaged through a needs assessment and later invited to place a link to the survey on their websites. The survey was further promoted with a DHTML pop-up banner on the campaign's central website and announced in its newsletter.

The three key variables used in this evaluation are website credibility, active trust attitude and behavioural intent. The online survey items, grouped by these categories, are listed in the Appendix; they consisted of 7-point Likert-type scales. The latent variable website credibility was composed of survey items that measured perceptions of content trustworthiness and expressed expertise; these items were based on survey items form Ohanian (1990) scale and together these credibility dimensions had a Cronbach's alpha of .736. The behavioural intention latent variable measured a website's influence on a user's intention to support the camping in the future and its impact on their activity level; together, they had a Cronbach's alpha of .837. A users' active trust attitude—measured with a single variable—evaluated a person's confidence in acting on the advice of a website.

Following procedures for data screening, Little's Missing Completely At Random test indicated that unanswered survey questions did not follow a systematic pattern, and hence incomplete records could be safely deleted without biasing the data. Mahalanobis distance and multivariate plots were used to identify and remove

extreme multivariate outliers [27]. After processing the data, there were 197 valid cases from 40 campaign websites. For this analysis, the number was further reduced to 160 cases that had complete data for all variables.

To evaluate the two hypotheses, Structural Equation Modelling (SEM), with AMOS 7.0, was used to confirm model fit measures and correlations between variables. Maximum likelihood was selected as the estimation method best suited to the data as it requires multivariate normality and is commonly used with Likert-type scales [28].

4 Findings and Limitations

The first model, to evaluate H1, is presented in Figure 5. For presentation purposes, error and disturbance terms have been removed from Figures 5 and 6. H1 states that website credibility and behavioural intent are bi-directionally related. For this confirmation, both website credibility and behavioural intent were directly linked by a covariance. Across a range of goodness of fit measures, this model produced a near perfect fit with a NFI=.999, CFI=1, GFI=.999, AGFI=.995 and RMSEA=0 with a p=.740. This suggests a strong fit between the data and model. The association between website credibility and users' behavioural intent was (r=.75, p<.001). These strong fit measures and the significant correlation between website credibility and behavioural intent provide significant support for H1.

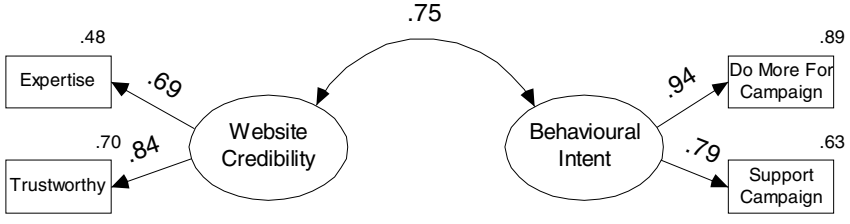

Fig. 5. Website credibility and behavioural intent bi-directional model (H1)

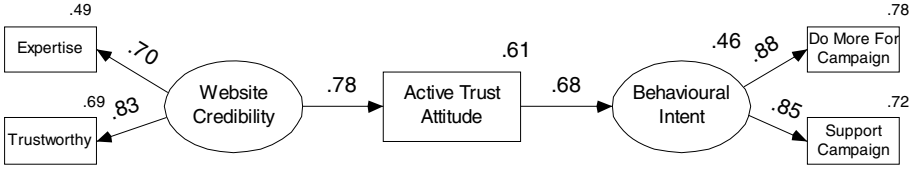

Fig. 6. Active trust mediation model (H2)

The second model, to evaluate H2, is presented in Figure 6. H2 states that active trust mediates the effect of website credibility on behavioural intent. This model was evaluated with the same data and estimation methods as the first model. Across a range of goodness of fit statistics, there was evidence to support a moderate fit between this model and the data. The incremental fit measures showed an NFI =.944 and CFI =.953, indicating a strong fit. The absolute fit measures GFI=.950 and

AGFI=.813, also indicated a strong fit. However the RMSEA=.163 was good, but its p=.002 was not significant. These various fit measures suggest a moderate fit between the data and this model.

As can be seen from Figure 6 and Table 1, website credibility showed a significant association with active trust attitude (r=.78, p<.001) and accounted for 61 percent of the variance. Likewise, active trust attitude showed a significant association with behavioural intent (r=.68, p<.001) and accounted for 46 percent of the variance in behavioural intent. The moderate goodness of fit statistics and strong significant correlations provide moderate support for H2.

Table 1. Results from the active trust mediation model (H2)

From	To	Standard Regression Weights*	Squared Multiple Correlations of the 'To' variables
Website Credibility	Active Trust Attitude	.78	.61
Active Trust Attitude	Behavioural Intent	.68	.46
Behavioural Intent	Intention to support campaign in the future	.85	.72
Behavioural Intent	Intention to do more for the campaign	.88	.78
Website Credibility	Expertise	.70	.49
Website Credibility	Trustworthy	.83	.69

** Significant at p<.001, two-tailed*

Taken together, the confirmatory SEM evaluations provided strong support for H1 and moderate support for H2. It suggests that website credibility and behavioural intent are bi-directionally related, with active trust partially mediating the effect of website credibility on behavioural intent.

A number of limitations must be considered. As this research was conducted in a natural setting, as opposed to a controlled environment, it is assumed that the data is noisier than clinical data, and consequently, trends are harder to detect. Bias may have been introduced due to survey wording, differences between translations and uneven proportions of participants from different websites. Also, as a convenience sample, self selection and self reporting may have introduced further bias. Instead of measuring behaviour directly, reported behavioural intentions had to be utilized. Regarding generalizability, users of advocacy websites may not be the same as target audiences from other types of social change campaigns.

5 Discussion

This research suggests a number of practical considerations in regards to the role of credibility and trust in selling online social marketing products. First, as e-commerce sites aim to increase sales and loyalty through increasing credibility and trust, online social marketers can increase their capacity to sell behaviours online by understanding

how their target audiences judge website credibility and leveraging this insight to move users from psychologically passive trust into physical active trust.

Second, given a bi-directional association between website credibility and behaviour, social change campaign websites can profit from iterative behaviour change loops. Given that acting on the advice of a website can influence a users' perceived credibility of website; and that the perceived credibility can influence their likelihood of adopting behaviours, this lends credence to focusing on foot-in-the door strategies which build up to larger behaviour patterns through small steps. As foot-in-the door techniques have been shown to operate by email [29], small behavioural acts such as signing e-petitions or even registering in a website have the potential to prosper into larger behaviours such as recycling or practicing safe sex.

Third, exchange theory has been called social marketing's primary theory which accents its marketing roots [30]. Within this theory, trust supports social exchanges by stimulating cooperation, creating reservoirs of goodwill, decreasing fears and reducing risks [31]. The social marketer's concept of *product* and *price* denote the core exchange theory elements, with products representing benefits and price, the costs to target audiences, in terms of time and effort. Figure 3 shows how Deutsche's (1962) definition of trust relates to product and price, with product as the beneficial outcome and price as harmful outcomes. Given online risks (such as misinformation, phishing, cyberstalking or privacy abuses), social marketers may stand a better chance of motivating offline behaviour adoption if they can increase online credibility and trust in order to reduce online costs: risks resulting from mistrust.

6 Conclusion

This paper examined similarities between social marketing, e-marketing and persuasive technology. It focused on website credibility, users' active trust attitudes and behavioural intentions. A distinction was made between passive trust, with psychological evaluations of trustworthiness and active trust, with physical acts that place a person in a dependency relationship with potential risks.

The results of this evaluation supported two hypotheses. First, website credibility and behavioural intent are bi-directionally related. Second, active trust mediates the effect of website credibility on behavioural intent. Out of these two hypotheses, it seems that active trust plays a significant, but partial, mediating role.

The implications for social marketers are first, that online campaigners can increase their capacity to sell behaviours online by identifying the factors that can move particular segments to first from passive trust, and then to form active trust attitudes. Second, given a bi-directional association between website credibility and behaviour, social change campaign websites can profit from iterative behaviour change loops that lead users through small and safe interactions which build towards larger and more demanding activities. Third, social campaigners can reduce barriers to action by increasing credibility and trust while reducing online risks.

For the future, there still remains work to assess the extent to which active trust mediates the effect of website credibility on behavioural intent; to understand this association across different online contexts and user groups; and to explore differences between active and passive trust. Given the common ground between

social marketing and persuasive technology, there is room to explore how mass online social marketing interventions can leverage persuasive technology approaches to strengthen large-scale behaviour change campaigns aiming to improve our environment, public health, safety and communities.

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Appendix

The following survey items composed the SEM models.

Dimension	Statement	Seven point scale
Website credibility (Trustworthy)	Information on this website seems: Also, information on this website seems:	Untrustworthy-Trustworthy Unreliable-Reliable
Website credibility (Expertise)	Content on this website reflects authors who are: Also, content on this website reflects authors who are:	Not Experts-Experts Unknowledgeable-Knowledgeable
Behavioural intent	Because of this website, I am more willing to support this campaign in the future. This website has inspired me to do more for the White Band Campaign.	Agree-Disagree Agree-Disagree
Active trust attitude	If I were to act on the advice of this website, I would feel:	Unconfident-Confident

Network Awareness, Social Context and Persuasion

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Abstract. This paper brings a sociological perspective to an area dominated by social psychology, that of persuasion. It discusses how networks can be used to describe context for persuasive messages. It has been previously argued that network awareness, having knowledge of how networks affect behavior and perception, combined with knowledge of the networks in some part of society such as an organization or region, is important for innovation and productivity. This paper expands on this by introducing the concept of "social context." While the idea of location in social structure is not new, the difference here is that this paper talks not just about abstract location in social space, but the more concrete realization of it in communication networks based on cell phones, social networking software, IM, email and other new technology is. I argue that the ability to observe and measure these networks can give insight into the user's behavior, attitudes and worldview and provide a context for persuasion to take place.

1 Introduction

This paper brings a sociological perspective to persuasion research. It discusses how networks can be used to describe context for persuasive messages. It has been previously argued that network awareness, having knowledge of how networks affect behavior and perception, combined with knowledge of the networks in some part of society such as an organization or region, is important for innovation and productivity[1]. This paper expands on this by introducing the concept of "social context." While the idea of location in social structure is not new, the difference here is that this paper talks not just about abstract location in social space, but the more concrete realization of it in communication networks based on cell phones, social networking software, IM, email and other new technology is. I argue that the ability to observe and measure these networks can give insight into the user's behavior, attitudes and worldview and provide a context for persuasion to take place.

Persuasive technology, or *captology*, is as a new way of talking about interaction with individuals. The term *persuasion* is defined as 'non-coercively changing an individual's attitudes or behavior." Persuasive technology is technology that is specifically designed to persuade people [2].

The term persuasion is not without controversy and "a lively debate has existed for centuries over the defining characteristics of the term *persuasion*" [3]. Social

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psychology assigns a number of variables to persuasion [4] that are divided into the broad categories of source, recipient, message and context. Each of these categories has a number of variables within them. In addition, it is somewhat difficult to draw a line between what is persuasion by technology and good old fashioned persuasion[5, 6]. This paper shows how technology can be used to determine a context for persuasion and set the stage for persuasion of any sort. To do this, the paper looks at"social roles" and "opinion leaders." It introduces the idea that "similarity" can be considered in terms of "role" from a sociological perspective and that it is possible to think of roles as patterns of relations rather than attributes of individuals. Though some sociologists differentiate between roles that are gained by achievement (doctor, lawyer, accountant) and roles that are assigned by society (woman, geek, jock) [7], others look at roles as positions in social space that can be described with networks [8]. Structuralist social theory has long conceived of "persons" as constructed by their relationships and this paper draws heavily on the ideas of Harrison White in that vein (See *Identity and Control*, 2nd edition, especially chapter 4). In persuasion there needs a persuader and persuaded and the role of the persuader, say a policeman, gives the role authority [9].

The idea of "social context" can be understood by thinking first of the idea of "geographic context." Today, most new cellular phones have GPS chips so the phone knows where it (and therefore the user) is geographically. This has lead to the idea of "context based services" for cell phones. These could be used persuasively. For instance, it might be able to persuade people to have better health by detecting that they are on the way home and reminding them to stop at the gym. It could be used to locate children; people can advertise their location for meeting others, and countless other purposes. The idea of context both lets users know where they are, but also lets others know where they are if necessary. Geographic context is straightforward and though social context is analogous.

Much of what we experience in the world is mediated by our culture and language. Abstract "things" like organizations and even physical objects like drinking glasses require our active intepretation. This point of view is characterized by persuasion researcher Daniel O'Keefe:

> Persons live in a meaningful, made-sense-of world. The meanings that persons (individually and socially) construct provide the basis for conduct. Thus it is only by understanding the everyday social actor's perspective that one can come to understand the actor's conduct, and hence the researcher's task is to describe the actor's point of view [10, p. 228].

One way of learning the actor's point of view is to ask her. Unfortunately, our impressions about how we will act are not always the same as how we do act. O'Keefe gives several examples where the self reported effect of persuasive messages did not result in any measurable change in behavior or attitude. A question is how to think of "point-of-view" in a way that can be measured. This same problem was seen in sociology. The insightful work of Nadel [7] on roles has great intuitive appeal. However, the only method of discovering roles was asking people, how can we specify a role more precisely? Anthropologists, have looked at kinship structure as a formal way of describing roles in some societies [11]. However, in modern society kinship roles are accompanied by professional roles [2, 9]. The notion of a "roles" is not straightforward, but can be valuable.

In the late 60's sociologist Harrison White and his students at Harvard did careful analysis of roles within organizations using empirical data. For instance, the Methodist ministries of the US had kept detailed records of movements of clergy. Ultimately they showed that the best way to view the mobility was to consider the roles and the individuals separately [12, 13]. Conceptually, there are a finite set of available roles, much like rent controlled apartments in Manhattan or hermit crab shells[14]. In order for someone to move in, the slot has to become vacant. Subsequent work showed that the roles could be describe by patterns of relationships [15] called "structural equivalence." To compute structurally equivalent sets, the graph is converted to an NxN array with nodes as indices on both dimensions. If there is a link between two nodes, then there is a non-zero value in the corresponding cell, otherwise zero. If two rows in the array are the same then the nodes are structurally equivalent. This took the folk notion of a "role" and turned it into something that has specific mathematical properties This allowed to operationalize the idea of a role into something tangable.

In social science it can be difficult to determine cause and effect. For instance, there is an assumption that beliefs cause or, at least, guide actions. Researcher Doug McAdam did a long term study of the participants of Freedom Summer, a part of the US Civil Rights Movement. Young, white college students from the North went to the South to register black voters. It was a dangerous activity and a number were beaten and even killed. By interviewing the participants and carefully analyzing the patterns of their relationships he showed that strength of belief in the cause was not a predictor of involvement, but that involvement could be predicted by the number and intensity of ties to others who went [16]. On the one hand, this might call into question the entire idea that a "persuasive message" is what is changing attitudes and behavior, but that is out of scope here and I am simply pointing to an additional way we test our theories of causality. In *Identity and Control*, Harrison White talks of our experience of the world as "accountings" or "stories." He is suggesting that we generally generate causes (in some sense following Hume [17]), something happens to us and then we explain it. These explanations are "what really happened" from our point of view. His claim is supported by experimental psychology and brain research:

> …people have no direct access to their nonconscious dispositions and motives, they must construct a conscious self from other sources. The constructed self consists of life stories, possible selves, explicit motives, self-theories, and beliefs about the reasons for one's feelings and behaviors. [18, p. 73]

Juxtaposing our stories about what happens with the empirical work McAdam did on the participants of Freedom shows that we should not take our ideas of cause and effect at face value. There is another recent study that reinforces this. Researchers looked at a number of possible causes of obesity in a large group of people over a 32 year period. Their conclusion was that social network relationships were the best predictor of who would become obese [19]. This study brings up an interesting issue, which is the relationship between influence and persuasion. It is unlikely in most case that people persuade others to get fat (though there are communities where this happens). The social context of the target of persuasive messages needs to be taken into account, and, in the Freedom Summer case, the location in the network was more important than the messages. Network awareness and social context hold promise in aiding the design of persuasive technology.

Social networks are not limited to social networking software or the users of any particular platform (Facebook, MySpace, LinkedIn, etc). Social networks are networks of people, groups, organizations and other things we identify as things capable of interacting with other things. These networks can be represented as graphs with circles as nodes and lines between the circles. The drawing in Fig. #1, David Krackhardt's "kite network," represents possible relationships. It is not hard to see that different people have different "positions." For instance, Jane and Fred are next to each other, but Ida is a considerable distance from Jane. Edward is connected to many people, and if Gail were gone, Howard and Ida would be completely disconnected. Using this physical analogy we can talk of different contexts for the individuals, but, what does the drawing represent in the real world?

The short answer is that it is a map of a social network. Currently the idea of "social graphs" has generated excitement [20]. Social graphs are drawings of contact relationships between users in "social networks" like Facebook. Though Facebook is new, the idea of drawing out social relationships is not. It originated with James Moreno in the 30's with his idea of a "sociogram"[21]. A sociogram is a map of individuals who have some relationship with each other. His theory was that "social configurations" affected the psychological well-being of individuals.

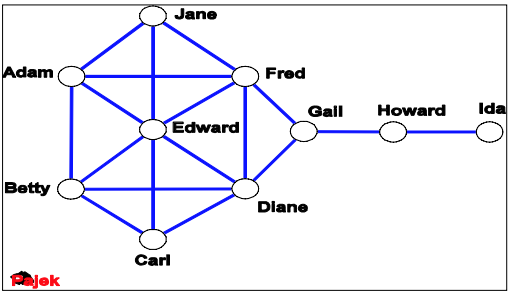

Fig. 1. Kite networks – David Krackhardt

A question that needs to be asked is: "do the patterns of relationships have any effect on individual attitudes and behavior?" Put another way the question is: "what are the sources of attitude and behavior?" Do they originate within the individual, or is it affected by others, and if so, are individuals that are at different positions in the network affected differently? If so, then how does this work? In the case of persuasion is it that if one hears the message from more than one person it is more persuasive, or are their other factors? Would a message from Howard to Gail prove more persuasive than one from Diane to Gail? What would help a persuasive message flow through the network and what would block it? In the nearly 80 years since Moreno first created his sociograms there have been countless research projects that help answer these questions, but social networks were mostly invisible. Now thanks to technology, they are becoming visible and can play a role in captology.

Though description of networks can become nuanced, with hundreds of ways of describing network or locations within networks, this paper will examine a few areas that relate to persuasion: diffusion, influence, roles and boundaries.. Diffusion is the

spread of innovations throughout networks, influence is network positions that are more influential in the spread of innovations, roles are positions where persuasive messages must be different, boundaries are area where persuasive messages need to change.

2 Diffusion

Diffusion through networks and society has been studied for a number of years. One aspect of it is the "innovation decision process" or the steps in its spread.

1. **Knowledge** (exposure to its existence, and understanding of its functions)
2. **Persuasion** (the forming of a favorable attitude to it)
3. **Decision** (commitment to its adoption)
4. **Implementation** (putting it to use)
5. **Confirmation** (reinforcement based on positive outcomes from it).[22, P. 20]

This definition of persuasion is just an aspect of the definition given previously which could include the first 4 items here. What is defusing is not just artifacts, but practices, like washing hands. The innovations diffuse through a "social system.", which can be represented as networks. Observations about "innovator," "early majority," describe the rates of individual adoption. Innovation does not spread like a cold, from person to person, but through subnetworks or even disconnected roles [23]. The same message that might be persuasive in one context may not be, or even have the opposite effect, in another. These ideas help develop the concept of "social context." Innovators and influencers do not occupy the same locations in the networks and the content of the persuasive messages will need to be different".

A prominent researcher in the field of diffusion, Everett Rogers, describes categories, from innovators to laggards partially as locations in networks. For instance, Rogers' description of innovators, is that

> .. their interest in new ideas leads them out of local circle of peer networks and into a more cosmopolite social relationships. Communications pattern and friendships among a clique of innovators are common, even though these individuals may be quite geographically distanced. [22, p. 282]

Only a small percentage of people are innovators. As the innovation gets more widely adopted the next group is the "early majority adopters," who are far more numerous amd "interact more frequently with their peers " [22, p. 283]. This type of relationship is what is commonly thought of as a "core/periphery" relationship with the innovation moving from the outside to the denser core of communication relationships. People in the center of an organization already have many contacts, status and have little personal incentive to change, people on the periphery of the organizations may interact less with others in the organization and have a smaller stake in the status-quo. Over time the environment will change and the people at the center might find that doing things the same way no longer works and something that was being done on the periphery works better. The history of Silicon Valley has seen a succession of industries and it continues to reinvent itself by this process [24]. An example of an industry where the core stayed stable is the US tire industry [25]. Persuading someone at the core of a network to do something differently will be different than persuading

someone at the periphery and network analysis is a way we can learn who is at the core and who is at the periphery.

3 Structural Equivalence and Roles

If innovation were to spread in a way so that any person that was exposed to a new idea were equally likely to be persuaded to adopt the attitude or behavior, then we would see a pattern where innovations were scattered randomly through society. For instance, a similar random number of corporate executives and college students would dress as gangsters and listen to hip-hop. It is not difficult to notice that people tend to dress in ways similar to others that are "like them." But what does it mean for someone to be "like them?" Current marketing research segments people by income, race, age, education, gender and other such factors. This is where "structural equivalence" comes into play.

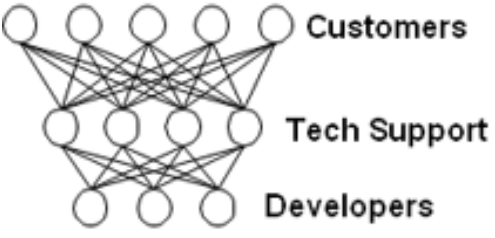

Fig. 2. – Structural Equivalence

It is not difficult to see in Figure #2 that even without assigning names to the nodes, the nodes on the top level have the same patterns of links to the nodes on the middle level and that pattern is repeated from the middle level to the bottom. If this were to be represented as an array, the rows on each level would be identical. There are many similar configurations in society such as professors, TA's and students; auto manufactures, auto dealers and customers. This type of pattern is called "structural equivalence" and research shows that people in the same "set" (who are at the same level) are often perceived as "similar" by observers [26]. This observation is bolstered by a study by Ron Burt, from University of Chicago Business School.

Burt reanalyzed a study by James Coleman on diffusion of a medical innovation, tetracycline [27]. He discovered that if he compared the hypothesis that the innovation spread by contact like a cold, to the hypothesis that innovation spread across structurally equivalent sets that structural equivalence was a far better predictor [23] of the spread of innovation. To rephrase this, the hypothesis that people are more likely to adopt innovations from people they think are like them than those that are not like them is verified by social network analysis [9]. The difference is that by using "structurally equivalent" as the criteria for matching, we do not need to do extensive surveys about preferences. While people do think of attributes to identify with groups, "young," "female," "athletic" and so on, the attributes might be explanations after the fact rather than causative [28]. Do people like hip-hop or Mozart because of some

predisposition? It is far more likely that we all have similar abilities to like any kind of music, but our location in the social world biases us towards some kinds of music rather than others. It is like language. It is extremely unlikely that people in the are born with a predisposition to learn English instead of Chinese. Saying that someone "likes hip-hop" is a reasonable way to categorize her and it give some idea what type of persuasive messages to craft to sell her music, but it is not really about her, but the community in which she is involved, just like the Freedom Summer participants in McAdam's study were not predictable by values and beliefs but by the social networks in which they were involved.

The observation that people live in different social worlds is a not new one. marketers divide the country by zip codes and spend money advertising hip-hop records in East LA and money advertising country music in Nashville. But ultimately those are proxies for the networks; they are going where they are more likely to find people tied together in networks. But, as well as it works, the promise of network based persuasion is huge. For instance, the spread of innovations across structural equivalent sets does not require the members are in contact[26]. Look at Fig. 2 again and you will see that the customers, the tech support and the developers do not have ties among themselves. We have ways of knowing a lot about what others like us are doing, through the media, gossip, conversation, stories and more. We use geographic segmentation because that is the best we can do, but it is social relations that are what we are interested in, something that has long been hidden and is just now becoming visible.

4 Opinion Leaders

Another claim that has been made in researching the diffusion of innovation is that not all people are equally persuasive. There is a concept of "opinion leaders" or "influencers." These can be thought of as exceptionally persuasive individuals who have the ability to change the attitudes and behaviors of others. It is most likely that their influence is local. In diffusion of innovation research researchers have found that "interpersonal diffusion networks are mostly homopholous" [22, p. 307]. Likewise, studies of social networks have repeatedly shown a tendency towards homophily [29, 30]. This means that the tend to be with people that are like them. A group may be disconnected from another and a message that has influence in one part of social space may have no influence in another. In fact, one group may define themselves as being different than another and the adoption of a behavior by one group may be a signal to oppose it in another.

Health promotion researcher Tom Valente at USC did a comprehensive study of different approaches to identifying influential individuals[31]. Valente's group works with health promotion, an area where persuasive technology might provide real benefits. Of the 10 methods he evaluated, the most comprehensive is "sociometric" in which all of the respondents are asked to whom they go to for advice. This is a method that can be done much more easily with technology and overcome that it is "time consuming and expensive" because it has the advantage that it "may have high validity and reliability" [31, p. 884]. There are reasons to believe that people who bridge between different parts of a network might be important as opinion leaders. There is a significant amount of work that shows such people are more innovative

[32-34], they have better health [35] and become more successful in a number of ways [36-38]. Excitingly, opinion leaders have high network centrality as well [39].

Since, by definition, opinion leaders are persuasive, it is interesting to ask "is the persuasive power of opinion leaders do to their network centrality, or is their network centrality due to their persuasive abilities?" It is probably some of both, but from the point-of-view in this paper; it does not make a difference. Since there is a correlation between opinion leaders then their location in the network, the social context, is a way of identifying opinion leaders that does not require surveys and other attribute based ways of identifying people. There is little correlation between most personality types and social networks with, unsurprisingly, some correlation between extroversion and social network centrality, but no correlation between network position and the other 4 of the big 5 [40]. However, part of the argument that positions in social networks can show opinion leaders rests on a personality trait.

The personality trait is called "self-monitoring." A person is "high self-monitoring" if she takes her clues on how to act from her social environment. A person is "low self-monitoring" if she looks inside herself and at her inner values for how to act. High self-monitors are sometimes characterized as chameleons, changing to fit the environment[41]. Though the original idea of a self-monitoring personality type comes from social psychology, it is widely discussed in marketing because high self-monitoring individuals are the opinion leaders. High-self monitoring individuals are concerned with the impression they make on others, so they are constantly looking to others for clues how to act. The various self-monitoring assessments [41-43] show they try to gain the good will of others, and they are concerned about their appearance. These are the qualities that make them opinion leaders. One view of opinion leaders is that they are a channel that adopt the ideas and innovations and that others look to them for guidance on what to do. This view may have some truth to it, but self-monitoring individuals are aware of how they are perceived in their immediate social surroundings. This leads to an idea of influence that is bidirectional, where the opinion leaders both get new ideas, but are testing them within the community as well. Conversely as they search for new ideas, they do it with the consideration of how the innovation can be used in other communities [44].

High self-monitoring individuals also have high network betweenness centrality [39]. Self-monitors are those who are comfortable adapting to different social environments, so it is not surprising that they would be the ones who bridge between social groups. Self-monitoring resembles what Granovetter calls "cognitive flexability"[29] referring to people who have many "weak ties" or links between disconnected social groups.

Social network analysis allows authors of persuasive technology to create an exact description of the roles of sender, receive and of context. The roles of the sender and receiver are matters of structural equivalence. The opinion leaders can be discovered finding the people on the shortest path between others. Separate components, disconnected networks, are important in persuasion as well, because often people form who they are, their identity, from group affiliation. A message from within the group has been found to be more persuasive than one from out of the group. In fact, the idea of "bottlenecks," "brokers" and "disconnected groups" are something that are common knowledge. But, as O'Keefe pointed out above, what we believe is going on and what actually is going on is not the same. Our perceptions of networks and their

actual structure do not always coincide [45, 46]. Thus, accurate measurement of the networks make the analysis valuable. The data that is becoming available is making this possible.

5 Data Sources and Social Networking

One difficulty has been in gathering the data. Another has been in the analysis of the data. Some techniques go back to the 60's. There are many types of analysis. Useful graphical visualization is less than 10 years old. Some of the measurements are not computationally complex, but others require exponential time to process. As with many such problems algorithms can and have been developed that throw away improbably cases and reduce the computation time but often the solutions are not obvious.

Data is traditionally gathered by surveys of the type "who are your friends?" "Who do you go to for advice about your job?" "who do you talk to more than 3 time a week?" and so on. These are error prone and researchers will find people who nominate someone as a friend and the nomination is not reciprocated. The researchers need to go back to the individuals and determine if it is a one way friendship or a memory error. This can be time consuming. Some of the most important things we can find about a network, like disconnect between groups or groups connected by a single gatekeeper are sensitive to accuracy. If a single link is missing the results can give a distorted picture.

Over the last few years there have been more and more papers analyzing network traffic by using traces from email and cell phones [47, 48]. Potentially this can be done with social networking sites and IM as well. A question that arises is "how do these relate to each other?" One way to think about it is to remember that the real network is the people that communicate with each other. IM, cell phones, social networking software are all tools to make that happen more easily. It the past, it was only possible to discover a tiny amount of this communication. When Sanley Milgram did his famous small world experiment and discovered we are separated by 6 degrees of separation in 1967[49], no one had a good idea what the large scale patterns of connections between people were like. The idea of using computers for collaboration and hypertext, which are the roots of the current social networking software, goes back to 1945 and Vannevar Bush [50]. These developments are mostly independent of the social structure of the people using the software [51].

In the case of a large company, say IBM or Oracle, there could potentially be a huge amount of communication by all of those methods. "Social networking" software is relatively easy to write and there is no reason that these companies could not have internal versions of something like Facebook. In this situation all of the data belongs to the company so they can add it all up and do social network analysis.

This is already being done in cell phone companies. An Austrian cell phone company hired network researchers FAS Research to analyze their phone networks. The privacy issue was dealt with by giving FAS anonymized data, with all the names converted to numbers. In an interesting example of using network location in conjunction with persuasion FAS identified customers with many connections into other networks, those with none and those with few. Instead of offering all customers the same incentives (persuasive messages) they offered those with many in other

networks price breaks so they would not defect, those with few in other networks incentives to bring the others into the network and those with no connections into other networks were offered no incentives. This is a simple example of using knowledge of networks, network awareness, as a way to craft persuasive messages.

If we do not look at the content of an email message the relationship has no meaning. Is it a gratuitous CC, hate mail, or a link of advice or friendship? This is also true with phone conversations and IM. Social networking software like *Xing* allows users to create networks based on their interest groups and allows for more natural affiliation. This is something that is possible to do within organizations and, in fact, has been being done since 1979 with the birth of Usenet [52]. From one perspective, each interest group is a separate network. If the networks are added together, we get a communication network, who talks to who, which is valuable in itself [53]. However, the idea of a role is context dependent and the interpretation of a persuasive message will vary based on the role. An individual might be the head of household and her messages would be persuasive to her children, but at work she might have low status and simply perform assigned tasks. The way she would craft persuasive messages would be different in the different contexts. Ideally, persuasive technology would allow us to realize that people have different roles in different contexts and use that information for more persuasive messages.

The more network data there is, the more this can be done. It is easy to think of reasons for and against integrating more network data including better recommendations, collaboration, health on the one hand and intrusion, unwillingness to share data and other realities on the other. Within organizations, it is not a problem. The fact is that the network data on people is growing and the opportunity to use it is expandind.

6 A Representative Case

A huge question is "why?" This is a question that can be asked about persuasion in general. There is a classic example from network theory that gives one reason.

A dramatic example of using social network analysis to solve a problem in an organization can be seen in its use in solving a labor dispute in a wood processing facility [54]. When a new management team proposed changes to the worker's compensation packages the workers did not accept and called a strike.

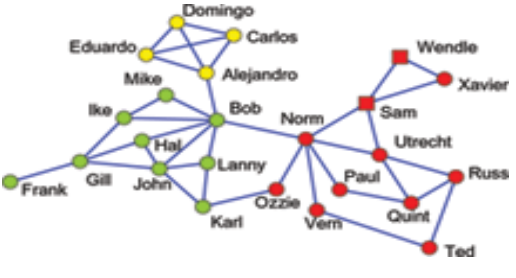

Fig. 3. Strike at a paper plant

After a long period of stalemate, the management hired a communication consultant to analyze the communication structure among the employees. They did not feel that the union representatives had communicated their proposal accurately to all of the employees. The consultant created a map of the communication about the strike by creating a survey asking each of the members of the organization to list their colleagues and rate how often they spoke to them about the strike on a five point scale ranging from "almost never" (less than once a week) to "very frequently" (several times a day). The consultant then used the values of 3 or above to create the map in Fig. 3.

The drawing shows a clear separation into three groups, the one connected by a single link to the rest at the top is the Spanish speaking employees. Alejandro speaks the best English of the group, and Bob speaks some Spanish. The group on the lower left is the younger employees and Ozzie is Karl's father. Bob owes Norm for getting his job. However, it is clear from the picture that the younger and older employees do not have that much contact, with all information going through Norm.

The two nodes that are represented as squares, Wendle and Sam are the union representatives, but they rarely discussed the management proposal with most of the people in the networks. When Norm and Bob were brought together with the management and the situation was explained, the strike was settled in a matter of days.

In this case, the management was trying to create a persuasive message "accept the new plan," but they were not delivering it to the right people. We do not know that the attitudes or mental models of the employees are, that was not documented in the article. We do know the social context of the union representatives and of Bob. In this case, that knowledge was enough to create the appropriate message. This is a simple example of how network awareness can help craft better persuasive messages. The way that the data was gathered was low tech, but new data sources are changing this. Social context and network awareness can be an important part of future persuasive tools.

7 Summary and Conclusion

By definition a persuasive message needs a context. This paper argues that social network analysis gives a way of defining context that has replicable properties. It explains these properties and gives case studies of persuasive messages that became successful because of the better understanding of the context. While much persuasive technology focuses on dyadic interaction between the user and the artifact, I am proposing that behind the scene assistance would provide great value. Just as a restaurant recommendation from one's cell phone would be far more valuable if on is in the vicinity of the restaurant, knowing a user's social location can enhance persuasive messages. New technology is making this possible.

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Persuasion in Knowledge-Based Recommendation

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Abstract. Recommendation technologies support users in the identification of interesting products and services. Beside the wide-spread approaches of collaborative and content-based filtering, knowledge-based recommender technologies gain an increasing importance due to their capability of deriving recommendations for complex products such as financial services, technical equipment, or consumer goods. The identification of best-fitting products is in many cases a complex decision making task which forces users to fall back to different types of decision heuristics. This phenomenon is explained by the theory of bounded rationality of users which is due to their limited knowledge and computational capacity. Specifically in the context of recommender applications bounded rationality acts as a door opener for different types of persuasive concepts which can influence a user's attitudes (e.g., in terms of product preferences) and behavior (e.g., in terms of buying behavior). The major goal of this paper is to provide an overview of such persuasive aspects and possible formalizations in knowledge-based recommender systems.

Keywords: Recommender Systems, Persuasion, Decision Phenomena.

1 Introduction

Due to the increasing size and complexity of product assortments customers are challenged to find the items best fitting their wishes and needs [4]. Specifically in online selling situations recommender systems [2][4][10][17] can effectively support users in the product and service selection process. The most well known recommendation approach is collaborative filtering [10] which basically simulates word-of-mouth promotion where buying decisions are influenced by the opinion of friends and benchmarking reports. Furthermore, content-based filtering [17] is based on exploiting similarities between user preferences (represented, e.g., by previously purchased products) and existing product descriptions. Content-based recommendation approaches are applied, e.g., in the context of searching Web content. Finally, knowledge-based recommendation [2][4] exploits deep knowledge about the product

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and/or service domain. Thus it is able to support intelligent *explanations* (e.g., argumentations as to why a certain product has been recommended) and product recommendations which are determined by a set of explicitly defined constraints [4]. In contrast to collaborative and content-based filtering, knowledge-based approaches are in the majority of cases applied for recommending complex products and services such as consumer goods, technical equipment, or (financial) services.

A major precondition for successfully deploying recommender applications in commercial environments is to understand and take into account the specific limiting factors users are subject to when confronted with decision tasks. Numerous psychological studies have investigated user behavior in different decision contexts (see, e.g., [1] [5] [8] [9] [11] [12] [22] [23] [24]). A person's *need for cognition* [13] is a trait which indicates to which extent a person is willing to invest time in cognitive efforts related to the identification of an interesting product or service. Research on behavioral decision theory points out the existence of adaptive decision behavior [16]. which is related to the fact that people have limited cognitive resources and preferably try to identify optimal choices with as little effort as possible. This *effort-accuracy tradeoff* has first been shown in a number of offline studies (see, e.g., [16]) and in the following has as well been observed in online situations such as Web content search [12]. Both, the complexity of the decision task and the degree of a person's need for cognition strongly influences the approach chosen to solve a given decision making task – this phenomenon is well known as decision making with *bounded rationality* [20]. Specifically the phenomenon of bounded rationality acts as a door-opener for different types of non-conscious influences on a consumer's decision behavior which can take over the role of persuasive technologies [6] in recommendation contexts. This view on decision making tasks has major consequences on the role of recommender systems which moves from traditional *preference elicitation* to so-called *preference construction*, i.e., in most cases users do not have a clear view on their preferences and therefore construct preferences in the course of a recommendation session. Consequently, the design of a recommender application can influence the outcome of a decision making task.

Within the scope of the COHAVE[1] project we investigate different decision phenomena which have the potential to persuade users of recommender applications. Such persuasive concepts can have different effects such as *increased trust in the recommendation process*, a higher *satisfaction with the supplier's Web page*, *increased trust in and satisfaction with the recommended products* (e.g., due to a lower post decision dissonance), an increased number of sold products (due to an increased willingness to buy), shifts in the *distribution of sold products* (e.g., significantly more higher-priced products have been bought), or shifts in the *attitude regarding specific product types*. In this paper we will discuss different basic concepts which have the potential to act as persuasive technologies in recommendation contexts. Concretely, we will show how serial position effects [5][8] can be taken into account when we present lists of product recommendations and corresponding argumentation lists explaining the reason why a specific product has been recommended. Furthermore, we show the application of context effects [9] [11] [19] [22] [23] in the presentation of recommendations. For all those concepts we present

[1] The project COHAVE (Consumer Behaviour and Decision Modelling for Recommender Systems - *cohave.ifit.uni-klu.ac.at*) is funded by the Austrian research fund (contract 810996).

basic computational models directly applicable to the development of knowledge-based recommendation applications. These components altogether form a framework consisting of modular components supporting the personalized configuration of product and service configurations.

The remainder of this paper is organized as follows. In Section 2 we introduce the basic concepts of knowledge-based recommendation. Section 3 shows how utility-based approaches are used to rank product alternatives such that the most interesting items are presented first. In Section 4 we show how explanations can be ordered by taking into account serial position effects (primacy and recency effects). In Section 5 we present a model which supports the specific configuration of recommendation results sets taking into account context effects.

2 Knowledge-Based Recommendation

A recommendation task has the goal of identifying a set of products fitting the wishes and needs of a customer. Such a task can be defined as follows.

Definition (**Recommendation Task**)**.** A recommendation task can be defined as a basic Constraint Satisfaction Problem (CSP) (V, C, P), where V is a set of finite domain variables describing product properties, C is a set of constraints describing the requirements of the current customer, and P is a constraint specifying the offered/available products or services.

Example (**Recommendation Task**)**.** A simple example for such a recommendation task is the following. Note that P is a single constraint which specifies the available assortment in a disjunctive normal form (i.e., disjunctions of conjunctions)

- **V** = {type, manufacturer, price}, where *domain*(type)=[desktop, laptop, server], *domain*(manufacturer)=[A,B,C], and *domain*(price)=[500 … 6000].
- **C** = {type=laptop ∧ manufacturer!=C ∧ price<5000}.
- **P** = {type=server ∧ price=4990 ∧ manufacturer=A ∨
  type=laptop ∧ price=2500 ∧ manufacturer=A ∨
  type=desktop ∧ price=1500 ∧ manufacturer=B ∨
  type=server ∧ price=6000 ∧ manufacturer=B ∨
  type=laptop ∧ price=2000 ∧ manufacturer=B ∨
  type=desktop ∧ price=1100 ∧ manufacturer=C ∨
  type=server ∧ price=4500 ∧ manufacturer=C ∨
  type=server ∧ price=5500 ∧ manufacturer=A ∨
  type=server ∧ price=4700 ∧ manufacturer=C}.

Definition (**Recommendation**)**.** Each assignment of the variables in V is denoted as consistent recommendation for a recommendation task (V, C, P) if and only if each variable in V has an assigned value which is consistent with C ∪ P.

Example (**Recommendation**)**.** On the basis of the given example, the two laptops r_1, r_2 can be recommended to the customer (see Table 1).

Table 1. Example recommendation result

recommendation id	*type*	*price*	*manufacturer*
r_1	laptop	2500	A
r_2	laptop	2000	B

This simple approach to identifying product recommendations can be extended by explicitly taking into account different types of decision phenomena. This issue is in the focus of the following sections.

3 Personalized Product Rankings

In order to support a customer-specific ranking of recommendations, we apply the basic concepts of Multi-Attribute Utility Theory (MAUT) [26]. Such a personalized ranking allows us to take into account primacy effects [5][8] which explain the fact that users pay more attention to items at the beginning of a list. Such rankings can increase the trust in recommendations since customers immediately see that the recommender system proposes interesting products in the first place. MAUT allows the evaluation of different product alternatives with regard to their utility for the current customer. In this context, each product has to be evaluated according to a predefined set of interest dimensions. *Economy* and *quality* will be used as simple example interest dimensions throughout this paper. Tables 2-4 reflect scoring rules describing the interrelationships between the given product attributes and the corresponding interest dimensions. For example, Table 3 denotes the fact that low-priced solutions have a higher contribution to the interest dimension economy whereas high-priced solutions have a higher contribution for the interest dimension quality.

Table 2. Scoring rules for product property *type*

type	*economy*	*quality*
desktop	10	5
laptop	6	5
server	2	10

Table 3. Scoring rules for product property *price*

price	*economy*	*quality*
<=2000	10	5
>2000, <2500	6	6
>=2500,<5000	4	8
>=5000, <6000	3	10
>=6000	0	10

Table 4. Scoring rules for product property *manufacturer*

manufacturer	*economy*	*quality*
A	2	10
B	5	5
C	10	4

On the basis of Tables 2-4, our set of example recommendations can be ranked as follows. The ranking of products (*productutility*(*r*)) is calculated using Formula 1, where *con*(*r*,*i*) denotes the contribution of product *r* to the interest dimension *i* and *in*(*i*) specifies the degree in which the customer in interested in dimension *i*. Table 5 reflects the evaluation of the recommended products on the basis of the interests of a concrete customer. This customer has a higher interest in the dimension *economy* (importance of 0,6) than in the dimension *quality* (importance 0,4). Note that in real-world applications (see, e.g., [4]) we derive the importance of interest dimensions from the given customer requirements. For reasons of simplicity, we assume that the importance weights have been directly specified by the customer.

Table 5. Overall utilities of recommended products

recommendation id	*economy*	*quality*	*overall utility*
r_1	6+4+2=**15**	5+8+10=**23**	15*0,6+23*0,4=**18,2**
r_2	6+6+5=**17**	5+6+5=**16**	17*0,6+16*0,4=**16,6**

$$productutility(r) = \sum_{i=1}^{n} con(r,i) * in(i)$$

Formula 1: Calculation of the overall utility of a recommended product

4 Explanations

For each product part of a recommendation we have to present a set of explanations (argumentations) as to why this product fits the wishes and needs of the customer [7] [14] [21]. Such explanations can change or reinforce the beliefs and attitudes of customers by, e.g., increasing the trust in recommendations or even increase the willingness to buy a product [18]. An explanation can be seen as a specific type of argumentation [3] [15] which takes into account both, positive and negative argumentative intents [3]. In the recommendation context positive explanations are used for indicating the major benefits of a product, whereas negative explanations provide an indication for, e.g., which features are not supported by the product. Table 6 depicts a simple example for a set of explanations directly defined for the recommendation r_1 (only positive explanations are used in this context).

After having defined our example set of explanations, we can now evaluate those explanations with regard to their utility for the customer. On the basis of the

preferences of our example customer (importance of economy = 0,6; importance of quality = 0,4), we can calculate the overall utilities of $\{e_1, \ldots, e_5\}$ (see Table 7). Formula 2 is used for this kind of utility calculation.

$$exutility(e_a) = \sum_{i=1}^{n} con(e_a, i) * in(i)$$

Formula 2: Calculation of the utility of a single explanation

The function $exutility(e_a)$ defines the utility of a specific explanation, $con(e_a,i)$ specifies the contribution of e_a to the interest dimension i, and $in(i)$ specifies the degree in which the current customer is interested in dimension i.

Table 6. Example set of explanations for r1

explanation id	*explanation text*
e_1	This laptop is a high-quality product of supplier A with numerous positive reviews from customers.
e_2	The offered system has a good price-performance ratio, it includes lots of innovative technical features.
e_3	This recommendation represents a high-class laptop in a lower price segment.
e_4	The laptop includes proven components with extremely low failure rates.
e_5	The system represents the newest generation of the most popular laptop series of company A.

Table 7. Overall utilities of explanations (e_1 … e_5): e_3 has the highest utility

explanation id	*economy*	*quality*	*overall utility*
e_1	2	9	2*0,6+9*0,4=**4,8**
e_2	7	4	7*0,6+4*0,4=**5,8**
e_3	9	7	9*0,6+7*0,4=**8,2**
e_4	2	10	2*0,6+10*0,4=**5,2**
e_5	3	8	3*0,6+8*0,4=**5**

Given a set of arguments (explanations) related to a specific product, an important task is it to identify an ordering of those arguments which the customer finds interesting and convincing. In our basic computational model for presenting explanations we assign to each argument position a corresponding utility value. The evaluation (see Table 8) has been selected due to the results of our experiment regarding serial positioning effects in the presentation of product properties [5]. Related results indicated the existence of significant primacy and recency effects regarding the memorization of explanations regarding product properties. Consequently, our approach is to position the most valuable explanations at the beginning and at the end of a sequence.

Table 8. Utilities of explanation positions, e.g., *posutility*(*1*)=*5*

explanation position	1	2	3	4	5
utility of position (posutility)	5	3	1	3	5

Assuming that we have n explanations (in our example n=5), we have n! permutations of orders in which those explanations can be presented (in our example 5! = 120 different possibilities). Out from those n! combinations we want to identify the ordering which maximizes the overall utility of a given sequence of explanations. The formula used for determining the overall utility of a given set of ranked explanations is the following (Formula 3) where $exorderutility(e_{1..m})$ specifies the overall utility of the sequence, $exutility(e_{pos})$ specifies the utility of a specific explanation part of the sequence (see Formula 2) and $posutility(pos)$ represents the utility of a specific position *pos* (see Table 8).

$$exorderutility(e_{1..m}) = \sum_{pos=1}^{m} exutility(e_{pos}) * posutility(pos)$$

Formula 3: Calculation of the utility of an explanation sequence

When we test our example set of explanations $\{e_1, e_2, e_3, e_4, e_5\}$ in the sequence $[e_1 \rightarrow 1, e_2 \rightarrow 2, e_3 \rightarrow 3, e_4 \rightarrow 4, e_5 \rightarrow 5]$ we get 4,8*5 + 5,8*3 + 8,2*1 + 5,2*3 + 5*5 = 90,2 as the overall utility of the sequence (on the basis of Formula 3). However, there exist explanation sequences with a better overall utility such as, e.g., $[e_1 \rightarrow 3, e_2 \rightarrow 5, e_3 \rightarrow 1, e_4 \rightarrow 2, e_5 \rightarrow 4]$ with the overall utility of 8,2*5 + 5,2*3 + 4,8*1 + 5*3 + 5,8*5 = 105,4 which turns out to be the optimal ordering of explanations in our example. Intuitively, this sequence corresponds to the fact that our example customer is more interested in the dimension economy that in the overall quality of a recommendation (argumentations regarding price are included in the first and last position).

Note that in our simple example we do not take into account dependencies between explanations. However, in real-world settings such dependencies exist and must be taken into account. For example, we could require that explanation e_3 is always positioned before e_2 or that e_3 is always on the first position. Furthermore, we could require that explanation sequences contain at most or exactly four items. Consequently, explanation orderings have to take into account additional constraints (typically imposed by marketing and sales experts). For calculating alternative orderings for a given set of explanations (which take into account such constraints) we introduce the following explanation ordering task.

Definition (**Explanation Ordering Task**)**.** An explanation ordering task can be defined as a basic Constraint Satisfaction Problem (CSP) (V, C), where V is a set of finite domain variables $\{e_{1pos}, e_{2pos}, \ldots, e_{npos}\}$ defining the ordering of explanations and C is a corresponding set of constraints c_i defining restrictions on orderings.

Example (**Explanation Ordering Task**)**.** A simple example for an explanation ordering task is the following. In this context, c_1 imposes the restriction that all positions have to differ and c_2 requires that the explanation e_3 has to be quoted before explanation e_2. Furthermore, e_1 is defined to be on the third place (c_3) and the

maximum number of arguments to be displayed for the customer is four (c_4). This is as well the upper bound since only five ordering variables have been defined.

- $\mathbf{V} = \{e_{1pos}, e_{2pos}, e_{3pos}, e_{4pos}, e_{5pos}\}$
- $\mathbf{C} = \{c_1$: *alldifferent*$(e_{1pos}, e_{2pos}, e_{3pos}, e_{4pos}, e_{5pos})$,
  c_2: $e_{3pos} < e_{2pos}$,
  c_3: $e_{1pos} = 3$,
  c_4: $e_{1pos} + e_{2pos} + e_{3pos} + e_{4pos} + e_{5pos} = 10\}$

This CSP representation allows us to calculate all possible sequences which take into account the defined set of constraints in C. In order to find the optimal solution, each of the identified sequences must be evaluated on the basis of Formula 3.

5 Contextual Product Presentations

The way in which multiple decision alternatives are suggested can have an enormous impact on the final decision taken by a customer. A decision is taken depending on the context in which decision alternatives are presented [1]. Such context effects have been intensively investigated in research, see, e.g., [9] [11] [19] [22] [23]. In the following we assume that the server products of Table 9 are part of a recommendation result. Furthermore, we assume that the vendor of these server solutions is interested in increasing the sales of server r_1 which promises the highest return. In the following we will show a simple model which supports our vendor in achieving this goal.

Table 9. Example recommendation result (server solutions)

recommendation id	*type*	*price*	*manufacturer*
r_1	server	4990	A
r_2	server	6000	B
r_3	server	4500	C
r_4	server	5500	A
r_5	server	4700	C

One of the most well-known context effects is asymmetric dominance, see, e.g., [11] [25]. In the example depicted in Figure 1, recommendation r_1 dominates recommendation r_2 in both dimensions (quality and economy) whereas recommendations r_3, r_5 are dominating r_2 only in the dimension economy and r_4 is dominating r_2 only in the dimension quality. Exactly such a situation can trigger a so-called asymmetric dominance effect: if our goal is to increase the sales of r_1 (target product T) compared to the competitor products (C) r_3 and r_5, we have to introduce the decoy product r_2 (D) which makes the option r_1 more attractive compared to other (competitor) options.

Note that the asymmetric dominance effect is one example for the general decision phenomenon that choices from subsets of a larger set of alternatives differ significantly and systematically from those of the larger set [23]. For reasons of simplicity we focus on this type of context effect. However, our CSP-based approach can as well take into account similarity effects [19] and compromise effects [22].

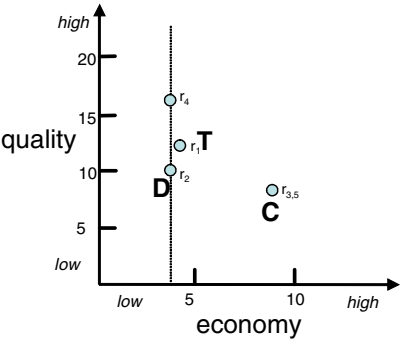

Fig. 1. Example for Asymmetric Dominance Effect

The calculation of utilities of the different product alternatives (recommendations) is performed analogously to the calculation shown in Table 5. The utilities of the product alternatives are needed in order investigate in which way those alternatives are dominating each other. This approach to reduce a given set of product attributes to a set of corresponding interest dimensions corresponds to the approach used in [19].

Table 10. Utilities of recommendations (r_1 … r_5)

recommendation id	*economy*	*quality*
r_1	2+4+2=**8*0,6=4,8**	10+10+10=**30*0,4=12**
r_2	2+0+5=**7*0,6=4,2**	10+10+5=**25*0,4=10**
r_3	2+4+10=**16*0,6=9,6**	10+8+4=**22*0,4=8,8**
r_4	2+3+2=**7*0,6=4,2**	10+20+10=**40*0,4=16**
r_5	2+4+10=**16*0,6=9,6**	10+8+4=**22*0,4=8,8**

Based on a given set of recommendations (in our case $\{r_1, \ldots, r_5\}$), one goal for an online selling platform could be to automatically configure a subset of those products (product bundle) which helps to increase the share of a specific set of products (part of the recommendation). We define the task of configuring such a set of products (subset of the initial set of recommended products) as follows.

Definition (**Product Bundling Task**)**.** A product bundling task can be defined as a basic Constraint Satisfaction Problem (CSP) (V, C), where V is a set of finite domain variables describing products and their membership in the resulting bundle and C is a set of constraints specifying basic properties which must be satisfied by all products which are part of the bundle.

Example (**Product Bundling Task**)**.** The following simplified example for a product bundling task is based on the information defined in Tables 9-10.

- **V** = $\{p_1, p_2, p_3, p_4, p_5,$
  $p_{1economy}, p_{2economy}, p_{3economy}, p_{4economy}, p_{5economy},$
  $p_{1quality}, p_{2quality}, p_{3quality}, p_{4quality}, p_{5quality}\}$, where *domain*($p_i$)=[0,1],
  domain($p_{ieconomy}$)=[0..1000], and *domain*($p_{iquality}$)=[0..1000].

- **C** = {c_1: $p_1 = 1 \wedge p_1 + p_2 + p_3 + p_4 + p_5 <= 3$,

  c_2: $p_{1economy} = 8$,
  c_3: $p_{2economy} = 7$,
  c_4: $p_{3economy} = 16$
  c_4: $p_{4economy} = 7$,
  c_5: $p_{5economy} = 16$,

  c_6: $p_{1quality} = 30$,
  c_7: $p_{2quality} = 25$,
  c_8: $p_{3quality} = 22$,
  c_9: $p_{4quality} = 40$,
  c_{10}: $p_{5quality} = 22$,

  c_{11}: $(p_{1economy} > p_{2economy} \wedge p_{1quality} > p_{2quality} \vee p_2 = 0) \vee$
  $(p_{1economy} > p_{3economy} \wedge p_{1quality} > p_{3quality} \vee p_3 = 0) \vee$
  $(p_{1economy} > p_{4economy} \wedge p_{1quality} > p_{4quality} \vee p_4 = 0) \vee$
  $(p_{1economy} > p_{5economy} \wedge p_{1quality} > p_{5quality} \vee p_5 = 0)$,

  c_{12}: $(p_{1economy} > p_{2economy} \vee p_{1quality} > p_{2quality} \vee p_2 = 0) \wedge$
  $(p_{1economy} > p_{3economy} \vee p_{1quality} > p_{3quality} \vee p_3 = 0) \wedge$
  $(p_{1economy} > p_{4economy} \vee p_{1quality} > p_{4quality} \vee p_4 = 0) \wedge$
  $(p_{1economy} > p_{5economy} \vee p_{1quality} > p_{5quality} \vee p_5 = 0)$,

  c_{13}: $(\forall p_i, p_j\ (i,j\ !=1, i!=j)$: $p_{ieconomy} > p_{jeconomy} \wedge p_{iquality} > p_{jquality} \Rightarrow$
  $p_i = 0 \vee p_j = 0)\}$

The above CSP is a simplified definition of a product bundling task. All solutions to this CSP are product bundles (consisting of at most three selected products – see constraint c_1) which support increased sales of product p_1 (the target product).

In this CSP, c_{11} denotes the fact that p_1 must completely dominate at least on of the products in the resulting bundle, i.e., there must exist a decoy element for product p_1 which potentially supports an increased sales of p_1. Furthermore, c_{12} requires that none of the products part of the bundle is allowed to completely dominate p_1 since such settings would decrease the sales of p_1. Finally, we require that none of the non-target products completely dominates another product since this would lead to side-effects which increase the popularity of products different from the target.

Consequently, the basic goal of the above CSP is to identify solutions which help to increase the probability of sales of p_1 (the target product) and to identify those products which should not additionally be included in a result set (at least in the first place). This goal is achieved by systematically identifying those products which have "negative" impacts on the acceptance of p_1. A similar approach can be used to exploit other types of context effects [19] [22] when presenting recommendation results.

6 Conclusions

In this paper we have presented three major techniques of knowledge-based recommender technologies which have the potential to be enriched with persuasive technologies. Primacy and recency effects should be taken into account when

ordering recommendations and explanations of product properties. Context effects can influence customer selection behavior due to contextualized presentations of decision alternatives. A more detailed understanding of the impact of the above mentioned decision phenomena clearly helps us to create new and more intelligent recommender technologies. However, we have to keep in mind that those new technologies can be exploited in a pure positive sense (e.g., increasing a customers trust in calculated recommendations) as well as in a pure negative sense (e.g., by persuading customers to purchase more expensive products or services).

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Persuasive Technology Design – A Rhetorical Approach

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Abstract. This article offers a rhetorical design perspective on persuasive technology design, introducing Bitzer's method of the rhetorical situation. As a case study, knowledge workers in an industrial engineering corporation are examined using Bitzer's method. Introducing a new system, knowledge workers are to be given the task of innovating and maintaining business processes, thus contributing with content in an online environment. Qualitative data was gathered and Bitzer's theory was applied as a design principle to show that persuasive technology designers may benefit from adopting rhetorical communication theory as a guiding principle when designing systems. Bitzer's theory offers alternative ways to thinking about persuasive technology design.

Keywords: Rhetoric, persuasive design, persuasive technology design, persuasion, knowledge workers, knowledge management, community.

1 Introduction

This article investigates the relation between persuasive technology and rhetorical communication theory by applying Lloyd F. Bitzer's [1] model of the rhetorical situation as a lens on qualitative data gathered from an industrial engineering corporation. It is shown that we can find constraints that require mitigation when designing a knowledge sharing system that needs to persuade its own usage. Grounded in the analysis, it is argued that the field of persuasive technology could benefit from the rhetorical communication model and use it to guide design efforts, thus the paper represents a methodological contribution to persuasive design.

2 Persuasive Technology and Rhetoric

When we speak of 'persuasive technology' we speak of technology that attempts to change the attitudes or behaviors or both of its end-users without coercion or deception [2]. Persuasive technology is a young field [3]. Only in 2006 was the first conference dedicated to the study of Persuasive Technologies held [4]. Today we speak of the persuasive traits of different types of technologies in a multitude of situations, for instance: health, games and social consciousness. It has been established that computers have unique traits when used for persuasion, namely interactivity [2].

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Before the field of persuasive technology came to existence, rhetoric was addressing questions concerning how humans persuade each other and by what means [5]. One famous definition states, "Rhetoric may be defined as the faculty of observing in any given case the available means of persuasion." [6]. Since Aristotle's definition, more modern definitions of rhetoric have been offered, for instance that rhetoric can be seen as an action that humans perform when they use symbols for the purpose of communicating with one another [7]. Both definitions clearly show that rhetoric and persuasive technologies are related since they share the objective of addressing persuasion in a deliberate fashion. It can be noted that in comparison to rhetoric and its theories of written and oral persuasion, computer mediated persuasion is in its infancy. Rhetoric has been concerned with persuasion for more than two thousand years and it might be beneficial for the field of persuasive technology to explore if it is possible to adopt experiences from the field [8].

3 The Rhetorical Situation

To explore whether a rhetorical communication theory can act as a guiding principle when planning a persuasive design, Bitzer's theory of the rhetorical situation [1] was chosen for further investigation. This was done for the following reasons:

Firstly, Bitzer's theory is a relatively simple model. Choosing a simple theory allows bridging of persuasive technology design and rhetoric in a not too complex manner. This was appealing since the application of rhetorical communication theory as a lens of persuasive technology design is an attempt to stretch a theory beyond its intended domain.

Secondly, Bitzer's model provides a lot of explanatory power enabling us to conduct a high-level analysis of the *context of persuasion* itself in a given rhetorical situation. The model was expected to offer persuasive technology designers the possibility to better and more explicitly elaborate on design choices made, using a new terminology that would enable them to speak differently of the persuasiveness of systems.

3.1 The Constituent Elements of the Rhetorical Situation

According to Bitzer [1], a rhetorical situation has three constituent elements: 'exigence', 'audience' and 'constraints'. The term 'fitting response' is also important to note.

The first of the three, 'exigence' is defined in a rhetorical situation as an "imperfection marked by urgency." [1 p. 6] This imperfection is to be solved or remedied by communication, thus a situation is only rhetorical if it can be resolved with communication that persuades an audience to act in a way that removes the imperfection. For instance, rainy weather could not normally be considered an exigence since talking about it can not change it, whereas global warming can be seen as an urgent imperfection that could be resolved by persuasion. The second constituent element, 'audience', as described by Bitzer "consists only of those persons who are capable of being influenced by discourse and of being mediators of change." [1 p. 8] They can ensure the wanted change, if they are persuaded. Thus a rhetorical audience is comprised only by those capable of being influenced and capable of resolving the exigence. The third element, 'constraints' is described as "persons,

events, objects, and relations that are parts of the situation because they have the power to constrain decision and action needed to modify the exigence." [1 p. 8] Thus constraints are both positive and negative traits of the communication situation that influence the options and choices of the communicator. Lastly, the 'fitting response' is the communication that resolves the 'exigence' by addressing the 'audience' to ensure the wanted outcome. One rhetorical situation can have many fitting responses.

A short example of a classical rhetorical situation could be an election. In a democratic election the candidates are faced with an exigency, namely to persuade the audience to vote for them. The audience is the citizens that can vote, but each member of the audience will only vote for one politician. The candidates communicate deliberately to persuade voters to vote for them. We can imagine numerous constrains for this situation. Let us say that it has been rumored that a candidate will raise taxes. In the situation of an election this could emerge as a negative constraint for that particular candidate. If the candidate is not somehow able to address this rumor he might lose votes or even be prevented from winning the election. The candidate might mitigate the constraint with deliberate communication, possibly by publicly promising that a vote for him will not result in a tax raise. As another example of a constraint, we might observe that some voters are pro-abortion, but some politicians have as a central part of their values that abortion should not be legal. Such a politician could perceive the pro-abortion segment of the audience as not being mediators of change, since they will never vote for him regardless of what he says. In the politician's deliberate communication, he might choose not at all to address a large section of the audience. They are a part of the whole audience, but they are not part of the rhetorical audience, which is defined as part of the audience that can help the politician to resolve his exigence namely getting votes to win the election.

3.2 Methodological Benefits of the Rhetorical Situation

From a theoretical perspective, we already note two interesting methodological benefits offered by the rhetorical situation for persuasive technology designers. Firstly, the theory offers a clear delimiter of whether or not it is appropriate to speak of persuasion at all. We can use the theory to speak of situations that are rhetorical and addressable with deliberate persuasive technologies and situations that are not. This is useful when investigating a new situation and considering whether or not to address it with persuasive communication. This is the macrosuasion level of persuasive technology design concerned with the overall persuasive intent of a product [2].

Secondly, the rhetorical situation provides a clear terminology for persuasive technology designers to describe the actual situation they are designing for. From a persuasive perspective, designing a handheld barcode scanner for warehouse workers is not as rhetorical as for example designing a heart rate monitoring sports watch. The latter situation is clearly more rhetorical by nature, since it invites software design that both influences and motivates the end-user to do something voluntary; whereas warehouse workers normally do not have a choice in using the provided barcode scanner.

The rhetorical situation allows for designers to think about the macrosuasion level of the situation they are addressing by noting exigence, audience, and constraints prior to designing a fitting system response. Thus the design can be made more

intentional. This empowers designers when designing objects that are to persuade the end-user in a rhetorical situation.

4 Case: Knowledge Workers Sharing Knowledge Online

To further investigate the feasibility of using the rhetorical situation on a macrosuasion level as a lens for persuasive technology design, a case study was conducted. Research was focused on investigating and analyzing the current situation at X-Corp[1], where the management had communicated a wish of introducing virtual best practice communities. They were in need of a design suggestion for that purpose. The aim is not to introduce groupware or document sharing, as these types of software are freely available at X-Corp. Rather the object is to form self sustaining internal online communities that would autonomously maintain existing business processes as well as invent new ones, spotting trends as they emerge and incorporating them into the X-Corp repository of business processes. The software used today for storing such processes is the SharePoint server [9]. Although it offers all the functionality necessary for the task, it unfortunately has proven hard to have employees update processes in this system. In reality, the challenge is to design a new community system that would in itself persuade its own usage, a system that would get or demand priority in the daily work.

Qualitative data was gathered from different sources. Three months of onsite observations took place at X-Corp Global Headquarters. The main activity was observing and engaging with the knowledge workers (KWs), both in work and in social events. The situations that were investigated comprised cross divisional corporate meetings, small and large workshops, meetings in business units and with middle managers. In addition, meetings were held with a multitude of stakeholders and casual lunches as well as informal discussions at the water cooler and in hallways took place. Meetings were documented with notes and interesting facts were noted post event, when that was deemed more appropriate. Data was also gathered both in five loosely structured interviews (20 minutes duration) and in six structured interviews (1½ hours duration).

5 Applying Bitzer at X-Corp

Using Bitzer's notion of the rhetorical situation, the data was analyzed in order to understand the rhetorical situation at X-Corp. This was done to investigate whether a fitting system response could be found and developed from this rhetorical perspective.

5.1 Exigence

A clear exigence was found. The situation at X-Corp makes it exigent for the management at X-Corp to ensure that continuous development, sharing and learning of business processes can be accelerated to meet the overall corporate strategy of continuous sustainable growth. The global strategy is to ensure a continuous growth

[1] This pseudonym for the company name will be used throughout the paper.

mindset and attitude from the workforce in order for X-Corp to survive against larger competitors that already have a competitive advantage of having more uniform business processes since it has proven less costly to have uniform processes.

X-Corp is historically comprised of three divisions each having their own distinct culture. During the past five years acquisitions of smaller companies have only added to the diversity in business processes. To mitigate this situation, a new cross divisional department has been created: Corporate Business Services (CBS). In the words the Vice President and Chief Development Officer, CBS plays a central role in ensuring the success of X-Corp:

> *The ability to continuously do things better than before needs to become a strong part of our culture. CBS will enable us to take a huge improvement step, sustain it and then take another huge step – over and over again.*

CBS has taken the initiative to diffuse best practices into the whole of X-Corp via dedicated programs addressing certain processes within several business domains: the sales program, the production program, the purchase program, the product development program etc. These programs are establishing the first generation of business processes at X-Corp and also undertaking the diffusion of the processes into the individual business units. Currently, processes are developed by dedicated employees. However having large programmes for this purpose is costly and the future envisioned by the management is that, for instance, sales business processes should be developed and maintained by autonomous heterogeneous communities composed of sales specialists, sales managers, trainers and local people in the field themselves. The management at X-Corp envisions that the employees will work using online technologies maintaining and developing business processes and methods. The communities will assume the responsibility of continuous process innovation within specific areas of competence and ensuring fresh processes based on fresh knowledge available throughout the corporation. Notably, the current system used for sharing processes and keeping documents available is a SharePoint Portal system [9]. The ownership of updating this system is still being handled centrally, in the sense that employees are pushed to update their versions of existing processes and making suggestions for new ones.

For the management at X-Corp, it is exigent that the new community system should influence KWs to positively engage in self sustainable communities of best practice. A fitting system response will be a new system that to a higher degree persuades its own usage.

5.2 Audience

According to Bitzer, the rhetorical audience is only comprised of the people that can mitigate the exigence. In the case study presented here, the audience is the KWs at X-Corp. They are a heterogeneous group working in a complex environment with many stakeholders, shifting priorities as well as firm deadlines. A significant portion of the audience will be sales people or sales managers for whom the customer comes first. The person who sells is the person that gets the bonus. The sales people and managers

put in long hours in a very competitive environment. Another segment is specialists and trainers, the people maintaining the training in the context of the existing programmes like the sales programme. They have to travel a lot in order to actually conduct training. These are the two main audiences that can mitigate the change that the management would like to see occur. They are the people that should engage in sharing knowledge autonomously. They are the people that will act as drivers of the communities having the task of determining what processes to focus on next as well as making training materials.

5.3 Constraints

Employing the theory of the rhetorical situation, we next turn to see what constraints are on the audience in regards to engaging in self-sustaining communities that are organizing and developing new business processes. Constraints are both the positive and negative traits of the communication situation and its elements in regards to resolving the exigence with communication.

The audience is a negative constraint: The first constraint is the audience itself. KWs know more about their jobs than their managers do and have often gained their knowledge through formal education [10]. At X-Corp, some KWs have special domain knowledge from many years of highly specialized work experience within a specific domain. In that sense there is a knowledge gap between the management that sees an exigence and the audience that are mediators of change. Making the audience understand and feel the exigence is a negative constraint in itself.

When speaking of sharing successful best practice sales processes online so that other KWs could perform in a similar fashion, one subject casually explained his view, “People have a hard time telling others the tricks of the trade because it undermines their own identity. It is so difficult to get that knowledge - even in real life.” He went on to argue that he had observed that a dichotomy existed between being a high performer in real life and then sharing the knowledge that made that happen in a community, “If everybody else can do what you do, will you still be high performing or will you turn into a medium performer? Why would you want to do that if you are a hero?”. While everybody theoretically speaking can agree that all would benefit from sharing, in reality, the person who benefits the most is the one not contributing while reaping the benefits of the contributions of others. This has been referred to as the “The knowledge workers prisoner dilemma” [11] and partially also referred to as the utilitarian perspective, where workers employ an individual cost benefit analysis on knowledge sharing [12].

Time is a negative constraint: The KWs at X-Corp work very hard. They are to some extent suffering from time famine [13]; during observations it was clear that people worked long hours. They worked from home in the evenings and on some weekends. One employee casually spoke of feeling guilty that she did not spend enough time with her family. In another interview an employee also spoke of the difficulties of maintaining a healthy work-life-balance. Several other signs were observable; people spoke of mail “dying” silently in their mail boxes since there was always too much of it. One subject had disabled the corporate chat client, since it was just another way for her to get work assigned. One secretary explicitly wrote that

people should read her meeting requests, "Please read the whole of this meeting request!".

Lack of experience with community software is a negative constraint: It was discovered that the audience is not particularly tech savvy. Naturally they produce documents and presentations using Office software, but they are not seasoned users of online communities or online communication as such. At loosely structured interviews six random subjects were asked, "Do you use the Internet in your spare time? For what?" All subjects first mentioned mail and when pressed more for other types of usage they first said they did not use the Internet for anything else, but when pressed harder the remembered: internet banking, booking travels and researching for travels. No subjects used the Internet as entertainment or for socializing in communities, chatting or spending time on multimedia content. When asked if they were accustomed with adding content to the Internet, they all replied no. During the onsite observations, no subjects were observed using their computers for community or social purposes. No subjects were blogging, writing in wikis, reading message boards, using social network sites, chatting for personal reasons or similar. During an informal discussion some of these findings with a subject, he humoristically remarked, "If you are very happy in your first life, why would you go into second life?"

Another discovery in regards to contributing with content online was that making KWs update the existing document sharing portal sites was a task that demanded an external driving effort. For some sales people, updating was not a top of mind task or a naturally reoccurring. Clearly for many KWs it was not a very important assignment, nor a highly visible one; it was not an obvious way to be clearly noticed.

Missing incentives for process innovation is a negative constraint: In structured interviews it became clear that no uniform incentive structure is in place for process innovation at X-Corp. The only well established reward is a patent award. This award is relatively small compared to the effort needed to get an idea, develop it and finally file a patent. Also, the patent award bonus is often shared as patents are usually the result of a small group effort therefore must be shared among the members of the group. Some subjects spoke of the difference between process and product innovation and made clear that product innovation normally is rewarded more directly. Some subjects mentioned that process innovators might receive oral praise and possibly enhance their chances of a larger yearly bonus.

More constraints could be listed, but for the purpose of this paper, the most explicit findings have been listed and notably no clear positive constraints were found. The constraints were found employing a rhetorical communication theory, but we notice that many of the constraints found already have been arrived at by others using different methods for instance: time [13], lack of clear incentive structure [11], [14], upsetting social structures or position [15] and lack of clear "what's in it for me" benefit [15] or performance expectancy [16].

5.4 Summary of the Rhetorical Situation at X-Corp

After this analysis we may begin to summarize some core findings that a fitting system response will have to address in a meaningful way in order to make the audience becomes mediators of change. It was found that the rhetorical situation

creates an exigence for the management at X-Corp. Seen from the VP's chair, the situation of knowledge not being shared is an imperfection marked by urgency, because the lack of knowledge sharing is not compatible with meeting the demands of the global strategy. But analyzing the rhetorical situation we found that the situation is not necessarily exigent for the KWs that are to actually share knowledge in community's structured formed around best practices. The KWs do not feel that the lack of knowledge sharing is an imperfection marked by urgency since they are under the influence of many other situations that feel more exigent to them for instance displaying good results locally, maintaining good relations with their colleagues and nearest manager, making the sales that would result in a fat bonus etc.

The management is somewhat in control of this part of the rhetorical situation. They have the power to make room for the new community tasks in a serious manner, for instance making clear what work would disappear from the KW's agenda to make time for engaging in the online community. Hence, a fitting system response must be deeply anchored in the organization in particular at the management layer. Any KWs nearest manager must also feel that this work is indeed important – that it is exigent.

However, more time will not suffice to resolve the exigence. A fitting system design will also have to offer a clearer benefit an egoistic value proposition targeted directly at KWs. The sharing of knowledge must make as much sense seen from a KW's chair at a local business unit as it does from the chair of a VP at the global headquarters. The unspoken KW question is, "What's in it for me?" That question is not answered by replying, "This software is really usable"; "We really want you to share knowledge" or "The corporate strategy depends on it". The posture taken by some KWs at X-Corp has also been dubbed the utilitarian perspective [12]. Following this perspective, it is assumed that when it comes to sharing knowledge at a corporation, individuals are calculative and driven by self interest, and further that the individual and collective interests are at odds or even fundamentally incompatible since the individual that owns or holds the knowledge can choose to, or not to, share it. Thus, sharing becomes the object of the individual's analysis of benefits over costs [12]. The difference between the work contexts of KWs and blue collared workers becomes strikingly apparent in that blue collared workers will normally have to adopt the system provided to them, whereas KWs might simply not adopt a system provided.

5.5 Fitting System Response: A Social Incentive Proposal?

The case analysis of the rhetorical situation at X-Corp makes it possible to address the exigence with it a deliberate persuasive system design. Having analyzed the situation we can begin to produce intentional design suggestions that directly address the context of persuasion itself.

Regardless of the system introduced or strategy chosen, there is a clear need to focus on the *mutual benefit* of both management and the community participants. A new system could, for instance, ensure that the work on best practices online is made highly visible at least on the Intranet. This could be part of a social incentive structure, in reality a different type of value offer. If not directly offering a monetary recognition, then a social reward in the form of exposure. Another practical dimension would be is to ensure time for the actual work to be done in the system. This naturally reaches far beyond the scope of designing software. This must be

addressed as part of the rhetorical situation; however here I will focus more on the aspects of the IT system itself.

One possible fitting system response could be to address the exigence held by the management by offering the KWs a clear functionality benefit. The aim of the effort could be to develop software that would truly empower the KWs in such a fashion that it was a clear benefit in itself. Such a fitting system response would however require offering the KWs a system that could enable real 'intelligence amplification' [17] in regards to process innovation. The software would simply have to empower its users to outperform non-users. Naturally, this is very hard to do. Since the object of this software is to gather share and innovate new best practices for business processes, I would argue that a pure functionality offer is not feasible and that X-Corp should instead focus its design efforts on other types of values.

Another possible fitting system response might simply be to introduce communities without anchoring them in the context of best practices. A first step might be to design a communication experience ensuring the KWs positive experiences online regardless of the KWs possibly being more social than productive. In that sense the development of best practices would be seen as a secondary design criterion (or even an ulterior design motive). Thus, the first step is to address the KWs capability to engage, without having to work, and then later introduce the shared distributed tasks of maintaining processes as well as adding ideas to new ones. The qualitative data showed that the KWs observed and interviewed did not have much experience with social software.

A final fitting system response offered in this paper would be to allow the communities to form around the KWs natural egoistic needs. This could for instance be done by offering a corporate link service. Offering such a service would allow for the individual user to store his links in a smarter fashion than locally in his browser. Adding a network effect to this functionality has both proven popular on the World Wide Web [18] and in a corporate context [19]. In this way the individual KW is not working for somebody else, but as long as he maintains his own links, he and others can benefit from the network effect of all members doing so for instance seeing what the most popular links are or exploring the links of likeminded KWs. We could imagine sales people gathering information about the competition in this manner.

More inspiration for fitting system responses might be found by observing systems already making users perform in a desired manner. Within the realm of Web 2.0 [20], community systems are very successful in attracting dedicated users that produce staggering amounts of content (Facebook [21], Wikipedia [22], Youtube [23], etc). Although this is not done in the context of work, we might learn from the structures behind these contributions. Unfortunately they are not very well described in the literature. For instance, investigating what motivates voluntary contributions in Wikipedia [22] Nov remarks that "no empirical, quantitative data is available that illustrates why people contribute to outlets like Wikipedia," and points out that there is a need for better understanding of this phenomenon [24]. Nov measured eight different volunteering motivations and found that the top reasons for contributing was "fun" and "ideology". Ideology was understood as sharing in the altruistic open source sense. This was almost antithetical to the KWs at X-Corp who were not found to be altruistic in sharing and were not observed to be having any fun on the SharePoint server. Far clearer incentives must be presented up front for communities

of best practice to succeed at X-Corp. A few examples of such value have been supplied here. But more research needs to be done to clarify this difficult question.

6 Conclusion

This paper was aimed at applying a rhetorical communication theory directly as a guiding principle for designing persuasive technology in a corporate context. A perspective on persuasive technology design was thus presented, and using this new angle it was shown how designers of persuasive technologies might benefit from analyzing the rhetorical situation for framing the context of persuasion itself prior to actually designing persuasive technologies.

Analyzing qualitative data and employing Bitzer's model of the rhetorical situation, it was found that best practice communities at X-Corp must offer something in addition to mere functionality in order to present a fitting system response that would make KWs contribute. By employing Bitzer's theory, it was possible to determine the main constraints in the rhetorical situation at X-Corp and shift the focus of the design considerations to address the main negative constraints, i.e. time, lack of clear incentive structure, upsetting social structures and the lack of clear "what's in it for me" benefit. Some of these constraints are addressable with software and some of them are not. Shear lack of time or even time famine is probably not something we can address with a community system.

It was found that the approach envisioned by the management at X-Corp in reality reflected mostly on the immediate exigency of ensuring continuous growth. Bitzer's theory was applied and yielded the discovery that the management should address the rhetorical situation in a different way, namely by offering alternative values to the KWs. Thus the main design criterion is not to enable or to empower knowledge sharing, but to devise a system that motivates knowledge sharing in a self sustainable way.

7 Future Work

Moving forward, the research should firstly aim at describing characteristics of the creative and innovative activities that KWs undertake in the early phases of innovation when developing business processes. This could be done focusing on designing new products, processes or services using collaboration software. The object of the research could be to investigate whether it is possible to uncover types of processes that are addressable with technology and which are not. Secondly, research should be undertaken to describe the motivational factors that must be present if knowledge workers are to take part in gathering, communicating and innovating new business processes in an online environments. Thirdly, as touched upon in this paper, it might be possible to gather some generic issues that most designers of collaboration software will sooner or later face when they design software that aims at supporting innovation activities.

Overall this could enable designers of collaborative working environments to address the motivational-context, when designing these environments to be deployed in a global distributed organization.

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Benevolence and Effectiveness: Persuasive Technology's Spillover Effects in Retail Settings

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Abstract: Results point to perceived store benevolence and staff effectiveness as important spillover effects in the use of persuasive technologies in the retail setting. The comparison of customer exit interviews, conducted at control stores and at test stores, before and after the introduction of video displays playing advertising and promotion messages, documented that customers noticed the displays, recalled the content and were influenced toward the desired effect. Additionally, significant attitudinal differences related to customer perception of staff and stores were also noted. Product marketers, brand managers, retailers, and academicians can draw actionable insights for the use of persuasive technologies by understanding the impact of persuasive technologies on relational exchanges.

Keywords: benevolence, effectiveness, retail, video display, advertising, promotion, engagement, persuasion, persuasive technologies, relational exchange.

1 Background

The value of shoppers' eyeballs at the point-of-purchase has persuaded both retailers and manufacturers to create in-store media and marketing programs, affording marketers additional touch points for their brand-building and promotional messages and affording retailers ad revenues as well. The effectiveness of in-store persuasive video technologies in achieving intended and unintended effects [1] with retail consumers is the focus of this study.

The intended effect of retail marketing is to get consumers to establish preference for products and purchase those products again and again in order to produce revenues. Retailers have basically three ways to increase revenues. Get more customers. Increase the shopping frequency of their current customers. Sell more per visit to their current customers. Likewise, marketers' ability to sell more products depends not only on increasing awareness of the brand or the product, but also of reinforcing the rational [2] and emotional appeal [3]. Additionally, trust is a critical factor in relational exchanges between consumers and service providers, and it is mediated by value in two distinct facets of consumer trust judgments—frontline employees and management policies/practices [4].

In-store video messaging is a relatively new persuasive technology that is being deployed at point-of-purchase in retail locations. The new medium is generating

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strong interest in convenience stores because effects at the point-of-purchase contribute to the impulse purchases that boost store revenues [5]. In the retail environment, convenience has been described using four dimensions: location, selection, transaction and consumption [6].

In today's attention economy [7] getting and managing consumers' attention is paramount for both retailer and supplier. The combination of relevance and targeting, combined with engagement, is gaining prominence among advertisers and marketers as a way to enhance the effectiveness of persuasion. According to a recent blue ribbon panel and current working groups of the Advertising Research Federation (ARF) [8],

> "The interrupt and repeat model of mass advertising, which rose to prominence with the growth of network radio and television, can no longer be the predominant path to creating brand demand. . . In this context, the new role for marketing is to create brand demand, not just brand awareness. We know now that creating brand demand requires more than a smart positioning or attention getting advertising, building awareness and providing trial incentives."

Advertising professionals working in ARF groups have articulated the meaning of engagement as "turning on a prospect to a brand idea enhanced by the surrounding context." [9]

To harness the potential of engagement on sales, retailers and marketers using persuasive technologies in retail environments are asking two questions:

> *What if – messages to engage prospects' interest could be delivered to motivated shoppers in the context of the purchase opportunity?*
>
> *What if – persuasive messages could be delivered when prospects are engaged with the brand, and they would not only be able to buy it but also be able to consume it at that moment?*

In the retail environment, convenience has been described using the four dimensions that are reflected in these two considerations: location, selection, transaction and consumption [10]. Over the past ten years, consumers' expectations for all dimensions of convenience have escalated as more and new offers of convenience have established new thresholds for customer expectations and as retailers compete to meet and exceed these expectations and, in fact, continue to raise the bar [11].

Insights about the size of the impact and the factors that influence the effectiveness of persuasive technologi es in retail environments are closely held by the private entities that track and measure such factors because of the very strong competitive business value of such insights. Veronis Suhler Stevenson and PQ Media have documented that dollars placed in alternative out-of-home media grew 27.0% in 2006 to $1.69 billion and were projected to grow at an accelerated 27.7% rate in 2007 [12]. According to the VSS/PQ Media Alternative Out-of-Home Media Forecast 2007-2011, alternative out-of-home advertising is one of the fastest-growing segments of the media industry, expanding at double-digit rates every year from 2001 to 2006 and posting compound annual growth of 22.6%. Studies conducted under the auspices of

the Point of Purchase Association International (POPAI) have documented that point-of-sale messaging results in an increase of 5 to 13% on product purchase in convenience stores [13]. Few published studies have explored the effect or the effectiveness of in-store video media in retail environments.

The conceptual framework for the experiment reported here expands Fogg's definition of persuasive technologies as interactive computing system designed to change people's attitudes and behaviors [14] to include computer-driven messaging systems that deliver messages to either groups of people or to individuals or both. Measures of effectiveness used in this study encompass the shaping and reinforcing aspects of change acknowledged by Stiff [15] and include both the brand-linked emotional associations and brand-linked rational associations (beliefs) acknowledged in Heath's hierarchy-of-processing model of persuasion in advertising [16]. Along the continuum of intentions to influence and control what people think and do, persuasion differs from conditioning by evoking, either physically or virtually, the presence of or reference to other people as social agents [17]. In this study relational exchanges are explored using the Sirdeshmukh model of consumer trust, value and loyalty in relational exchanges [18].

This study was designed [19] to test the effectiveness (changes in intent and purchase behavior) of persuasive technology (data-driven networks of digital video messaging) at the point of purchase using measures of engagement (awareness and recall), purchase (sales) and relational exchange (perception of the store and in-store messaging.)

2 Method

To better understand the effectiveness of in-store video messaging in engaging consumers and impacting both their perceptions of product brands and store experiences as well as their purchase decisions, this study compared consumer awareness and attitudes at convenience stores before and after in-store video display messaging [20] was introduced. Following installation of video messaging at the test stores, purchase activity was compared across test stores and control stores.

The pre and post measures, acquired in this study via exit interviews, were constructed to validate the foundational concepts of marketing effectiveness: awareness, attention, recall, and purchase behavior. Measures were also constructed to capture customers' perceptions of in-store communications, as well as of the store experience, using indicators of proven drivers of customer satisfaction in convenience stores [21] :

Awareness of the video screens and perception of the video messages were used as a measure of "turning on a prospect". Recall or purchase of the brand or product advertised in the video message was used as a measure of effectiveness. Staff and store perception were used as measures of relational exchange.

Four convenience stores, in the same locale, with the same socio-economic characteristics, the same square footage and with the same planogram were selected for this study. Two stores were test stores; a video screen playing advertising, promotion and informational messages in a split-screen format was introduced into each test store. The other two stores were control stores and had no video display screens. Printed in-store messaging in all stores was seasonal and unchanged during this study.

Immediately upon exiting the convenience store, shoppers were invited to participate in a five-minute interview about messages, products, brands and experiences. All exiting consumers were invited to participate. Three weeks following introduction of the video displays at the test stores, exit interviews were again conducted at the test stores, as well as at the control stores.

At all stores, the interviews were conducted on the same day during two high traffic times of day: 6 to 10AM and 4 to 8PM. The interviews were conducted without incentive and included open-ended as well as closed-ended questions. Open-ended responses were coded for analysis.

A total of 400 interviews were conducted. One hundred twenty-five interviews were conducted in the test stores before the video displays were introduced, and one hundred twenty-five interviews were conducted in the test stores after video displays were placed in the those stores. Seventy-five interviews were conducted in control stores during the pre-installation phase, and seventy-five interviews were conducted at control stores during the post-installation phase.

The 5-minute exit interviews included questions to measure three dimensions: brand idea (purchase and/or intent to purchase or visit); engagement (awareness, recall); and context (perceptions of the messages the store environment.)

3 Findings

The analysis of results (reported only for $p<.005$) revealed that this persuasive technology is effective. The messages on the video displays have shopper impact, boost shopper attention to other in-store messaging, boost sales of advertised products, add value for shoppers, and increase high impact dimensions of customer satisfaction. Shoppers noticed and liked the video displays; they recalled the ads, and they purchased the advertised products. Interestingly, the presence of the video displays also had an impact on shoppers' engagement with other in-store messaging, as well as on their perception of the store and its staff.

Unprompted, over one quarter (28%) of the shoppers in test stores noticed the video displays. [Figure 1]

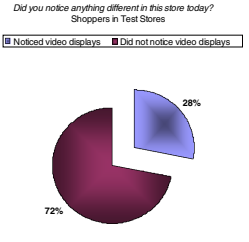

Fig. 1. Unaided Awareness of In-Store Video Displays

Prompted, over half of shoppers in test stores (58%) said they noticed the displays. [Figure 2]

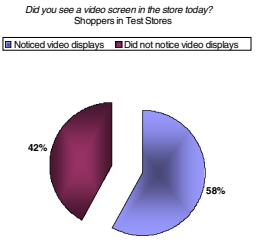

Fig. 2. Aided Awareness of In-Store Video Display

Shopper attention to other in-store messaging, in particular the hanging signs, was elevated following installation of the video displays. The proportion of all shoppers who recalled printed signs hanging in the store increase from 38% to 57% following the installation of the video displays. [Figure 3]

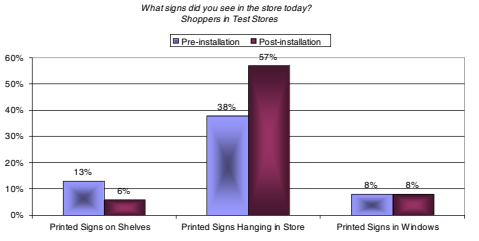

Fig. 3. Unaided Awareness of Signs in Store Before and After Installation of In-Store Video Displays

Most shoppers recalled the content of the video displays, mentioning the images (14%), the ads themselves (48%), the brands (59%), and the products (66%) that were shown. Only 17% of shoppers who noticed the displays said they did not recall the content on the video displays. [Figure 4]

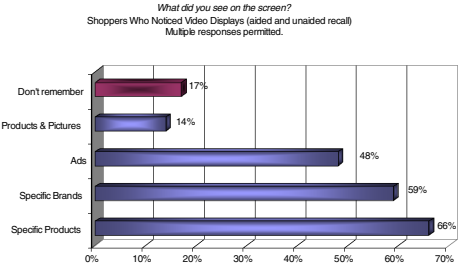

Fig. 4. Unaided Recall of Content on In-Store Video Displays

Purchase of advertised products was positively influenced by the in-store ads. [Table 1] Store sales of products advertised in the video displays were averaged in control stores on the interview day after installing the video displays to establish an index based to 1.0. Store sales of the same products at test stores on the post-installation interview day were compared to that index. Product sales of advertised products ranged from 2 to nearly 3 times higher in test stores.

Table 1. Sales* of Products Advertised in Test Stores Compared to Control Stores

Sales in Test and Control Stores		
	Test Stores	Control Stores
12 oz/12 Pk Carbonated Beverage, Brand A	2.71	1.00
2 Liter Carbonated Beverage, Brand A	2.76	1.00
20 oz. Carbonated Beverage, Brand B	2.24	1.00
4 oz. Pk Potato Chips, Brand A	2.94	1.00
**Sales Index is based to average of control stores on post-installation test day.*		

Only 10% of shoppers who noticed the video displays said their shopping was not influenced by them. Other responses indicated the displays offered positive value. In open-ended responses shoppers attributed benevolent motives to the store for operating the video displays. Nearly half (48%) of the shoppers who saw the displays said they believed the screen content provided money-saving information; over one quarter (28%) said their shopping was influenced by the entertainment value of the displays. Fourteen percent noted that the displays provided helpful information. [Figure 5]

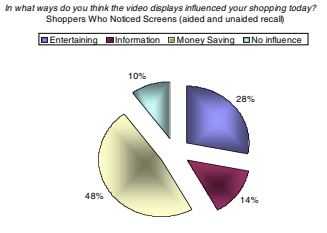

Fig. 5. Reported Influence of Video Content on Shopping in Store

Shoppers in test stores rated their shopping experiences higher after the video displays were introduced. After screen installation, shoppers rated the store higher on three key customer satisfaction indicators: speed of service (up 0.7), staff friendliness (up 0.6), and employee attentiveness and attractiveness (up 0.4), all significant differences on the 10-point scale at the $p<.005$ level. [Figure 6]

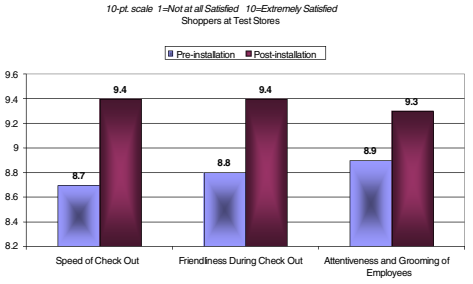

Fig. 6. Impact of Video Displays on Perception of Store

No significant differences were noted in pre and post conditions or between test and control store for other indicators of customer satisfaction, which included cleanliness, store layout, motorist services, product selection, convenience of parking, access to location, and quality of prepared food.

Additionally, the video displays had an impact on shoppers' perception of their surrounding context by adding value to products advertised as well as to the shopping experience. Among shoppers who noticed the video displays, there was strong agreement (4.7 on a 5-point scale) that the video displays were more likely to be noticed than printed signs in the store. There was strong agreement that products advertised on the displays were a better value than non-advertised products (4.5). Shoppers also agreed that their shopping experience was more enjoyable because of the video displays and their content (4.1). [Figure 7]

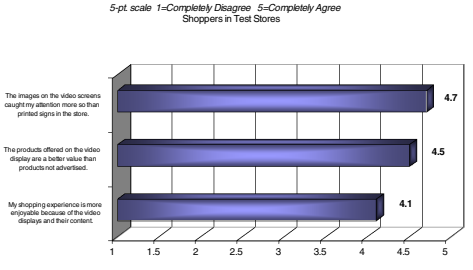

Fig. 7. Impact of Video Displays on Shopper Perceptions

4 Discussion

Results of this study provide insights on how in-store video messaging can be used to persuade shoppers. Opportunities for persuasion are not limited to the products advertised in the video displays. Opportunities for persuasion also include positive enhancements of the relational exchange reflected in consumers' attitudes toward the store and its staff.

Further studies may contribute to an actionable understanding of how low attention or high attention message strategies can be used in retail setting to optimize behavioral

change and how personalization and co-creation can further enhance the relational exchanges present in retail experiences.

Video displays boost shopper attention to point-of-purchase advertising located elsewhere in the store. Video displays improve shoppers' perception of store and its employees as well as their perceived value of the advertised products. Shoppers like savings and entertaining content and remember it. Shoppers buy more of the advertised products. Persuasion is delivered conveniently, consistent with the context, and customer satisfaction is increased.

Measures of customer satisfaction that have been developed specifically for convenience stores and tracked over nearly ten years show an erosion in customers' perceptions of convenience and continued low ratings on price and service quality. Indicators used to measure these perceptions include staff friendliness, helpfulness and attractiveness [22]. In response to consumers' dissatisfaction, retailers are searching for ways to elevate consumers' perceptions of convenience, add value to the experience, and leverage brand engagement for store loyalty [23]. Results of this study point to opportunities to leverage the engagement in persuasive technology to improve satisfaction with the retail environment as well as create brand demand.

Creating brand demand with both customers and potential customers requires a brand idea that is relevant to the surrounding context. Engagement with that brand idea in the relevant context helps to build preference and a sense of co-ownership that results in loyalty. New qualitative measures for brand engagement such as co-creation, personalization, and depth of meaning have been recently introduced by working industry groups and may offer further opportunities for testing in convenience stores, as well as other retail settings [24].

Results of this study have also shown that in convenience stores in-store video contributes to both brand awareness and brand demand at the point-of-purchase. Messages can be delivered to motivated shoppers in the context of purchase opportunity. Engagement with a brand idea boosts both purchase and perception. When engaged with a brand idea, shoppers have the opportunity to purchase and consume.

Studies on the relative effectiveness of diverse media – for specific categories and with specific markets – are now underway [25] and are likely to lend important insights to decisions that have the potential for high rewards. New technologies are in development to deliver real-time response data – at the store and brand levels – that will afford both retailers and advertisers opportunities to optimize all aspects of customer engagement with their brand messages in ways that are relevant with the surrounding contexts.

Further studies will benefit from comparisons of effectiveness at various times of day, as well as experimentation with different technology designs - impact of multiple screens and with screens placed at various locations in the store. Additionally, further experimentation with various persuasion approaches, as well as with the aesthetics and content of messages, will benefit marketing strategists, media and account planners, creative developers and retailers.

More and more, marketing and advertising in all forms of persuasive technologies need to engage prospects (customers and potential customers) in order to build preference, loyalty and a sense of co-ownership." [26] The results of this study validate the effectiveness of in-store video to engage shoppers with a brand idea in order to create brand demand in convenience stores. Results of this study also support

the effectiveness of persuasive technologies using in-store video advertising to provide return on investment in relationship-building initiatives. The persuasive impact on customers' attitudes toward both the products and the store reflect the important role that engagement plays in developing the relationships on which loyalty is based. In-store video advertising has strong potential to deliver return on investment to both advertisers and retailers.

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Persuasive Technology for Shaping Social Beliefs of Rural Women in India: An Approach Based on the Theory of Planned Behaviour

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Abstract. This paper presents the Personal Health Information system (PHI), which has been designed to influence health behaviours of rural women. The objective of the PHI is to offer health information to rural women to increase their awareness about menses and maternal health. The design and development process of the PHI is based on the theory of planned behaviour and employs social cues of persuasive technology to increase perceived behaviour control of rural women. In order to measure users' level of engagement, a comparative study between the PHI and conventional health information system was conducted. The results of the interactive sessions with women of different age groups and literacy levels illustrates the usefulness of PHI in motivating rural women to challenge existing social beliefs and practices, thereby persuading them to follow correct health practices. In this paper, design process of PHI, preliminary results of the initial study, and future research plans are discussed.

1 Introduction

Recent studies have shown that due to orthodox socio-cultural norms and user irrational behaviour related to healthcare, acceptance of current health interventions have been limited [6]. The limited acceptance of health interventions could be attributed to existing social beliefs and inefficient infrastructure in rural areas [7]. A study by [8] indicated that ignorance of these culturally divergent beliefs and traditional health care practices may lead to failure of the health information system. However the existing health care approaches using traditional mediums i.e. paper-based pamphlets, posters or door- to- door visits to users and ICT mediums i.e. showing movies to villagers or radio programmes doesn't include health related social beliefs while disseminating health care information.

The existing ICT- based health information systems in rural areas provide an overview of all the prevailing diseases, but doesn't address domain specific information needs of users such as maternal health, menses, or diarrhea [9]. Additionally, due to the large amount of (semi-) illiteracy most users are dependant on community health worker to access health information. As a consequence, the delivery of relevant personal health information to improve the well being of rural population is still recognized as a large challenge for the government and private sectors in rural India [1, 2, 3]. Despite several

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outreach programmes run by the government, non-government organisations, and private sectors, there is still an alarming rate of deaths in rural area due to lack of primary health information [4, 5].

The above situation raises the following two challenges for the designer towards developing a PHI system for rural women in India: First, how to identify social beliefs related to heath care in rural areas, and second, how to design interventions which might positively shape users' existing social beliefs, thereby influencing user health behaviour. To address both the challenges, we applied the theory of planned behaviour [10], which is one of the most widely implemented conceptual frameworks to examine the causal antecedents of health related behaviours. The theory focuses on why people perform, or fail to perform recommended health practices. This theory has been used successfully in understanding diverse health related behaviours related to exercising, adhering to low fat diet, using condoms for AID prevention or wearing a safety helmet [11]. Despite its successful application in varied discipline, theory of planned behaviour has a limitation. The limitation is in the area of volitional control [12]. Volitional means the ability to make conscious choices or decisions, and is also known as perceived behavioural control.

According to the theory of planned behaviour, the user is expected to change his behaviour only after he has the intention to do so. User intention to change behaviour is dependent on the degree of perceived capability to perform the behaviour (perceived behavioural control). For instance, a smoker knows that smoking is injurious to health. However, unless a smoker doesn't have high degree of perceived behavioural control, they will only become aware about the health problems related to smoking, but won't quit smoking. Thus, in addition to making them aware about health issues, there is a need to persuade a smoker to increase their perceived behavioural control, thereby increase smoker's intention to change smoking behaviour.

To bridge the current limitation of the theory of planned behaviour, we employed social cues of persuasive technology [13] as a means to increase users' perceived behavioural control. Persuasive technology, can be understood as any interactive computing system designed to change people's attitudes or behaviour [13]. Persuasive technology has strongly emerged as a strategy for changing people's social and health related attitudes in the western world [13]. Application of persuasive technology varies from persuading users to reduce energy consumption [14], assisting patients to remember pill intake [15], or persuading young girls to avoid early pregnancy [13]. Currently, use of persuasive technology has been largely limited to development of information systems in western countries and urban users. However, there is little evidence on how persuasive technology could be used in rural areas of developing countries to address socio-cultural issues related to healthcare.

In the current research, field studies were conducted to identify health related behaviours, practices, and existing subjective norms of a rural community. The questionnaire for the study was based on the theory of planned behaviour. The field results served as an input for the design of effective interventions to enhance knowledge on the health- related issues. A PHI system including different design strategies to shape users existing social beliefs; increase perceived behavioral control of the user to have high behaviour intention, was developed. The PHI design process was based upon the persuasive technology [13]. In particular, social cues based on persuasive technology were applied in designing information content, physical environment, and physical

system design. As a test case, menses and maternal health issues were selected for applying persuasive strategies in rural India.

This paper aims to present different persuasive strategies employed in rural India to improve information dissemination and user interaction with the self- constructed health information systems. Furthermore, the study followed Ajzen's theory of planned behaviour as a framework to identify social beliefs and health related behaviour in rural India. The PHI was tested in the field to assess the level of engagement and compared with conventional health information system. To measure engagement, two indicators were considered (a) participants re-visits, and (b) number of questions received after each interactive session. These indicators were based upon the theory of planned behaviour. The following sections describes the conceptual framework, field study, persuasive strategies applied in the design of PHI and concludes with future research plans.

2 Conceptual Framework

To shape social beliefs related to menses and maternal health of rural women in India, the conceptual framework which could integrate the following research issues in a single research cycle was selected. The research issues include: a) determine social beliefs of user, (b) select persuasive strategies for the PHI, and (c) conduct longitudinal studies to measure behaviour change. In this paper, social belief and selected persuasive strategies for the PHI will be discussed.

According to the theory of planned behaviour [10], human action is influenced by three major factors: a favourable or unfavourable evaluation of the behaviour (attitude towards the behaviour), perceived social pressure to perform the behaviour (subjective norm), and perceived capability to perform the behaviour (perceived behaviour control). According to the theory, the combination of attitude towards the behaviour,

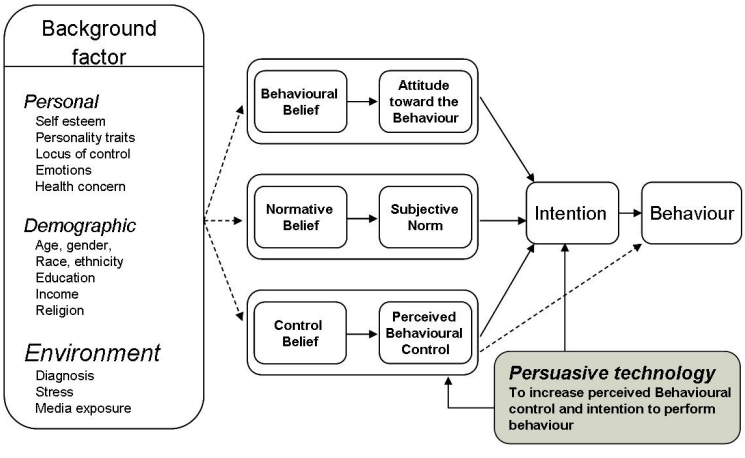

Fig. 1. Depict conceptual framework involving, the theory of planned behaviour (Ajzen,1991;Ajzen & Manstead, 2007) and persuasive technology (Fogg,2003)

subjective norm, and perceived behaviour control lead to the formation of a behavioural intention (see figure-1). Several studies have indicated that, the greater the perceived behavioural control, the stronger should be the persons intention to perform the behaviour in questions [10, 11, 12]. Background variables such as personal, demographic, and environment are included in this theory, because they all influence user behaviour indirectly (Ajzen, 1991). Stage of perceived behaviour control has an important role to play in terms of influencing degree of intention to change behaviour.

In influencing degree of intention, the design intervention employed different persuasive strategies to increase perceived behaviour control of users against existing social beliefs and practices related to menses and maternal health. The design process of the PHI employed persuasive strategies in designing information, physical environment, and physical system design. The role of the persuasive technology was to shape existing social beliefs via an interactive system to motivate rural women to have high behaviour intention and thereby change their behaviour. As depicted in figure-1, persuasive technology is projected as a means to persuade rural women to have high perceived behavioural control, thus high behaviour intention.

3 Field Study

Following the theory of planned behaviour a contextual inquiry (Beyer 1998) with rural women (N=115) was conducted to identify existing social beliefs and practices related to menses and maternal health. The inquiry involved structured questionnaires related to perceived value of health care among user, beliefs and practices followed during menstruation and maternal period and current health information source. Additionally, background information including personal, demographic, and environment factors were collected. The enquiry team included one industrial designer, and two local community health workers conducted all the observation and interviews. One health worker asked questions in the preferred language by the interviewee, the other worker observed and asked additional impromptu questions arising during the interviews. All the interviews were audio and video recorded, where possible, photographs were taken. Interviews with doctors were conducted by the team's industrial designer. Local community health workers were hired to gain accessibility to rural women, and build up positive reputation with rest of the villagers. Interviews with community health doctors (N=5) were carried out to determine the possible origin of the existing social beliefs. The beliefs related to menses and maternal health was categorized differently.

For the quantitative analysis, frequency of occurrences related to each belief, between different age group and literacy level were calculated as percentages. Contextual inquiry insights related to social challenges, community sensitive needs and design challenges have been reported in the previous research [9]. The contextual inquiry data was used as a basis for designing the PHI concepts. The PHI included audio-visual media to facilitate interaction of illiterate and semi-literate women. The information content of the PHI incorporated an explanation of the most important social beliefs and practices related to menses and maternal health. These social beliefs were based on the outcome of the contextual inquiry. Additionally, a persuasive environment was developed by incorporating the existing group behaviour of rural women in designing interaction of the PHI. Details of the PHI design will be given in the next section.

4 Design of Personal Health Information System (PHI)

The PHI (figure 2) is designed to offer personal health information related to maternal health and menses to rural women. PHI was developed for rural women to positively shape their existing health behaviour and increase their perceived behavioural control against social beliefs. The PC based system set up of PHI includes a monitor, a customized icon based keyboard with 9 keys and a trackball. The information is presented by audio visual aid in local language using PowerPoint, which can be accessed by the iconic keyboard using the 9 keys. PowerPoint platform was selected for information presentation due to its flexible and simple interface [16]. Power point was also selected because the content had to be easily updatable by the PHI operators.

The healthcare content in PHI was designed by incorporating the social beliefs related to maternal health and menses found by [4, 9]. The social beliefs related to maternal health included issues such as child delivery should only be done at home, pregnant mother should be given less food and pregnant ladies should not take any medical injections. The social beliefs related to menses include issues such as, only cotton clothes should be used during menses, during menses girl should not be allowed in the kitchen and menses is a punishment from God. In terms of literacy, no formal study was available to know percentage of literate and (semi-) illiterate users at the pilot site or surrounding areas. However, during the contextual inquiry, out of 117 women, the study found only one user with graduation level education. Rest of the user group had only gone to school for three to four years in their entire life. Illiteracy rate was found high among elder women group i.e. 40 and above.

In addressing these multiple beliefs and varied literacy level, the challenge was to offer rational information to user, but at the same time not burden them with information, which is difficult to understand. One of the design challenges was related to categorization of the data for (semi)-illiterate users. During the study, high number of

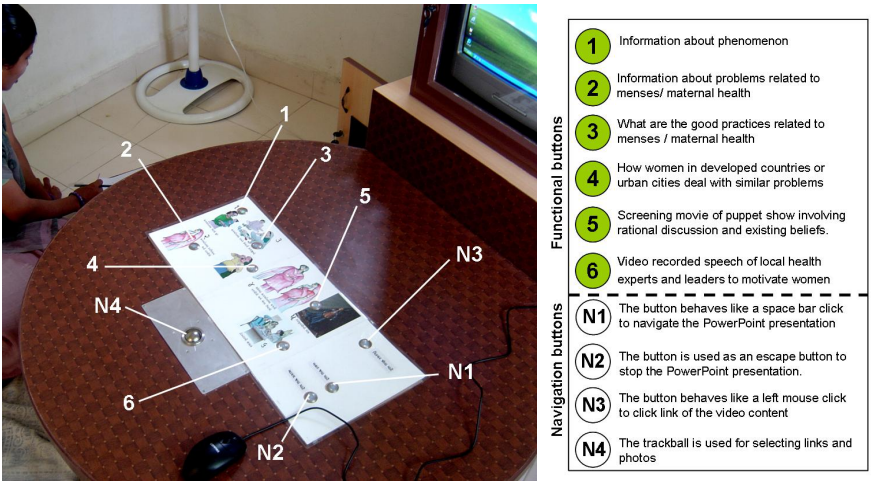

Fig. 2. Depicts layout of the design platform and explanation of each key

users reported their limitation to understand too much information at a same time. In addressing this limitation, the PHI content was divided into six categories as depicted in (figure-2). Next to each input key, icons were designed to assist rural women in understanding the function of the concerned key. The system has the flexibility to offer information sharing environment at individual or group level. Three community health workers with knowledge of Microsoft office were appointed as operators. Their responsibility included giving assistance to rural women in interactive sessions, and regularly update the PHI content. The PHI is physically located in the community hall at a pilot village site in western India.

5 Persuasive Strategies Employed in the PHI Design Process

Table-1 depicts six information categories and corresponding persuasive strategies employed in designing of an information content and physical form suggested by [13].

Table 1. Depicts six information categories and persuasive strategies employed in designing content and physical form

PHI components	**Persuasion strategies employed in the PHI**
Input keys: Information categories	
Key-1: information about menses and maternal health.	Psychological clues*, Language*, story telling technique, Audio-visual feedback in presentation.
Key-2: information about problems related to menses and maternal health.	Graphics depicting worst health condition of a women during maternal health, Story telling technique, Audio-visual feedback in presentation, Language, Psychological clues
Key-3: what are the good practices related to menses and maternal health.	Story telling technique, Audio-visual feedback in presentation, Language, Psychological clues
Key-4: how women in developed countries or urban areas deal with similar problems	Story telling technique, Audio-visual feedback in presentation, Language, Psychological clues
Key-5: screening health related videos	Social roles*, Using traditional folk songs, puppet shows, Story telling technique, Audio-visual feedback in presentation, Language, Psychological clues
Key-6: video recorded speech of local health expert and leader to motivate women.	Social roles, Story telling technique, Audio-visual feedback in presentation
Physical form	
PHI form design and environment	Social dynamics*, Physical*, Social role

Physical clues*: According to [13], computing technology can convey social presence through physical characteristic. Furthermore, physical attractiveness has a significant impact on social presence. In the PHI, due to low physical height, rural women could easily sit on the floor to interact with the system. The sitting position is culturally acceptable among rural women because it's a standard posture for discussing any issue among rural women, thus persuaded women to sit for long hours.

Psychological clues*: According to [13], computing product can lead people to infer, often subconsciously, that the product has emotions, preferences, motivations, and personality. In the PHI, the following three animations of local personas were used to deliver the content: a) teenage girl for discussing menses issues, b) married woman for discussing maternal issues, and c) a doctor for answering girl and woman queries. Additionally, folk music, and puppet shows were used to convey the stories weaved around the personas. In all the 6 categories, the three personas presented existing beliefs and discussed its effects rationally. Due to similarity between the screen character and rural women, they could emotionally relate to beliefs and problems being discussed. As a consequence, women were persuaded to discuss beliefs among them selves in the interactive sessions.

Language*: According to [13], computing products can also use written or spoken language to convey social presence and to persuade. In the PHI, during interactive sessions, each section of information item concluded with a provocative message, which persuaded rural women to press next input key and access additional information. A critical issue of varied literacy level was addressed by offering health information in the local regional language.

Social dynamics* : According to [13], most cultures have set patterns for how people interact with each other such as, rituals for meeting people, taking turns, or forming lines. These rituals indicate the social dynamics. In the PHI design process, current pattern of accessing information in public or private places, rituals of meeting people and community sensitive needs of rural users were considered. The PHI physical design offers flexibility to have individual or group based interaction with rural women. Inviting women in groups includes family members; this includes sister in law, mother in law, and best friend of a woman. This led to interesting discussions during interactive sessions.

Social role* : According to [13], humans play authority roles, computers can also act in these roles, and when they do, they gain the automatic influence that comes with being in a position of authority. In rural areas, local doctors and village leaders are seen as authority and influential people. The word from these authorities has high value among rural women. In the PHI, recorded videos speech of these authorities has been shown to persuade rural women towards following healthy practices during menses and maternal health.

6 Comparative Study of PHI vs. Conventional Health System

The PHI system was installed at the pilot site on August 21, 2007. In terms of observation, operators have been collecting user feedback at two levels. First, (a) about content relevance, (b) check users' ability to recall PHI content which was shown

during interactive session. This has been done to evaluate users understanding about the content. Second, (a) about physical design and ease of use, for instance, how many users remembered PHI operating procedures from their first session. How many time users had to ask for operator's assistance? The on-going user feedback has been used to iterate content and physical design.

In terms of knowledge, community health doctor and health workers have been convinced about increased awareness about menses and maternal health among women user group. According to community doctor, women who were revisiting the system came up with issues which are never discussed in the public. This change complies with Ajzens (1991) theory of planned behaviour, which says that the more favourable the attitude and subjective norm, and the greater the perceived behavioural control, the stronger should be the person's intention to perform the behaviour in question. Users asking questions and questioning age old social beliefs at the pilot site indicates that the PHI system has been able to increase their perceived behavioral control, thus their intention to change their health behaviour.

(Ajzen & Manstead, 2007) indicated that, lasting belief change depends to an important degree on the mental engagement of the audience. In following the theory of planned behaviour, two indicators were selected to measure user engagement with the PHI system; engagement reflects user liking of the design concept and system. Measuring indicator includes (a) number of questions asked by the user: this information was considered relevant for determining new information impact on users.

Fig. 3. Depicts woman using conventional health information system

Fig. 4 & 5. Depicts interactive sessions with rural women

Furthermore, questions asked denoted their inquisitiveness to know more about personal health. (b) Number of re-visits made by an user: re-visits were taken as a sign to learn more about menses and maternal health. In order to measure the impact of PHI system, a comparative study was conducted with conventional health information system. In this study literacy level and age groups were not analyzed as a separate variables because analysis of contextual inquiry have revealed that, out of literacy level and age groups, only between age group, there seems to have some significant difference related to health practices (forthcoming in a journal paper).

The study was conducted at the pilot site in western India in two villages. In village A, the data was shown to (N=50) semi-literate and illiterate rural women on a conventional health information system (figure-3). The content of a conventional system was based on the available information related to menses and maternal health in the local hospital. In village B, the data was shown to (N=50) semi-literate and illiterate rural women through the proposed PHI (figure-4 & 5). The content of the PHI was based upon identified social beliefs; furthermore, PHI offered flexibility to have interactive session in groups. The sessions were monitored by the researcher and the appointed community health workers. In total, 100 rural women participated in the study. Participants were from 12-60 age groups. Both the villages were observed for two months. Local doctors were responsible for the verification of information content and providing answers to participant queries related to menses and maternal health.

7 Results

The results show that the Village B participants who interacted with the PHI were twice as much engaged in confronting the social issues as compared to participants from village A. Participant's engagement with the system was measured by two indicators, first amount and type of questions asked in the session, and second, number of re-visits by the participants to the health system. In total 23 questions asked from village-A and 58 questions from village-B were recorded during the interactive sessions. Questions asked from the participants were categorized using affinity technique [17]. The following 6 categories were identified: questions related to practices,

Table 2. Depicts questions recieved from village A- 23(100) and village B- 58(100)

Questions asked	Village- A	Village- B
	N= 50 rural women N (%)	N=50 rural women N (%)
1. Existing practices	5(10)	12(24)
2. Existing beliefs	3(6)	11(22)
3. Challenging existing beliefs	2(4)	7(14)
4. Data addition	8(16)	15(30)
5. Personal questions	2(4)	9(18)
6. Non- health related questions	3(6)	4(8)

Table 3. Depicts participants re-visits to the conventional health information system and the PHI

Number of re-visits	Village- A N= 50 rural women N (%)	Village- B N=50 rural women N (%)
Participants	17 (34)	36 (72)

beliefs, questions challenging existing beliefs, data-addition, personal questions requiring privacy, and non-health related question. Based on the frequency analysis, participant response on each category is depicted in table-2, and number of re-visits to the PHI and conventional health system is depicted in table-3.

1. According to this study, participants from Village- B were twice as much engaged in confronting social issues than participants from Village- A. Higher engagement in Village-B could be attributed to the content, which is based on the existing social beliefs and group based participation which motivated users to actively participate in the interactive sessions. The interactive session created peer pressure among similar background participants, also known as normative influence [13], which motivated participants to ask questions during the sessions.
2 The number of questions asked by Village-B, regarding practices and challenging existing beliefs, was nearly twice as much than Village-A. In village-B, issues about existing beliefs and practices were openly discussed by the participants during the session. Many participants saw PHI as an opportunity to confirm their knowledge about menses and maternal health.
3. The number of questions asked involving personal health and privacy was higher in Village-B, 9(18%) sessions than Village-A, 2(4%). This implies that, issues which were considered private were openly discussed in PHI interactive sessions. Group based sessions enabled women to share personal health issues in public. Conventional health system could only host one or two users at a time. Physical set-up of the conventional system had limited possibility of holding group based interaction (see figure-3)
4. In Village-B, 36 (72%) participants re-visited the PHI after their first session. Whereas, only 17(34%) participant re-visited the conventional health system from Village-A. The qualitative findings show that, participants from Village-A found information items relevant, but due to lack of discussion environment to discuss their thoughts, they could not understand the given information. Many participants also reported receiving too much information in one session and lack of discussion led to less engagement. Therefore they were not keen on coming back. The flexibility of inviting women in groups or individually in Village-B resulted in a higher degree of motivation and discussions between the participants.

8 Conclusion and Future Work

The PHI system was designed as a means to disseminate personal health information to rural women in India. The PHI was designed and developed on the basis of identified social beliefs and practices which were inhibiting the information dissemination

related to personal health. The conceptual framework deployed to design the PHI followed theory of planned behaviour to understand social beliefs and its origin, and applied social cues from persuasive technology to design the information presentation. The theory of planned behaviour offered a good platform to integrate the field findings, which included background factors and insights about user attitudes. Furthermore, the theory assisted in understanding the relation between perceived behavioral control and role of intention in behaviour change.

The results of the interactive sessions with women of different age group and literacy level illustrates the usefulness of PHI in motivating rural women to challenge existing social beliefs and practices, thereby persuading them to follow correct health practices. The questions received from rural women through PHI have enabled community health doctors to understand reasons behind users' current health behaviour. These questions have contributed towards generating a knowledge base, which can be useful for future development of health information system. We conclude that combination of planned behaviour theory and persuasive technology could play a positive role in design and development of health care information systems for rural users. This combination could motivate rural users to change their health behaviour, thus improve their well- being.

Future research work will include longitudinal studies with rural women to measure the impact of PHI system at the pilot site. The next phase of the PHI design will focus upon adaptive interfaces, which could understand user age group and literacy level in the beginning of interactive session. This could assist PHI to decide the suitable persuasive strategy for users at individual or group level. For timely support at the pilot site, we are thankful to Ashis Jalote Parmar for her critical feedback on PHI system.

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Enabling Calorie-Aware Cooking in a Smart Kitchen

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Abstract. As a daily activity, home cooking is an act of care for family members. Most family cooks are willing to learn healthy cooking. However, learning healthy cooking knowledge and putting the learned knowledge into real cooking practice are often difficult, due to non-trivial nutritional calculation of multiple food ingredients in a cooked meal. This work presents a smart kitchen with UbiComp technology to improve home cooking by providing calorie awareness of food ingredients used in prepared meals during the cooking process. Our kitchen has sensors to track the number of calories in food ingredients, and then provides real-time feedback to users on these values through an awareness display. Our user study suggests that bringing calorie awareness can be an effective means in helping family cooks maintain the healthy level of calories in their prepared meals.

Keywords: Ubiquitous Computing / Smart Environments, Home, Healthcare, Context-Aware Computing.

1 Introduction

After a busy day, many people find nothing better than a delicious home-cooked meal from scratch prepared by a caring family member. This is in accordance with a recent study indicating that most people still favor home-cooked meals or cooking meals from scratch [7]; in Europe, 52% and the US, 44% of people prefer scratch cooking. For many family cooks, preparing a tasty meal is as important as a healthy meal with the appropriate amount of calories. However, average family cooks may not know how many calories are in their cooked meals after raw food ingredients are mixed and cooked, or whether these meals are considered healthy and offer a good number of calories for their family members [11]. Reasons include that knowledge on healthy cooking may not be easily learned, and average family cooks cannot easily follow the steps of calculating calories during an intense cooking activity: first they have to estimate accurately the amount (weight) of each food ingredient used (such as oil, meat, vegetables and others), and then they have to look up a food calorie table to calculate and sum up the overall number of calories used in a course or a meal. Therefore, they

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are reluctant to put in much effort on examining and changing their everyday cooking styles. Additionally, a study by Bandura *et al.* [1] has shown that the expected efforts may cause users to regard their lack of skills and self-efficacy to perform healthy cooking. Based on their theory, increasing accessibility of calorie information to users may raise their confidence and willingness on healthy cooking.

This study presents a Calorie-aware Kitchen that can provide family cooks with awareness on the number of calories in their home cooked meals, thus enhance family cooks' willingness to make healthy meals with the appropriate amount of calories, as recommended by nutritionists. The Calorie-aware Kitchen is augmented with sensors that track the food ingredients used during cooking, and provides just-in-time digital feedback to raise healthy cooking awareness. For instance, when a user prepares a meal, the kitchen presents calorie information whenever the user performs a cooking action that changes the amount of food ingredients on the kitchen counter or the stove, such as by adding meat, pouring in oil, etc. Given the number of calories of each ingredient, an average family cook can perceive calorie information in the amounts of ingredients or the composition of a course. The developed kitchen also suggests the recommended number of calories for a meal, based on the Harris-Benedict equation [10].

2 Contextual Inquiry

This work targets experienced family cooks who are willing to cook more healthily but are reluctant to put in much effort on learning and calculating calories. An experienced family cook is defined as someone who can cook without following any recipes or by relying on weight scales to measure food ingredients.

A four-day contextual inquiry was conducted to understand the cooking behaviors of four experienced family cooks (aged 28, 30, 58 and 65) in their home kitchens as they were cooking a regular dinner for their family. During the cooking process, they were observed and videotaped; questions asked about their meal preparation and understanding to nutrition and calorie needs.

Our findings are as follows. (1) They expressed the desire to cook healthily, especially with respect to calorie and nutritional balance. However, given busy schedules, they could not afford too much time or make much effort to learn and follow the complicated steps of weighing food ingredients and calculating nutritional values during actual cooking. They preferred simple-to-understand, practical guidelines for them to refer. (2) Family cooks commonly added ingredients based on experience or preference (oil, butter, meats, for example). Three of them stated that they were unsure about whether their own cooking styles were healthy. (3) Since cooking is an activity that requires ongoing planning and thinking about the next cooking step, family cooks would like to focus solely on cooking. They do not like to be distracted by unrelated activities, such as operating complex electronic interfaces, because distractions are likely to cause cooking errors. They suggested that they want only simple, highly relevant information on cooking itself. (4) They regard a kitchen as part of a home and not a place of work. No standard procedure should tell them how to operate various tools in a kitchen to produce meals.

The contextual inquiry led to the following design considerations in designing the Calorie-aware Kitchen: (1) the kitchen should offer just-in-time calorie information on

food ingredients during their regular cooking process, reduce the effort required to calculate calorie manually, and help family cooks easily perceive calorie information. (2) Calorie recommendations should be provided for ease of comparison and adjustment. (3) Information should help family cooks make their own decisions, without constraining his or her natural cooking habits. When cooks must concentrate, they can choose to ignore the informational display. (4) Information should be presented simply, so that family cooks can easily grasp the calorie information by taking quick glances.

3 Prototype Design and Implementation

Based on the above design issues, an initial prototype of the kitchen was proposed, and is presented in Fig. 1(a). The kitchen is comprised of the following two modules; (1) a calorie tracker that tracks the calorie, composition, and position of food ingredients currently on the kitchen counter or stove, and (2) an awareness display that provides calorie information on the ingredients and dishes that mirror actual layout.

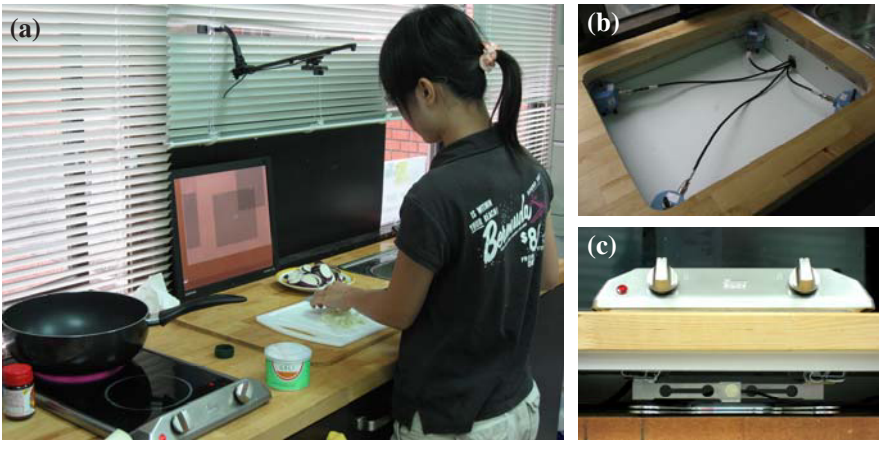

Fig. 1. (a) Calorie-aware Kitchen with digital feedbacks of calorie information during cooking process. An overhead camera is deployed over the counter. Weighing sensors are deployed under counter (b) and stove (c).

3.1 Calorie Tracker

Whenever a user performs a cooking action (adding or removing ingredients to or from a container) that may change the number of calories during cooking, the system must detect the cooking action in real-time. An example of such cooking actions is the addition of salad oil (130 kcal) to a pan or the removal of bacon (250 kcal) from a cutting board. Studies have shown that the number of calories can be derived from weights of ingredients [17], and calories are additive when composing ingredients. Therefore, to track calories, the weight and the composition of food ingredients in dishes need to be determined.

Our calorie tracker offers a hybrid sensing solution by combining weighing and camera sensing for accurate detection. Fig. 2 depicts the architecture for cooking activity recognition based on hybrid sensing.

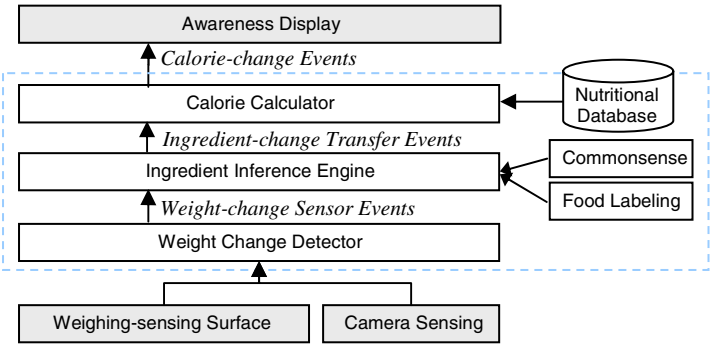

Fig. 2. Calorie tracker architecture

Hybrid sensing. To calculate calorie in food ingredients, we deployed a weighing-sensing surface in the kitchen. Based on our observations of cooking activities, most food preparation activities occur on the kitchen counter. They include putting ingredients on a plate, transferring foods among containers, cutting foods over a cutting board, mixing in a bowl and others. Hence, the system must accurately recognize the amounts (weights) of ingredients that are added to each container to calculate their calories. For the prototype, the design was based on the load sensing table [18] in which four weighing sensors were installed at the four corners underneath the kitchen counter (see Fig. 1(b)). All foods ingredients are assumed to be placed in or on kitchen containers (e.g., plates and bowls, cutting boards are also counted as containers here), rather than being placed directly on the kitchen surface. Hence, the smart counter can track the position of the containers on the countertop with an accuracy of 1 centimeter, and measure the weight of food ingredients in these containers. On the other hand, most cooking activities are performed on the stove, such as frying in a pan, so a weighing sensor must also be present under the stove (Fig. 1(c)). All of the weighing sensors are attached to weight indicators with a resolution of 1 gram, which output readings through a serial port at a frequency of eight samples per second.

Camera sensing using video analysis is employed to improve the accuracy by filtering noise from the weighing-sensing surface. Based on preliminary experiments, detection using only weighing sensors is not sufficiently accurate (recall of 54%, meaning 46 detections of noise per 100 weight changes), especially when cooking actions, such as cutting or stirring, generate lots of weight noise. Observations indicated that when these actions are performed, the cook performs similar motion of foods using hands and/or utensils. For instance, to cut bacon, the cook uses one hand to hold the bacon and the other hand to take the knife, cutting little by little. Therefore, video analysis using a color histogram comparison [12,4] is performed to filter false detections from weighing sensors. We deployed an overhead camera over the counter to capture an overview image of the counter (Fig. 1(a)). By comparing histograms of two camera images captured at different times, it can reduce sensitivity to the motion of objects

since unchanging objects differ only slightly in histograms, while a real weight change resulting in large change of color histograms can still be detected.

Cooking activity inference. Our cooking activity inference is based on an event-triggered system. First, the weight change detector detects *Weight-change* Sensor Events including weight and position, such as (50 grams, "position:(10, 50)") by processing weight samples from weighing-sensing surface and filtered with camera sensing. Second, an inference rule engine infers ingredient transfer activities by tracking the path of each ingredient from a starting container (as when bacon is put on the cutting board) to an ending container which holds the final cooked meal. A weight matching algorithm similar to that in our earlier work [6] is adopted to track this transference. That is, by matching a weight decrease (such as from a food container on a counter) to a weight increase (such as in a pan on the stove), food ingredient transfer is inferred and an *Ingredient-change* Transfer Event such as ("container$_1$", "salad oil", 50 grams) is sent to the calorie calculator. Commonsense knowledge on cooking is added to enhance inference engine. For examples, boiling water on the stove produces constant water evaporation resulting in weight decrease, and clams include non-edible shells that has no calorie. Third, because of the difficulties of recognition using computer vision or RFID tags on raw ingredients, a Wizard of Oz method that involves one human observer's manually inputting the name of an ingredient is currently used to identify new ingredients during cooking process. When the inference engine detects a new ingredient that cannot be inferred by weight matching, the camera captures an image which is then shows to a human observer to ask its name in the other display that the user does not see. A voice-dialog system is also tested to enable family cooks to identify foods using a voice input, for application in the subsequent stage.

Finally, a public nutritional database that provides the nutritional values of each ingredient is used by the calorie calculator to calculate the number of calories, based on the weights and the names of the ingredients [20]. A high-level *Calorie-change* Event describes ingredients and their calorie amount contained within a container, such as ("container$_1$", "salad oil", 130 kcal). This value is reported to the awareness display to interact with the user.

Recognition Accuracy and Limitations. From the user study of three participants who cooked a total of 15 meals, our activity recognition accuracy was 92%, meaning that 92% of the real calorie amounts of ingredients can be determined. For every cooking event (adding/removing ingredients), the average response time is 1 second to show calorie information on the awareness display. Since our tracking method is based on weight matching, the current prototype has a limitation that it cannot recognize concurrent or interleaving events, such as taking two dishes from a counter simultaneously and then immediately putting the ingredients into the pan on the stove.

3.2 Awareness Display

After the calories in ingredients have been determined by the calorie tracker, the system provides real-time feedback, as shown in Fig. 3, to increase the user's awareness of calories via an LCD display on the wall in front of the user.

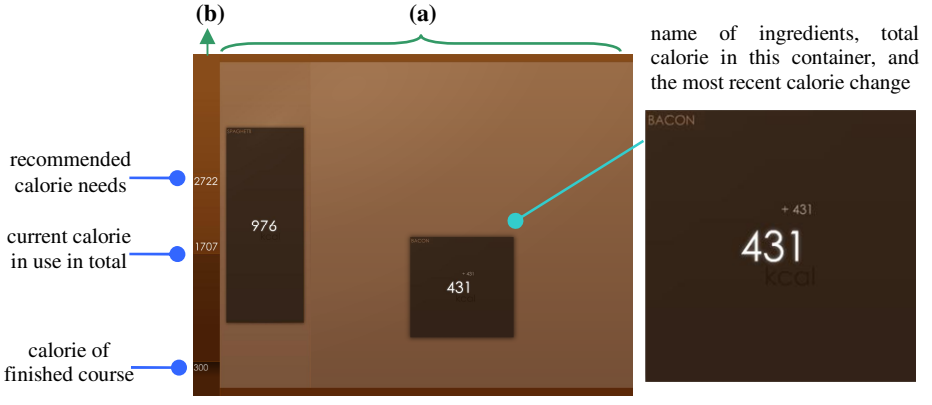

Fig. 3. User interface of Calorie-aware Kitchen, including (a) overview of calorie in the system; (b) recommended calorie needs and current used calories

The main part of this interface gives real-time awareness of calorie in use to users. It presents an overview of the number of calories in current ingredients on the stove and counter (Fig. 3(a)), to enable family cooks to obtain information efficiently. The layout of the information mirrors actual usage and actions, and the information on containers, including the total amount of calories and the names of the ingredients in it, are displayed (Fig. 3 right) based on the real position. All changes on the interface are made with a short and simple sound to notify users.

In the left part of our UI (Fig. 3(b)), a vertical bar is used to show the recommended number of calories for the meal, which is determined using the Harris-Benedict equations (based on weight, height and age) [10]. Therefore, before the system begins, the above details on the user's family members are inputted, and then the system calculates and presents the recommended calorie count for this family. During the cooking process, the current total calories in use are presented, to facilitate comparison for users. Additionally, when a user finishes one course and removes it from the system, the removal is recorded and the number of calories is kept in the bar to reduce users' memory load.

4 User Study

This section describes the user study. The following two questions guided this study: (1) How effective is the Calorie-aware Kitchen in improving the family cooks' awareness on calories in food ingredients during cooking? (2) What cooking behaviors are affected by the Calorie-aware Kitchen?

An evaluation was performed to determine how the awareness of calories during cooking affects users. Since the activities in the cooking process are complex, rather than focusing on a specific behavior, a holistic view is taken to gather both quantitative and qualitative observations.

Participants. Three adult participants, P1, P2 and P3 (Table 1), were invited to participate in the user study. They were all experienced cooks of more than five years who regularly cook meals for their family members.

Table 1. Profiles of participants and their family members

Participants	P1	P2	P3
Age	24	58	25
Gender	Female	Female	Male
Household size	4	3	4

Experimental Design and Procedure. Since our prototype kitchen was constructed in laboratory, it could not be easily moved to each participant's home. Therefore, participants were invited to cook in the laboratory. A video camcorder was used to record the participants' cooking sessions and their interactions with our system; their consent was obtained for subsequent analysis. A concern was raised on whether these participants' cooking behavior would be affected by the presence of the video camcorder (*i.e.*, the "monitor problem" of changing behavior when being watched). Participants expressed that this effect was limited because they already had strong motivation in learning healthy cooking and the presence of video camcorder did not increase/decrease their motivation.

Our user study involved the following three phases: (1) *pretest cooking* without feedback on calories, (2) *test cooking* with feedback on calories, and (3) *posttest* interview. To compare the effectiveness of our smart kitchen between pretest cooking and test cooking phases, each participant was asked to write a fixed dinner menu (Table 2) as if they were to prepare a regular dinner for their family. P1 and P2 wrote a Western dinner menu, whereas P3 wrote a Chinese dinner menu. Based on their dinner menus, they were asked to prepare ingredients using our budget and bring them to our kitchen. Then, the three participants were asked to cook meals in the manner that they did at home, for a total of five cooking sessions per participant in one week. In each cooking session, each participant was asked to cook according to their designated dinner menu in our laboratory kitchen. The participants were given freedom to modify the ingredient composition of the courses (such as by changing the salad dressing, removing mushrooms from spaghetti), but they were not allowed to add a new course or replace an existing course (such as by changing a salad to soup). At the end of the cooking session, participants were free to take their cooked foods home.

In the pretest cooking phase, each participant cooked two meals on two separate days without turning on calorie feedback. Before the start of the first pretest cooking session, the three participants were given time to familiarize with various appliances and the arrangement of cooking tools in the laboratory kitchen.

In the test cooking phase, participants came to cook for another three meals on three separate days using the calorie feedback on the awareness display. Before the start of the first test cooking session, the calorie feedback interfaces were explained to the participants. The participants were also asked not to perform cooking actions outside the recognition limit of the calorie tracker, i.e., avoid performing concurrent

Table 2. Menus designed by participants for testing

Participants	Menu
P1	Salad (with apple, celery, and thousand-island dressing); Salmon; Fried aubergine with onion; Spaghetti (with bacon, mushroom, onion, and milk)
P2	New England clam chowder (from Campbell's Condensed Soup [5]); Bream roll with bacon with special sauce (including UHT whipped cream, onion, white wine, and lemon), rice and vegetables (cauliflower, carrot, and sweet corn); Salad (with lettuce and thousand-island dressing)
P3	Shrimp with scrambled egg; Mapo tofu (fried tofu with meat sauce and green onion); Asparagus with abalone; Chinese Clam Soup; Rice

cooking actions. Participants followed this rule with reminders in the first cooking session, and then were able to remember it. Later interviews with participants revealed that although following these rules lengthened the cooking time, it did not affect cooking style.

A posttest interview was performed on the final test cooking day and after the participants finished their last cooking session. They were interviewed about their experience of the kitchen with calorie feedbacks.

Measurement. To determine how effectively participants perceived and utilized calorie awareness information, this study first measured their meal calorie during five cooking sessions. Reduction in meal calories from pretest to test cooking phases suggested that bringing healthy cooking awareness through calorie feedback was effective. The method counted the number of calories in a prepared meal by subtracting the weights of all food ingredients at the end of each cooking session from that at the start of the session. Then, the nutritional database was used to determine the total calories in every meal. Second, the amounts of changes in the ingredients between the pretest and test cooking phases of each participant were analyzed to understand how participants utilized calorie awareness to reduce meal calorie during cooking. Third, the cooking videos were analyzed and coded. The following data were recorded for each cooking session: (1) the frequency with which a participant glanced at the calorie display following a cooking action that resulted in a calorie change, and (2) the average duration of a glance at the awareness display. Finally, the posttest interview involved qualitative measurements of their understanding to ingredients and comments.

5 Results and Discussion

Table 3 presents the numbers of meal calories in each cooking session over five days. The two main findings are as follows. All participants reduced the number of meal calories from the pretest cooking phase (without calorie feedback) to the test cooking (with calorie feedback) by an average amount of (195, 688, 887) kcal. All participants cooked meals of calorie count within ±13% of the recommended amount, and the reduction of calorie used was up to 25.9%. Notably, participant P1 was originally aware of the amounts in use, so the calorie she used in the pretest was already around recommendation (2.8%). Participants P2 and P3 were lack of nutritional knowledge,

Table 3. Meal calorie (in kcal) during each cooking session

Participants		P1	P2	P3
(1) Recommended calorie		2,981	1,926	2,723
(2) Pretest	Day 1	3,070	2,677	3,951
	Day 2	3,058	2,641	3,976
	Average	3,064	2,659	3,964
	Over recommendation	2.8%	38.1%	45.6%
(3) Test	Day 3	2,937	1,916	3,308
	Day 4	2,780	2,099	3,027
	Day 5	2,890	1,897	2,896
	Average	2,869	1,971	3,077
	Over recommendation	-3.8%	2.3%	13.0%
(4) Reduction (PretestAVG -TestAVG)		195	688	887
	Percentage	6.4%	25.9%	22.4%

and they cooked above the recommended amount during the pretest cooking phase (38.1% for P2 and 45.6% for P3). Therefore, the system herein helped them be aware of calories, and further the reduction of meal calories from pretest to test cooking phases was more significant, for P2 (25.9%) and P3 (22.4%) than for P1 (6.4%).

We analyzed how participants changed their cooking behaviors to achieve calorie reduction. Our finding was that our participants were targeting high-calorie ingredients, in which a minor reduction in their amount leads to a significant reduction in the overall meal calories. For instance, in P1's meal, 61.2% of the total calorie decrease was from the oil. P1 planned to reduce the amount of oil when she found the calorie count was high, and thought it would help keep the number of calories under their required amount, while keeping the meal delicious. In P2's meal, 75.5% of the total calorie decrease was achieved by reducing the amount of condensed soup. P2 noted that the soup had more calories than she expected, and reducing the amount could greatly lower the calorie count while keeping the meal still tasty. Finally, in P3's meal, 34.8% of the total calorie decrease was achieved by changing the amounts of meat sauce and tofu. He responded that he found "Mapo Tofu" contained too many calories, so he just used smaller servings to reduce the number of calories.

Table 4 shows the results of video analysis. The first measurement yields the glancing rate, which is defined as the percentage of the times that a participant glanced at the calorie display after a calorie-changing cooking action. A high percentage indicates a strong desire to obtain calorie information. Since the purpose of the kitchen was to promote calorie awareness in users, checking whether users actually checked the calorie display while cooking is important. The glancing rate ranged from 55 to 74%. For instance, P2 was very interested in knowing the number of calories in most ingredients, especially when she put new ingredients on the kitchen surface. The second column in Table 4 lists the average glancing duration, which is defined as the average time a participant spends in glancing at the calorie display. A long average duration indicates that users take considerable time to comprehend the calorie information and then make an/no adjustment in the next cooking action. The average duration is about 2 seconds. The analysis indicates that users spent less than 1 second for low-calorie ingredients (such as garlic with 2kcal), but more time for high-calorie ingredients (such as spaghetti and oil).

Table 4. Results of video analysis

Participants	P1	P2	P3	Average
(1) Glancing rate	66.7%	74.0%	55.2%	65.3%
(2) Average glancing duration	2.75 sec	2.80 sec	1.48 sec	2.34 sec

The findings of the posttest interviews are described below. P1 said, "After perceiving this information, I would also consider the amounts of ingredients in my shopping. For example, now I have ideas about buying the appropriate size of salmon (given calorie consideration), and I will be careful not to buy (food ingredients) beyond my calorie target." P2 stated that "This kind of instant feedback is effective to remind me of what I already know about using the condensed soup and some high-calorie ingredients such as UHT cream." P3 said, "I'm glad to get this kind of calorie information without additional effort, because I should really be aware of using less of an (high-calorie) ingredient and not all in the whole package."

Participants had the following expectations of the future direction of this kitchen: (1) they were interested in preparing a nutritional balanced meal, including appropriate servings covering all five major groups of foods (grains, vegetables, fruits, milk, and meat and beans). However, nutritional balance is difficult to measure, record, and understand. (2) They wanted expert cooking tips, during their cooking sessions, about healthy alternatives or substitutes for certain less-healthy food ingredients (e.g., olive oil as a substitute of butter) or cooking method (e.g., frying).

6 Related Work

Work and commercial products have exploited mobile devices or ubiquitous computing to record personal food intake and calories, and further persuade people into healthy behaviors. MyFoodPhone [15] is a nutrition tracking service running on mobile phones, allowing users to send pictures of consumed foods, get feedbacks from dietitian, and share their record with the community. This provides a new method of engagement. The Diet-aware Dining Table [6] can track what and how much users eat on the dining table and then provide nutritional awareness to diners. Work from Mankoff *et al.* [14] tracks nutrition of foods users have taken and provides suggestions about healthier foods based on analysis of shopping receipt data. However, these projects focus on tracking and recording food intake itself; therefore differ from our work, which focuses on raising calorie awareness on preparing and cooking foods in home kitchens.

Much research effort has focused on augmenting kitchens with various digital media to create rich, interactive experiences for users cooking in a kitchen. Some work has focused on increasing awareness to support multi-tasking activities in the kitchen. For instance, the Counter Intelligence project from MIT [3] augmented a kitchen with ambient interfaces to improve the usability of the physical environment. It assists users to determine temperatures, find things, follow recipes and time steps during meal preparation. Other work has focused on digital interactive recipes that guide users through a step-by-step cooking process. For instance, Hamada *et al.* [9] developed a recipe navigation system that provides just-in-time instruction with multimedia

information including text, video, and audio. Such digital recipes offer a more interactive experience than a paper-based recipe book. Terrenghi *et al.* [19] presented the Living Cookbook, which enabled people to share cooking experience with others, to teach cooking lessons to others, and thus to foster of social relations. Rather than augmenting kitchens with a range of digital media to create interactive cooking experiences, our smart kitchen focuses on promoting healthy cooking by raising nutritional awareness during the cooking process, while leaving the decision about how to cook to the users.

Some related projects targeted cooking activity or food ingredient recognition. The Intelligent Kitchen project [16] presented an activity recognition system that adopted data mining techniques to infer what would be the next human cooking action and offer suggestion on the next cooking step through an LCD display or a robot. Kranz *et al.* [13] developed an augmented cutting board and knife to infer the type of food being handled. Bolle *et al.* [2] developed a vision-based system that recognized different types of fruits and vegetables. Commercial calorie scales [8] allow users to weight foods, identify names manually, and check their calories. Our work differs from them in tracking ingredients by an augmented kitchen during the cooking process, and show real-time calorie awareness for users to perceive.

7 Conclusion and Future Work

The Calorie-aware Kitchen employs UbiComp technology to improve traditional meal preparation and cooking by raising awareness of calorie information in ingredients that go into a meal. The kitchen is augmented with sensors to track ingredients and calorie changes during the cooking process, and then provides digital feedback on calories. The user study result suggested that providing just-in-time calorie awareness to users during their cooking process can be an effective mean in helping these family cooks maintain the healthy level of calories in their prepared meals.

For our future work, our smart kitchen will consider a broader context in its social and culture impacts of using UbiComp technology to promote healthy cooking. Cooking should be considered as a social behavior involving both meal preparation and consumption. Therefore, our design and user study should cover not only family cooks but also feedbacks on taste from family members as meal consumers. Finally, in addition to conducting a longer and larger-scale user study, a comparison between our design and traditional education should be made. This will enable us to observe different ways people could use this calorie information while preparing different dinner menus and help us to clarify the impacts of our system.

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perFrames: Persuasive Picture Frames for Proper Posture

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Abstract. Poor sitting habits and bad sitting posture are often the cause for musculoskeletal disorders like back pain. Also office employees are affected, because they carry out the majority of their work sitting in front of computers. Therefore we aim at sensitizing and motivating office employees regarding preventive healthcare. We have developed a persuasive interface in form of an interactive picture frame which integrates unobtrusively into the working environment – the perFrame. This frame contains a moving portrait of a person the employee loves or likes. It provides affective feedback in order to persuade employees for better sitting habits while working with a computer. We conducted a preliminary in-situ study, deploying these picture frames on the desktops of eight office employees. The results highlight the employees' acceptance of our application as well as its potential to foster awareness and achieve persuasion regarding healthy behavior in the office.

1 Introduction

With the dawn of office computers, discussions concerning the conditions of working behind a computer screen have become significantly more important in recent years. In response to the central role of computers in today's workspace, new laws, ordinances and regulations have been created (e.g. DIN EN ISO 9241). These incorporate both cognitive and physiological issues of Human-Computer Interaction (HCI) in the work place.

Musculoskeletal disorders (MSDs) are the most common work-related health problem in Europe [1], affecting not only workers in physically demanding work (e.g. mining) but also in low-intensity static work (e.g. computer work). The consequences of MSDs affect not only individuals who are facing charges and restrictions because of physical impairments. There are also enormous financial penalties in business and in national economy due to the decreased productivity, sickness absence and costs for treatments and hospital stays [2].

Poor sitting habits and bad sitting posture are often the cause of MSDs for office employees. Thus, it is necessary to sensitize and continuously motivate employees regarding preventive healthcare. As Intille [3] suggests, ubiquitous and

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persuasive technologies offer a new healthcare opportunity to promote wellness throughout all stages of life. For this purpose we have developed the perFrame, an ambient and persuasive picture frame. The perFrame aims at persuading office employees for better sitting habits while working with a computer.

In this paper we describe the multidisciplinary background of the perFrames (i.e. Ambient Interfaces, Persuasive Technologies, and Affective Interfaces), discuss its design principles and present a study with a prototypical implementation.

2 Background and Related Work

For addressing the problem of MSDs stemming from office and computer work we suggest to provide technology-supported preventive healthcare. To overcome these health risks, simple actions can be sufficient, e.g. taking regular breaks from sitting or sitting in a healthy posture. An early approach has been proposed by Jafarinaimi et al. [4] whose ambient display "Breakaway" encourages people to take working breaks more frequently. Our concept also aims to raise the awareness of office employees of potential risks and unhealthy habits in their everyday work life. The resulting application motivates and persuades the employees to act in healthier way, in order to avoid common health problems stemming from computer work. Therefore we propose a symbiosis of ambient and persuasive technologies and affective interfaces. This integrates information technology unobtrusively into the office environment and it persuades office employees for better sitting habits by utilizing affective output.

Office desks are often decorated with picture frames, holding photos of the family and beloved ones. Usually the persons on such photos smile at the viewer, but "in real life, a person's character is multi-faceted and complex, derived in part by subtleties, such as previous events as well as interaction with other people" [5]. We found such picture frames to be a promising support for preventive healthcare at work. Whereas Mynatt et al. [6] use digital picture frames with still images, our approach is to use moving pictures. If the frame contains not only a static portrait but an image that is agile and can be adapted according to certain situations and circumstances, it could provide office employees with information and feedback on the health impact of their habits and behavior at work: The employees usually have a strong relation to the portrayed persons on their desktops, and therefore will set a high value on the opinion and desires of those persons. This is due to the fact that people are more likely to agree with persons whom they like [7]. By providing affective feedback, conveyed by known and beloved persons via the picture frame, we aim at sensitizing and motivating employees regarding preventive healthcare.

2.1 Ambient Intelligence

Ambient Intelligence (AmI) refers to the pervasion of the everyday world with information technology. Computers are not bound to a desk anymore, but are integrated unobtrusively into the environment. This enables computing systems to anticipate the user's needs and to support the user in fulfilling these needs.

To make the AmI vision a reality, new interaction concepts like ambient displays [8] and implicit interaction [9] have been developed: *Ambient displays* integrate digital information into the physical environment, manifesting themselves as ambient media, i.e. "subtle changes in form, movement, sound, color, smell, temperature, or light" [8]. Ambient displays have been used to highlight energy consumption [10], to display information peripherally in an office setting [11], or to indicate the time a user is sitting at his desk [4]. *Implicit interaction* refers to input, which is not explicitly entered by the user, but is derived implicitly from the user's context. The implicit output is "output of a computer that is not directly related to an explicit input and which is seamlessly integrated with the environment and the task of the user" [9].

The design of the perFrames builds on the concepts of ambient displays and implicit interaction. By placing a picture frame on the desktop the employee is not really distracted from his work, but he has the possibility to easily monitor relevant aspects, which would otherwise remain unnoticed.

2.2 Persuasive Technologies

A Persuasive Technology is "any interactive computing system designed to change people's attitudes or behaviors" [12]. It facilitates persuasive interaction that leads to a voluntary change of behavior or attitude or both.

Persuasive interfaces that aim to improve health and well-being have the advantage that often people are already intrinsically motivated for a healthier lifestyle. They just need some support in order to make the first step towards a behavioral change or to follow through with a healthier lifestyle for an extended period of time. This is where persuasive interfaces can be utilized successfully. Often, they use a feedback mechanism to show users the effect of their behavior.

In particular, embodied conversational agents (ECAs) have been proposed to act as virtual coaches to persuade users to modify their behavior [13,14]. Cialdini [7] found a number of rules which determine the influence one person can have on another. Among these rules *likeability* is the strongest: "We most prefer to say yes to the requests of people we know and like" [7]. We will utilize this finding for our perFrame concept, by displaying a well-known person in an interactive picture frame.

2.3 Ambient Persuasion

AmI allows surrounding the user with persuasive technology in their everyday life, giving the possibility for persuasive interventions just at the right time and in the right place. We use the term "ambient persuasion" to refer to the use of persuasive technologies that rely on context sensing and a network infrastructure. This allows for combining context sensitive system behavior with persuasive content, which is personalized for the user, and delivered at the right time and the right place. The perFrame concept utilizes ambient persuasion to foster healthy behavior in an office context.

2.4 Affective Interfaces

We utilize the concept of affective computing in order to generate an expressed emotion. Of particular interest for our work is the dimensional approach to describe emotions. This approach claims that emotional dispositions cannot be described as static categories (like the concept of *basic emotions*), but are composed of independent dimensions [15]. This approach models emotion through two dimensions: valence and arousal. Valence indicates if an emotion is positive or negative, the arousal dimension refers to the intensity of the emotion.

Affective interfaces seem to be an appropriate tool to improve human well-being. Nowadays there is a variety of application fields, e.g. games, solutions for care issues, or as agents in an eLearning setting. Many of these research efforts incorporate ECAs [16], which are capable of conveying emotions via facial expression, gestures, tone of voice etc.

Our perFrame application provides affective feedback on the healthiness of the office employees' sitting behavior. For example if everything is well, the portrait in the picture frame will express a positive and consentient emotion. But if the employee sits in an unhealthy posture in his chair the portrait will express a negative and deprecative emotion. A rather similar approach of interactive and affective portraits was described by Zuckerman [5].

3 Persuasive Picture Frames

When we started to think about technology-supported preventive healthcare – and especially proper sitting posture – we were aware of the following facts: A preventive healthcare application has to operate in a twofold way: It should (1) foster awareness of unhealthy behaviors and habits, and consequently (2) persuade people to adapt their behaviors towards more healthiness. The primary user group for this application are office employees, who carry out the majority of their working day sitting at desks and working with computers. Thus, an interface which presents too complex information or is too obtrusive would require too much attention. This might harm the user's power of concentration. But it is not desirable to shift the focus of attention away from the user's primary work task which would result in loss of creativity and productivity. Moreover, we did not want to invade the user's workplace with an additional technical device, but rather an artefact which seamlessly integrates into the desk and which the employee appreciates as an aesthetic enhancement of his workplace.

This is how we got the idea of utilizing picture frames for our purpose. Office employees often use to have picture frames on their desks, which contain photos of their family and beloved ones. Thus, an interactive picture frame is an artefact that matches the above listed considerations.

The next task was to develop an appropriate persuasion strategy, which matches the given requirements. The Ambient Display should be unobtrusive on the one side and provide an intuitive output on the other side. For example, letting the persons in the picture frame give descriptions and lessons on proper sitting postures is certainly not unobtrusive. Moreover, this would have

destroyed the perception of the perFrames as picture frames and would have turned it into a traditional information display. Thus, we chose a persuasion strategy which utilizes a dialectic approach:

1. A human instructor gives the office employees lessons on how to sit healthy. Actually, this briefing is the persuasive message in our concept. The instructor argues for proper posture by explaining physiological facts and by pointing out potential health impacts resulting from bad sitting habits.
2. Then, the perFrame is used to reflect the healthiness of the employee's sitting behavior and habits. It does so by affective feedback, i.e. smiling for healthy sitting postures and looking sad or even angry for unhealthy behavior.

Finally, taking into account the Ambient Display heuristics of Mankoff et al. [17], we designed the perFrames according to following criteria:

- *Useful and relevant information:* The information should be useful and relevant to the users in the intended setting.
- *"Peripherality" of display:* The display should be unobtrusive and remain so unless it requires the user's attention. The user should be able to easily monitor the display.
- *Aesthetic and pleasing design:* The display should be pleasing when it is placed in the intended setting.
- *Consistent and intuitive mapping:* Ambient displays should add minimal cognitive load. Cognitive load may be higher when users must remember what states or changes in the display mean. The display should be intuitive.

3.1 The User's Input: Sitting Behavior and Habits

A system that provides users with feedback on certain aspects of their environment, needs to capture the corresponding data from the environment before it can process and present them. Thus, regarding user input, our application has to recognize and record the current sitting posture of a particular worker, e.g. does she slouch, lean in a certain position, or sit upright. This data is used for instant feedback via the perFrame but also for creating and maintaining individual user models of each employee. Having a user's personal habits stored in a formal way, allows for delivering appropriate feedback just in the right moment.

3.2 Output of the System: Affective and Persuasive Messages

The perFrame should not just contain static images which change from time to time. For our concept we use soundless video sequences to portray persons in order to allow them to change their facial expressions and perform gestures. It is very important that the portrayed person is somebody the user really likes, since likability is one of the strongest factors for influencing people [7].

Using video sequences instead of photos, the portrayed persons can easily express their feelings, estimations, and opinions on the sitting behavior of an employee. This should be a strong argument for the employees to rethink and

adapt their habits. For example, if an employee usually tends to sit in his office chair in a rather lazy and unhealthy posture, the portrait of her husband could express his disapproval on her unhealthy behavior. Bearing in mind that she could suffer serious back pain, she will try to sit in a healthy and ergonomically appropriate manner, to see her husband in the portrait smiling again.

The video sequences should be kept rather calm, i.e. the portrayed persons should not make any jerky movements. Only in case of an "escalation", i.e. if the employee does not react on the unobtrusive hints, the portrait should perform a gesture in order to draw the user's attention on the perFrame. When placed in the periphery of an employee's field of view, a perFrame can attract his attention whenever it is necessary: Due to the physiological nature of the human eye, it is easy for humans to detect motions in the periphery of their field of view. Thus, in case of requiring the employee's attention, the portrayed person in the perFrame simply needs to make a jerky movement, or perform a gesture.

4 Study

To research the perFrame concept, we developed a technical prototype and conducted a qualitative pilot study with eight participants. The prototype was deployed in-situ in an office, i.e. on the participants' desk. Our research questions regarding the perFrames strongly correlate with the design requirements:

- Is the feedback from perFrame useful and of relevance to the employees?
- Is the perFrame unobtrusive or does it disrupt the employee's work flow? Is the perFrame able to attract the employees' attention when needed?
- Is the perFrame an aesthetic and positive enrichment of the employees' workplace, or do they perceive it as yet another technical device?
- Are the employees able, to intuitively interpret the message of the portrait in the perFrame? Or are the messages ambiguous or even unclear?

Additionally, we also aimed at finding facts on the persuasive potential of the perFrame and the importance of likability in this context. For this purpose we chose to have two groups of participants: one group with a portrayed person of their own choice and another group with a work colleague of our choice, i.e. a person they know well, but the relationship between them is not so close.

We chose to recruit participants which are office employees and of the age between 20 and 30 years, because this age group has already several years of work experience and is usually not yet affected by health problems stemming from bad sitting postures. We only chose participants which did not have any diagnostic findings regarding MSDs. Otherwise such participants might have had problems to take a proper sitting posture due to physical restrictions.

4.1 Prototype

We have developed a prototype according to the perFrame specification from the previous section. We decided to use an HP Compaq tc1100 Tablet PC (see

Fig. 1. The perFrame prototype was implemented with an HP Compaq tc1100. The keyboard is rotated to the backside and serves as a stand for the picture frame. For our study the perFrame prototype was deployed on the employees' desks. The camera for the Wizard of Oz observation can be seen on the left edge of the right picture.

Fig. 1) due to its visual appearance (e.g. lacking buttons on the front side) and its technical specifications (e.g. Wi-Fi network interface).

For controlling the portrait, we used a Wizard of Oz technique [18]. By placing a camera next to employee's desk (see Fig. 1), we could remotely observe the participant's sitting posture in order to control the perFrame via the Wi-Fi network. On the Tablet PC we ran an instance of the VLC Media Player in fullscreen mode to display the portraits.

Useful and relevant information. The applied persuasion strategy is a dialectic one, comprising a human instructor (who teaches the employees how to sit healthy) and technology-support (which highlights the healthiness or unhealthiness of the employees sitting behavior). After the instructor's "sitting lessons" the employees should know, how and why to sit correctly. Now, the portrait in the perFrame gives them feedback on their sitting.

"Peripherality" of display. The perFrame is placed in the periphery of the employee's field of view and additionally the video sequences are kept as calm as possible. Hence, the perFrame usually does not attract the employee's attention.

For the feedback of the portraits we defined a characteristic, which uses the dimensional approach to describe emotions (see Fig. 2): Starting with a rather neutral feedback (0), the portrait smoothly switches to positive feedback (+1) when the employee sits in a good posture. If this healthy behavior is kept up for a longer period of time it will congratulate the employee (+2). This is a much more intensive emotion, thus in the +2 status the portrait performs a gesture in order to attract the employee's attention. This lasts only for a couple of seconds, then it switches back to +1. The same principle is applied for negative feedback.

Aesthetic and pleasing design. We chose a device which looks not too computer-like. Moreover, we used a portrait style which is aesthetically pleasing and which fits to the rest of the perFrame device.When shooting the videos we set

Fig. 2. An example perFrame portrait, with its five different states ranging from totally positive and consentient (+2) to totally negative and deprecative (-2)

a high value on appropriate lighting effects and by applying a black & white filter, adjusting contrast and brightness, using softener effects etc. we found a harmonical design concept for the perFrame. We shot and arranged the video sequences in way that allowed unobtrusively smooth transitions between the stages.

Consistent and intuitive mapping. The portraits in the perFrame depict persons, to which the employee maintains a strong a relation. Therefore, the employee knows the character of the portrayed person very well. When shooting the video sequences, we asked the "actors" to exactly imagine the situation, where we intended to use this scene in the perFrame. The employee will know, how to interpret gestures or little cues in the facial expression of the portrait. In combination with the knowledge on healthy sitting (from the teaching lessons), the employee should be able to intuitively react on the perFrame.

4.2 Method

For each of the eight participants we went through the following routine: (1) a briefing lesson on proper sitting behavior, (2) the deployment of the perFrame on the desk, (3) the observation of the participant during the deployment, and (4) an interview right after the observation.

Briefing. When we started the study, each participant received an individual briefing on the importance of proper posture, on potential health risks, and on how to sit healthy. For the conception of this briefing lesson, we consulted an osteopath and physical therapist. The result was a 4-pages handout, based on Brügger's work on healthy posture [19]. During the briefing, the instructor explained everything to the participant, who could follow the instructions also by the images in the handout. After the briefing the participant was told to keep the handout as reference material. This briefing is also the persuasive message in our concept.

Deployment & Observation. After the briefing the perFrame was placed on the participants' desk for half a day (either in the morning or in the afternoon). The perFrame should remain in their field of view, for ensuring the perception of jerky actions in the perFrame. The participants were told, that the portrait will react on their sitting behavior. But we didn't tell them anything about facial expressions, affective feedback or different levels of feedback. We also instructed them to work normally, as they would do if the portrait were not there.

Then the camera was placed in a rather unobtrusive manner (see Fig. 1), but in a way that allowed the observer (i.e. the "Wizard of Oz") to see the sitting posture of the participants. The observation was carried out in a separate room. The observer had to pay attention on the sitting postures of the participants and record them with an event logging software. Besides the current portrait status, the event log contained three possible events: "good posture", "bad posture", and "participant away" (each including time-stamps). In addition to recording the event log, the observer also had to control the perFrame. Based on his observations he could switch between the five different affect states of the portrait (ranging from -2 to +2).

Interview. After the deployment we conducted an interview with each participant in order to find out how they experienced the perFrame. We set up an interview guideline to address our research questions, e.g. "Did you react on the picture frame?", "(How) Did you adapt your behavior?", "Were the reactions of the portrait comprehensible?" or "Was the picture disturbing you?". After the interview the participants were asked to give us additional comments on aspects which attracted their interest.

4.3 Results

For evaluating the perFrames we had two data sources: the event logs and the interviews. The results generally indicate an absolutely positive attitude towards the perFrames.

Demographics & Computer Usage. We had eight participants which were evenly divided in two groups: Group A had to chose their own portrait, Group B had a portrait of our choice. Each group consisted of two male and two female participants. The mean age in Group A was 28.8 years, in Group B it was 26.0 years. One participant in Group A chose his girlfriend for the perFrame, the other three chose a very close friend, which they meet at least two times a week.

Participants in Group A stated to work an average of 7.1 hours per day in a sitting posture (6.5 hours with a computer). On a working day they spend an additional 2.0 hours on the computer at home. On weekends and holidays they spend 4.0 hours per day working on the home computer. This was rather similar for Group B: working 7.1 hours per day in a sitting posture (6.6 hours with a computer). After work they spend 2.0 hours with a computer at home, on holidays and weekends they spend 3.3 hours with their home computer.

Useful and relevant information. All participants grasped the value-add of the perFrame application for their personal health and well-being, and that the perFrame could help them for adopting better sitting habits.

Six participants stated that they could not always comprehend the reactions of the portrait, e.g. participants felt that they are sitting in a healthy posture but the portrait reacted in a negative way. This is a hint for the unawareness on the healthiness of their own sitting habits. One user reported that the portrait reacted on a certain posture in a positive way, and a little bit later it reacted

negatively on the same posture. Then she started to think, if she was really sitting in the same posture and tried to actively adapt her sitting posture.

Nevertheless some participants criticized, that the perFrame didn't give them sufficient information. For example two of them requested more detailed instructions on what they did wrong, in case of a negative feedback.

"Peripherality" of display. Regarding the peripherality of the perFrame, we received seven absolutely positive feedbacks. Only one of the participants from Group B felt disturbed and stated that she could not focus on her work (she had an important deadline that week). All other participants stated that they did not feel distracted from their work and they voluntary glimpsed at the portrait from time to time. One participant told us that sometimes she was curious to see what kind of feedback the portrait is giving her on her current posture.

Each participant stated that when the portrait performed a gesture, they noticed it, even when they were not currently looking at the portrait. Again all but the one participant felt that this short shift of attention had no effect on their productivity. Additionally, all four users from Group A reported that they felt amused seeing their friend caring for them.

Aesthetic and pleasing design. The visual appearance of the perFrame was considered as highly aesthetic. Three users explicitly pointed out the good quality of the videos, the fact that the transition between states is almost invisible, and the quality of the overall style using black & white portrait aesthetics.

Moreover, two of those participants told us that using video loops instead of static images was a good idea, because it enhanced the portrait. But due to the calm video sequences and its aesthetics, they still perceived it as a photo in a picture frame and not as a video.

Consistent and intuitive mapping. The results of this research question shows the widest difference for the two groups. The reason why we split up the participants in two groups was the factor of likability, which is not only important for the persuasive potential, but also related to the issue of "Consistent and intuitive mapping".

The participants in Group A reacted more enthusiastic in the interviews. Three users in that group told us that they knew the facial expressions and gestures of their friends very well and that they knew exactly what they were signalling them. It was quite the contrary in Group B, where three participants reported that they could not interpret what the portrait was trying to tell them, e.g. "I did not know if she was laughing at me or if she was happy with me".

This highlights the importance of likability and a strong relationship between the employee and the portrayed person in the perFrame. If the employee knows the person very well, he is able to interpret the facial expressions and gestures in the right way. Otherwise it is more likely that misunderstandings will occur through ambiguous expressions.

Persuasive Potential. The collected data also substantiate the persuasive potential of the perFrames. The participants told us that they reacted on the

portrait, especially when it performed a gesture. This is also confirmed by the event log. Moreover, when we asked them in which way they reacted, every participant told us, that they were reminded on the briefing and the handout. Then they tried to adopt a healthy sitting posture as it was demonstrated to them.

As the findings from "Consistent and intuitive mapping" indicate, also the likability factor has an influence on the persuasive potential. In contrast to Group B, the participants from Group A always reacted immediately on transitions from state -1 to -2. Regarding the adaption of his sitting posture, the participant who chose his girlfriend for the portrait stated: "I did it for her, not for me".

These facts indicate the persuasive potential of the perFrames, but in order to measure persuasive effects, a long-term deployment of perFrames is necessary.

5 Conclusion and Future Work

We have presented the design and a pilot study of the perFrames, an interactive picture frame for preventive healthcare in the office. The base concept of the perFrames comprises ambient persuasive technologies and affective interfaces.

We conducted an in-situ pilot study with office employees. The results indicate the users' acceptance of such an application as well as its usefulness for preventive healthcare, since it made them reflecting on their own habits. Users reported that they were not distracted in a way that harms their power of concentration or productivity. The visual design of the application was rated very pleasing. There was an even more positive attitude towards the perFrame when the participant maintained a close relation to the portrayed person. Also the persuasive potential of the application was confirmed by the participants.

As next step we aim at conducting a long-term study with several weeks of deployment and more participants. But before this can happen, there are additional technical components to be integrated: We have to provide an automatic sitting posture recognition (either vision- or sensor-based), which can be used for controlling the picture frame. The reactions of the picture frame should be provided by a computational system which adapts itself to the individual habits of each user. Furthermore, a larger selection of video scenes with more different gestures and facial expressions will be necessary in order to keep users engaged. Otherwise the reactions of the portrait could become too predictable.

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Persuasion for Stronger Passwords: Motivation and Pilot Study

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Abstract. Text passwords are the ubiquitous method of authentication, used by most people for most online services. Many people choose weak passwords that are vulnerable to attackers who simply guess all the passwords within the most probable password spaces. This paper describes a lightweight password creation mechanism that uses Persuasive Technology to influence users to create stronger passwords. Results from a pilot study show that our Persuasive Text Passwords (PTP) prototype system successfully influenced users to create and remember more secure passwords.

Keywords: authentication, computer security, passwords, Persuasive Technology, usable security.

1 Introduction

Online privacy and security relies heavily on authentication through textual passwords chosen by the users themselves. However, it is known that many users select weak passwords [5] that are vulnerable to automated attacks that systematically guess passwords and subsequently compromise users' account resources, privileges, and data. It is crucial that users create secure passwords, lest their online bank accounts be stolen, their electronic communications (e-mail, messengers, etc.) become monitored and manipulated, and their personal information be used for identity fraud.

Many security professionals have attributed the problem of weak passwords to a lack of user effort and motivation. However, Adams and Sasse [1] indicate that users create insecure passwords due not to a lack of motivation, but to misunderstanding the security threats, as well as how to effectively defend themselves with the provided mechanisms. Sadly, even when armed with such knowledge, limitations of human memory render users largely incapable of effectively using standard passwords [12].

In this paper, we consider how principles of Persuasive Technology (PT) [6] can help users create stronger text passwords that are nonetheless memorable. We first describe the background research on password choice and basic issues in evaluating password security. We present our Persuasive Text Passwords prototype system and explain how applied PT principles influence users to create more secure passwords. Finally, we describe our pilot study, report on the results, and offer our conclusions.

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2 Background

Some recent attempts to instruct users on creating strong but memorable passwords have been in the form of *mnemonic phrase-based passwords*: memorable phrases abbreviated into passwords. Yan et al. [18] found mnemonic passwords to be as secure as random passwords and more secure than normal passwords. However, Kuo et al. [9] found that most mnemonic passwords were based on phrases from external sources and were only as secure as regular passwords given the authors' attack model.

When creating accounts on the Internet, many websites offer advice on creating secure passwords through general suggestions or high-level feedback in the form of "strength meters". Furnell [7] discovered a lack of consistency and effectiveness across password requirements and advice provided by 10 popular websites. Apparently such advice has little effect, as recent findings by Florencio and Herley [5] show the majority of over 500,000 Internet users' online passwords (including for PayPal) consist solely of lowercase characters. Although memorability was not discussed, users created stronger passwords when one service provider imposed strength requirements. The authors also noted password re-use, averaging at about 3.22 website accounts per password. Thus, even when password instructions and memorability aids are readily available, users continue to behave insecurely.

Weirich and Sasse [16] assert that, for password security to be effective, users must exert extra effort in creating secure passwords. They further discussed reasons why conventional fear appeals fail to motivate users to behave securely. The authors propose *persuading* users to "buy-in" to a security-centred culture. They mainly employ user-centred design theory in their discussion of persuasion.

2.1 Persuasive Authentication Framework

More recently, Fogg [6] has presented Persuasive Technology (PT) as "interactive computing systems designed to change people's attitudes and behaviours". PT is a set of tools, media, and cues which technological solutions may implement to encourage users to behave in some desired manner. Persuasive tools assist users in accomplishing tasks more quickly and easily, persuasive media offer several representations by which messages are conveyed, and persuasive social cues endow products with friendly, knowledgeable, and trustworthy attributes.

Numerous persuasion strategies are associated with each of the three aforementioned persuasive roles. The persuasive goals, topic, medium, audience, and desired persuasive strength determine which persuasion strategies should be employed. PT has successfully produced desired behaviour changes in many domains, such as health [8, 15] and education [10].

PT is purposefully generalised so it may be used in any domain, but some PT theory does not readily apply to the unique challenges of usable security.

1. Security is a secondary task [17]; users will bypass any security measure which impedes them from completing their primary task.
2. Security systems are complex, making it difficult for users to form proper mental models [4]. Users may not even realise their behaviour puts them and others at risk or may underestimate the consequences of behaving insecurely.
3. Computer security must deal with the "barn door" property [17]; should private information be exposed even for a brief moment, it is impossible to guarantee that it has not been compromised by an attacker.

4. Users tend to concern themselves with privacy and security only when its impact on their lives is blatantly obvious [13]. Regrettably, this typically occurs no sooner than when users' security and privacy has already been breached.

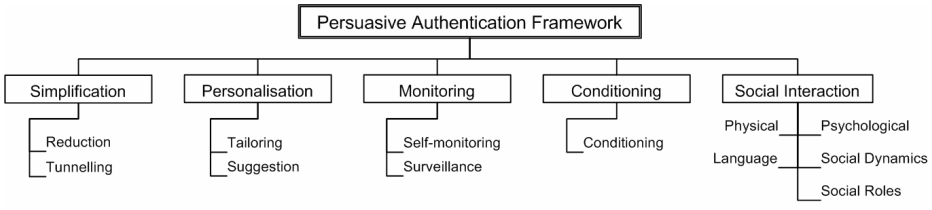

Fig. 1. The Persuasive Authentication Framework [3]

The Persuasive Authentication Framework [3] (Fig. 1) has recently been proposed. It condenses PT into five key principles that are applicable to the challenges of usable security and authentication. Each principle draws on various PT tools and cues.

Simplification. Authentication tasks should be made as simple as possible. This can be achieved by ensuring the authentication process is *reduced* to as few steps as possible and is *tunnelled* to ensure users make secure choices when using the system.

Personalisation. Since customised information is more persuasive than generic advice, *tailoring* the authentication process for users can persuade them to behave more securely. Greater persuasive power can result from offering personalised security *suggestions* at the most opportune moment.

Monitoring. Users may be more likely to behave securely if they know security administrators perform routine *surveillance* on their passwords. If the results of security analyses on users' passwords are visible to users (like password strength meters), they can *self-monitor* and adjust their behaviour to be more secure.

Conditioning. Users typically underestimate the threats and risks to their online accounts, and thus do not believe behaving securely is necessary. By applying various forms of reinforcement *conditioning* to synthetically encourage the correct behaviour, we can help shape the desired secure behaviour or turn existing behaviour into habits.

Social Interaction. Establishing a common rapport with users by emulating their *physical*, *psychological*, and *language* characteristics can make an authentication system more persuasive. Additional persuasion can be leveraged from *social dynamics*, such as thanking the user for behaving securely, and *social roles*, by using statements such as, "One weak link in the security chain is all it needs to break."

2.2 Password Space

Two fundamental concepts must be distinguished when evaluating the security of any authentication system. The first is the *theoretical password space* (TPS) size: the number of unique passwords users could theoretically choose in a given system. The TPS size is determined only by technical constraints independent of such factors as user-choice. Two main constraints in text passwords are the number of unique characters available on the keyboard, and any password character length limits.

The second concept is the *effective password space* (EPS): the number of passwords in the TPS that are likely to be chosen by real-world users. Clearly, the EPS can never be larger than the TPS. An ideal security system will have an EPS too large for an attacker to exhaustively guess in a reasonable amount of time.

Text passwords have a reasonably large TPS for passwords of sufficient length. They would be reasonably secure against guessing attacks if users chose passwords randomly and with equal probability. However, most users do not choose from the 95 English U.S. keyboard characters with equal probability. To simplify discussion, we consider 8-character passwords, since the arguments extend for longer passwords. The TPS size is the number of all possible 8-character passwords: $95^8 \approx 6.6 \cdot 10^{15}$.

Table 1 shows the growth in number of passwords as the password space character set becomes larger by using characters from different subsets, such as lower- and uppercase letters, digits, and symbols. We note Table 1 presents optimistic figures that do not account for biases towards dictionary words or commonly-used character patterns, which attackers readily exploit with cracking tools like John the Ripper [14].

Note the significant increase in password space size when all four character subsets are used. Such exponential jumps are well-recognized in the computer security field, and security estimates are typically expressed in base-2 logarithms [2], shown in the *estimated bits of security* column of Table 1. This security estimate naïvely assumes password characters are randomly chosen within their space. However, it is useful for coarse relative comparison. It is much harder to find a password amongst $95^8 \approx 6.6 \cdot 10^{15}$ others than it is to find amongst $26^8 \approx 2.0 \cdot 10^{11}$. Still, users continue to select passwords from small subspaces of the TPS, making attackers' guesswork less costly.

Table 1. A comparison of password spaces across various 8-character password subsets

Password space subset	Passwords in subset	% of TPS	Estimated Bits of Security ($\log_2$)
Lowercase	$26^8 \approx 2.0 \cdot 10^{11}$	0.003	37.6
Lowercase & digits	$36^8 \approx 2.8 \cdot 10^{12}$	0.043	41.4
Mixed case	$52^8 \approx 5.4 \cdot 10^{13}$	0.806	45.6
Alphanumeric	$62^8 \approx 2.2 \cdot 10^{14}$	3.291	47.6
Alphanumeric & symbols	$95^8 \approx 6.6 \cdot 10^{15}$	100	52.6

We propose improving the security of passwords by increasing the probability that users will create passwords in larger password spaces, and therefore requiring much more effort for an attacker to guess. Although this would be an improvement, we must be clear that this approach only improves security against guessing attacks, and does not address attacks such as surreptitious installation of keyloggers, other "malware" on users' machines, or social strategies such as "phishing" whereby users are tricked into revealing their passwords. We also note that the strategy of increasing the effective password space is the basis for other existing strategies [9, 18]. The difference in our approach is that we propose to use Persuasive Technology.

3 Persuasive Text Passwords

Traditional approaches to increasing the effective password space for text passwords involve either advice or prescription. Password advice approaches include education

through the publication of guidelines, as well as general feedback on the user-chosen passwords' strength. Approaches using prescription include enforced rules for password creation and system-generated passwords with no user choice whatsoever. As discussed in Section 2 these approaches are problematic, as advice is often ignored and prescription leads to frustration and poor password memorability.

Our general approach is a password creation system involving both user choice and a persuasive system-chosen *improvement*. The user may accept the improvement or *shuffle* for an alternative improvement. Our approach uses Persuasive Technology (PT) as a middle path between advice and prescription. As an active part of the password creation process, we hope this approach will be more effective than mere passive advice. Additionally, user involvement in the creation process should result in memorable passwords. The amount of PT employed is admittedly modest, but we wish to assess its impact before incorporating any additional persuasive strategies.

3.1 Variations of Persuasive Text Passwords

To explore this password-improvement approach, we designed three Persuasive Text Passwords (PTP) mechanisms, which randomly place between two and four randomly-chosen characters in users' passwords. All three mechanisms allowed users to press a shuffle button, causing the system to assign a new set of randomly chosen and positioned characters to the users' passwords. All improved passwords contained at least eight characters. See Fig. 2 and Fig. 3 for an example of the PTP system. We developed and implemented the following three Persuasive Text Passwords variations.

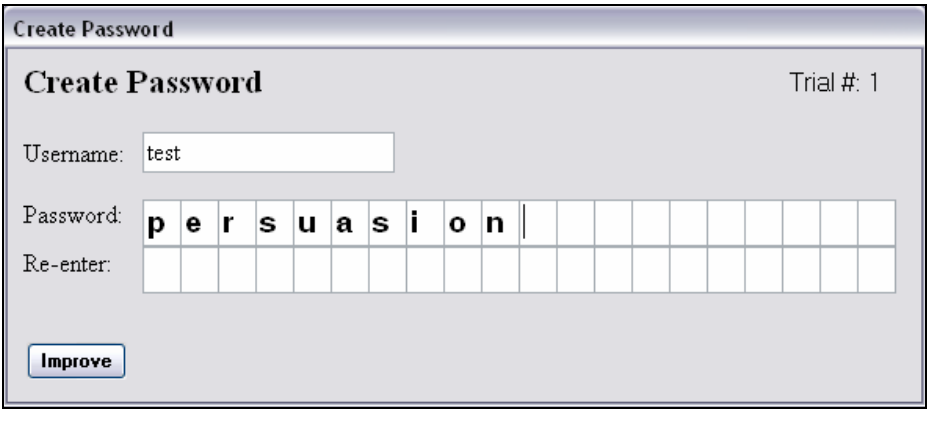

Fig. 2. A screenshot example of a user choosing "persuasion" as their original password in the Persuasive Text Passwords system

Preload. The system-assigned characters were randomly-chosen and positioned within the first eight character slots before the users began creating their password. In essence, the users created their password around the system-chosen characters.

Replace. As per a typical password system, users first chose their own password. The system then replaced two to four random characters in the password with new randomly-chosen ones.

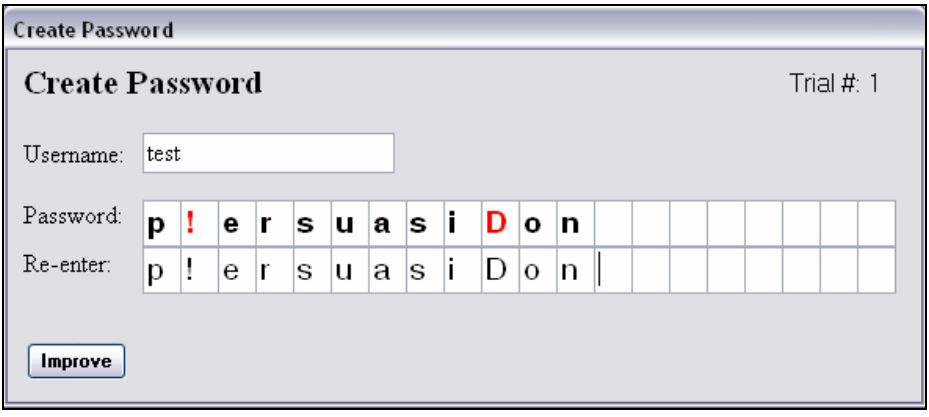

Fig. 3. A screenshot example of a user re-entering their Insert-improved password into the Persuasive Text Passwords system

Insert. After users chose their password, two to four random characters were inserted into the password at random positions**.** A screenshot of the Insert condition is shown in Fig. 3.

All 3 variations leverage these Persuasive Authentication Framework [3] principles.

Simplification. Since the PTP system takes on the responsibility of ensuring the password is secure, users can focus on making their password memorable, thereby simplifying the password creation task. Furthermore, the users' "path-of-least-resistance" is to comply with the system's initial suggestion, which is more secure than shuffling until a weaker set of characters (such as all lowercase characters) are found. Thus, when creating a new password, PTP makes the most secure choice the least burdensome; many other password schemes lack this property.

Conditioning. Shuffling repeatedly to find a specific set of system-assigned characters can be tedious. The PTP system makes less secure choices less attractive, hence guiding users away from poor security decisions.

Personalisation. Since the system-assigned characters are placed in a user-chosen password, users are likely to feel a kinship towards their password and thus are more likely to comply with the system's suggestions. Furthermore, we expect users are most likely to be open to password suggestions when creating one. Thus, PTP applies its persuasion at the most opportune moment. The persuasion may also develop their mental model of secure passwords, potentially leading them to apply the PTP random-character placement scheme to their other passwords.

3.2 Usability Pre-testing

Before conducting the pilot study, we first performed some informal usability pre-tests with six participants to uncover the most prominent usability issues. The following list describes the identified problems and the solutions we adopted.

Repeating Characters. Users would often repeat the system-assigned characters when creating a Preload password. For example, if the system presented the users with "_ _ B _ _ # _ 8", they were likely to choose a password similar to "BBB###88". Since the lack of distinct characters makes such passwords very insecure, we chose not to test the Preload variant in this pilot study.

Character Minimisation. Users would shuffle until the system placed only two randomly chosen characters into the password. Memorability seemed to suffer the few times users created passwords with three or four system-assigned characters. Therefore, we chose to examine only placing two characters for this pilot study.

Indistinguishable Characters. Certain system-chosen characters were difficult for users to tell apart, such as the grave accent (`) and the apostrophe (‘), or the lowercase "L" and the vertical line (|). To avoid such confounds in our pilot study, we removed the uncommon characters (the grave accent and vertical line) from PTP's set of system-selectable characters. The small loss in security due to removing the characters is worth avoiding possible user error, confusion, and frustration.

Character Memorability. Users had difficulty identifying the position and case of their password's system-chosen characters when confirming and logging in. Although their password was visible during creation, it was masked with asterisks (*) when confirming and logging in. To assist users in learning their passwords, the pilot study asks user to re-type their password unmasked (shown in Fig. 3) during the password creation phase. This additional step allows users to practice typing their entire password while visually verifying that the characters they type are correct. This assumes PTP passwords are created only in environments free of shoulder-surfing, where potential attackers can observe users entering their passwords**.**

3.3 Pilot User Study

The following pilot lab study procedures were evaluated and approved by our University's Ethics Committee for Psychological Research. We used a between-subjects design; 7 participants tested the Replace PTP variant and 8 others tested Insert. All were university students; 8 studying Computer Science and others from various disciplines. All used computers, the Internet, and passwords regularly. Data was collected from a total of 154 trials. Each participant completed 10 or more trials, each consisting of creating, confirming, and logging in with a password. Users also filled out a demographics and user-opinion questionnaire during the session.

The Persuasive Text Passwords system logged users' actions and passwords. When introducing participants to the system, they were told to pretend the passwords they created would be protecting their online bank accounts, and therefore to choose passwords that would be hard for others to guess but were still memorable. They were told the password system's improvements would help them create more secure passwords, but that they may shuffle as often as they liked to find system-chosen character combinations they preferred. Participants performed a practice trial to familiarise themselves with creating passwords in this new way. These practice trials are not included in the 154 total trials. Each trial consisted of the following phases.

Create a Password. Users would compose a password of at least 8 characters according to their randomly-assigned condition (Insert or Replace). Users then re-typed their improved password (with the system-assigned characters) to ensure they could correctly identify the characters in their password. In this phase, the password was visible in order for users to identify the system-assigned characters and accurately re-type them. Users could press a shuffle button to randomly change the system-assigned characters and positions. See Fig. 3 for a password creation example.

Confirm a Password. Users re-entered their password, improved with the previously system-chosen characters. The echoed password was visually masked by asterisks (*). If they were unsuccessful, they could try to confirm again. If they could not remember their password, they could move on to the next trial and create a new password.

Answer Two Questions. Users answered two 10-point Likert scale questions gauging the perceived password creation difficulty and predicted memorability after one week.

Distraction Task. For 45 seconds, users counted backwards in threes, beginning from a randomly-chosen four digit number (e.g. 4372, 4369, 4366, etc.). This was intended to clear their textual working memory [11] and simulate a longer passage of time.

Log In. Users logged in by retyping their improved password. The echoed password was again visually masked by asterisks (*). Similar to the Confirm phase, they could retry if they were unsuccessful. If users could not remember their password, they could skip this trial and begin creating a new password for the next trial.

3.4 Results

In considering the pilot study's results, we adhere to the twin goals of usable security. We must care for usability; the system should be easy to use for the purpose intended. In this case, created passwords must be memorable, and the creation process should not be time-consuming. However, the system should also accomplish the security goals. In this case, the resulting passwords should be sufficiently stronger than those originally chosen by the user. We now address both these issues.

Memorability. How memorable were the passwords?
Out of the 154 total trials where users created passwords, 145 (94%) resulted in a successful confirm, of which 132 (86%) was on the first attempt. Of the former 145 successful confirmations, 141 (97%) also resulted in a successful login, of which 128 (88%) were on the first attempt. Pearson's chi-squared tests revealed no significant distinction between the Insert and Replace conditions. Although our method did not test long-term memorability, the cognitive load was substantial due to the many passwords being created. Overall, we feel these results suggest a reasonable level of memorability, but warrants further testing.

Times. How long did it take to create passwords, confirm them, and login?
To create a password, users took a mean and median of 66 and 58 seconds, with a standard deviation of 31 seconds. This includes the time to construct an initial password, shuffle as much as desired, and re-enter the improved password. The mean times to confirm and login were 15 and 14 seconds respectively. A regression analysis showed login times became shorter as users completed more trials. Two sample t-tests revealed no significant distinction between Insert and Replace. We believe these times are acceptable as a starting point and are likely to decrease with daily use.

Shuffles. How often did users shuffle improved password suggestions?
Over all 154 trials, the mean number of shuffles per trial was 8, and the median was 3. Our observations suggest that most users shuffled until they found an improved password they felt was memorable. However, users were often persuaded to comply with the first system-suggestion, as they did not shuffle at all in 41 of 154 trials. T-tests revealed no significant distinction between Insert and Replace.

Perception. What opinions did users report about the usability and security of PTP?
Our post-test user-opinion questionnaire asked users to answer several questions, some reversed to avoid bias, on 10-point Likert scales. The main results are as follows, showing median responses. Users felt the new system was slower (4), that they would prefer a normal system if they were in a hurry (4), and that they would find the passwords more difficult to remember (4). However, they did feel the system was more secure than ordinary passwords (8), led to passwords that would be more difficult to guess (8), and with practice, they could get used to the system (8). These results seem reasonable for a new authentication system, and reflect a trade-off we would expect. We note that participant responses may be biased from being told the system's improvement would make their password more secure. Although we believe such a statement would be made if the system were deployed, we plan to test user acceptance of PTP when it is not introduced as a security improvement. Chi-squared tests revealed no significant distinction between Insert and Replace.

Security. Did the system help users create more secure passwords?
Table 2 shows the system's effect on password security by describing the nature of both the pre- and post-improvement passwords. For example, our improvement process reduced the proportion of very weak lowercase alphabetic passwords from 20.8% to 4.5%. The proportion of very strong passwords that included lowercase, uppercase, numeric, and special characters rose from 14.3% to 29.9%. Most passwords were improved to include characters from additional character subsets.

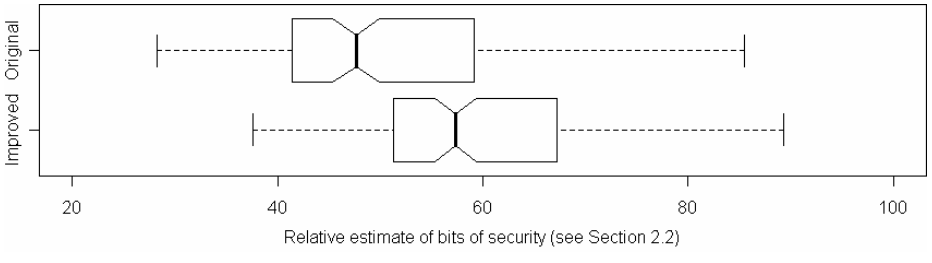

Fig. 4. Box plot of a relative bits of security estimate of users' original and improved passwords

Fig. 4 compares the distribution users' original and improved passwords' estimated bits of security (see Section 2.2). Each box denotes the 2nd and 3rd quartiles, divided by the bold line noting the median. The whiskers at each of the boxes' extremities show the 1st and 4th quartiles. The groups are statistically different if the notches in both boxes do not overlap. T-tests confirm the improved passwords were statistically stronger across all participants ($t(306) = -5.0532$, $p < .001$), and within both the Insert ($t(164) = -4.7548$, $p < .001$) and Replace ($t(140) = -2.5138$, $p < .05$) conditions. Thus, PTP influenced users to create passwords more difficult for attackers to guess.

Our user sample consisted of approximately half Computer Science (CS) students, and it appears these participants formed a distinct group. For example, 12% of CS students chose original passwords in all lowercase, while 30% of the other students did the same. The possibility for improvement was therefore reduced for CS students. Since such technical expertise was over-represented in our sample, we expect that the general impact of our approach would likely be greater than our study results suggest.

Table 2. Proportions of users' original and improved passwords across four character subsets

Character Subsets	% of Original Passwords	% of Improved Passwords
All lowercase	20.8%	4.5%
All uppercase	0.6%	0.0%
All numeric	0.0%	0.0%
All special	0.0%	0.0%
Lowercase & uppercase	1.3%	5.8%
Lowercase & numeric	26.6%	5.8%
Lowercase & special	5.9%	7.2%
Uppercase & numeric	2.0%	0.0%
Uppercase & special	2.6%	0.0%
Numeric & special	0.6%	0.0%
Lowercase, uppercase, & numeric	14.3%	16.9%
Lowercase, uppercase, & special	3.2%	9.7%
Lowercase, numeric, & special	7.8%	16.9%
Uppercase, numeric, & special	0.0%	3.3%
All four character subsets	14.3%	29.9%
Passwords in 1 subset	21.4%	4.5%
Passwords in 2 subsets	39.0%	18.8%
Passwords in 3 subsets	25.3%	46.8%
Passwords in 4 subsets	14.3%	29.9%

4 Conclusion

In this paper, we have outlined how Persuasive Technology can be used to improve passwords by reducing the likelihood that passwords can be guessed systematically, and thus increasing the security of users' online accounts (and the accompanying resources and capabilities thereof). Although the approach described in this paper uses a modest number of PT strategies, it yields a useful improvement in password strength, and we therefore believe the approach is worth further study.

Generalised advice and feedback have had limited success in helping users create more secure passwords. The main advantage of our approach is that it increases password strength while promoting password memorability through user involvement.

Our approach involves altering only the password creation step in the authentication process. Thus, PTP should be easily integrated with most password systems since it only requires minor modifications to the end-user interface and no changes to the password server. Moreover, the visibility of how passwords are made more secure can help form users' mental models of stronger passwords, which may lead them to create stronger passwords where our approach is not built-in.

Our immediate future work involves three lines of inquiry. We wish to expand our study with participants more typical of the online population, compare our results to a

control group, and test password memorability over longer periods of time as well as with more system-assigned characters. Secondly, we wish to refine our improvement strategy with regard to well-known patterns of systematic guessing, such as words, names, and other character patterns. Finally, we plan to increase the level of persuasion involved, leveraging more PT strategies.

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Six Patterns for Persuasion in Online Social Networks

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Abstract. Social psychology research has shown that persuasion happens in predictable ways. To identify patterns of persuasion in online social networks, we studied Facebook as a persuasive technology. Using a Grounded Theory approach, we found and named six persuasion patterns. Four patterns that led to large-scale viral adoption—Provoke and Retaliate, Reveal and Compare, Expression, and Group Exchange—are native to Facebook. Two patterns—Competition and Deception—are adapted to Facebook. We describe these native and adapted patterns and offer psychological explanations for each. We conclude that persuasion in online social networks follows regular, observable patterns, and we suggest promising avenues for future research.

Keywords: Online Social Networks, Facebook, Persuasion, Social Psychology, Applications, Patterns, Persuasive Technology, Viral Growth, Captology.

1 Introduction

Social psychology research has shown that persuasion happens in predictable ways, with phenomena such as "foot in the door" [1], "boiling the frog" [2], and "escalation of commitment" [3]. One might also expect patterns of persuasion to exist in online social networks, but these patterns have yet to be shown or named. To identify patterns of persuasion in online social networks, we studied Facebook as a persuasive technology. [1] Through our research we identified six patterns that Facebook applications have used to spread from person to person on a mass scale. According to Compete.com, these applications are used by 16 million out of the 32 million monthly users of Facebook. [4]

Using a Grounded Theory approach [5], we examined the top 100 Facebook applications in terms of user engagement according to *Appsaholic*[2] on December 6, 2007. This approach creates generates and tests hypotheses about emergent patterns iteratively,[3] and has been successfully used to study online communication. [6]

Based on this approach, we found six patterns of success. We then classified these patterns into a framework. The patterns can be either native to Facebook or adapted

[1] Persuasive technology is defined as "interactive computing systems designed to change people's attitudes and behaviors". [7]

[2] Appsaholic is a Facebook application which tracks the daily active user rate and total user number of each Facebook application.

[3] Grounded Theories should be judged on these four criteria: fit, relevance, workability and modifiability. For example: how well do the proposed patterns fit the applications on social networks? Do they "grab" attention? Do they explain variation in usage of applications on social networks? Can they be modified in light of new data?

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from other contexts. Native patterns are tightly integrated in Facebook Profile Pages and rely heavily on Facebook's built-in Friend Selector and other functionality exposed by Facebook. (The Profile Page is a highly customizable page that individual users create to share their pictures, preferences, and other personal information. The Friend Selector is a small piece of a web page that allows users to select one or more friends from their social network by either clicking on a friend's Profile Picture or typing part of a friend's name.) In other words, the native patterns leverage special properties embedded in Facebook technology to achieve successful viral growth. In contrast, adapted patterns are not based primarily around Facebook's exposed functionality. Although users remain on Facebook, their interactions follow patterns, often complex, which are adapted from other venues. Our classification is summarized in Table 1.

Table. 1. Six Patterns of Persuasion

	1. Native Patterns		***II. Adapted Patterns***
	1. Individually Directed	2. Group Directed	
A. Take Action	**1A. Provoke and Retaliate** *X Me, Bless you, Kiss Me*	**2A. Reveal and Compare** *Likeness, Send HOTNESS*	**IIA. Competition** *Scrabulous, Jetman, achievement "levels"*
B. Create Object	**1B. Self-expression** *Graffiti, Hatching Eggs*	**2B. Group Exchange** *SuperWall, BumperSticker*	**IIB. Deceive** *Fake Facebook buttons & install tabs*

2 Native Patterns

Native Patterns of persuasion rely heavily on functionality that Facebook provides. Within native patterns in Facebook, users can take actions or create objects that are either individually directed or group directed. We've named the patterns as follows:

Pattern 1A: ***Provoke and Retaliate***
Pattern 1B: ***Expression***
Pattern 2A: ***Reveal and Compare***
Pattern 2B: ***Group Exchange***

In the following paragraphs, we explain each pattern of persuasion and give examples of how these patterns work in successful Facebook applications.

2.1 Provoke and Retaliate (Pattern 1A)

Facebook applications that use the Provoke and Retaliate pattern allow one user to take action on another user (one of their Facebook "friends"). For example, users can throw snowballs at, kiss, hug, and poke other users. These applications gain persuasive power from the norm of reciprocity [8]. At times the reciprocity is emotionally positive, such as hugging, blessing, or kissing a "friend" on Facebook. The receiver of the gesture then has the social obligation to respond, following the norm of reciprocity.

However, reciprocity can also play out in a negative way: revenge [9]. This negative aspect of reciprocity has led to a host of successful Facebook applications. In *Zombies*, one user bites another. In *WaterFight*, users seem to have escalating exchanges with water, ranging from splashing to water cannons. The same pattern holds true for *SnowBall Fight*, *Pillow Fight*, and dozens of other Facebook applications.

Thanks to Facebook's Social Graph (the term used to describe the social links among users), the norm of reciprocity becomes a powerful persuader online. Users can provoke each other and retaliate to those provocations.

Most of these applications began as perhaps the simplest possible design: a decorated invitation page. Exhibit 1 shows screenshots from *KissMe*, *Hugs*, *BlessYou*, and *X Me*. As the screenshots show, Provoke and Retaliate applications are simple. Users invite their friends to the snowball fight or to the zombie world by throwing an initial snowball or biting them. The reciprocity dynamic is then set into motion.

Cognitive dissonance [10] is a driver of engagement for applications that follow the Provoke and Retaliate pattern. Here's how the cognitive dissonance dynamic works in these Facebook applications. On the one hand, these applications have no

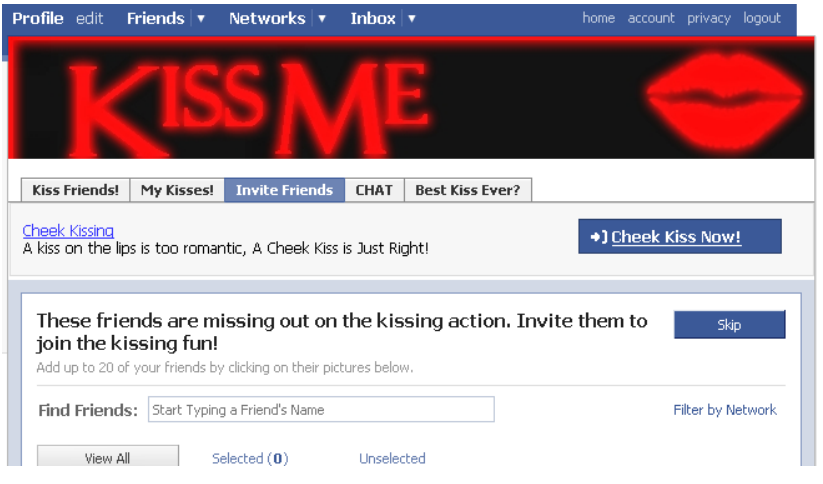

Exhibit 1. Screenshot of KissMe

clear instrumental purpose, a point which should be apparent to users immediately. On the other hand, a friend referred the user to the application, she freely installed it, and she even invited others to install it. To reduce the dissonance, a user concludes that this application must in fact be fun.

2.2 Expression (Pattern 1B)

The next persuasive pattern we call the Expression pattern. Facebook applications that use the Expression pattern allow users to create artifacts for themselves or for another person. For example, some applications allow users to show off a pet they have created; others allow users to highlight their favorite music or bands. These artifacts appear on a user's Profile Page.

The psychological drive to create artifacts that express identity, opinions, and affiliations is not new [11], [12]. Facebook gives people a new way to express themselves, tapping into this fundamental human motivation. As a result of our drive to express ourselves, Facebook and many applications on Facebook succeed.

Many of the applications in this genre, like *Movies*, *Causes*, or *Cities I've Been*, require large databases of content. Other applications in this genre have significant functionality to help users create artifacts, like the art tools of *Graffiti* and *Scribbled Photos*. (See Exhibit 2 for an example of this genre.) What all applications in this genre share is that users can create expressive artifacts—whether lists of favorites or artifacts that are funny or artistic—which can be attractively displayed on a user's Profile Page.

Although Expression applications do not have a natural call to action, which doesn't lead to rapid viral growth like Provoke and Retaliate applications, they leverage the psychological principle of ingratiation [13] as another driver of user engagement. Many of the top applications, like *Graffiti*, were launched at the very beginning of the platform launch and tapped into a need among many users on Facebook for new outlets to express themselves.

Exhibit 2. Sample artifact created by the Graffiti App for a Profile Box

Consistency [14] and conformity are both stronger drivers that make users return to Expression applications frequently after their first-time expressions. There were initially only 66 applications in May 2007 and then only a few hundred in the coming

weeks. All the while, millions of Facebook users were trying out the early applications. Those applications got exposure and were adopted. Once people adopted these applications and had created artifacts, they are unlikely to remove those applications. They had created artifacts of value (investment), and they had already made a commitment to the application (consistency).

2.3 Reveal and Compare (Pattern 2A)

Another persuasion pattern on Facebook is a dynamic we call Reveal and Compare. These applications allow users to take actions (as Provoke and Retaliate applications do), but these actions are group-directed (as are applications in Group Exchange, the next category.) Reveal and Compare applications successfully persuade users through factors including reciprocity [15], cognitive dissonance [10], and the need to belong and social validation [16].

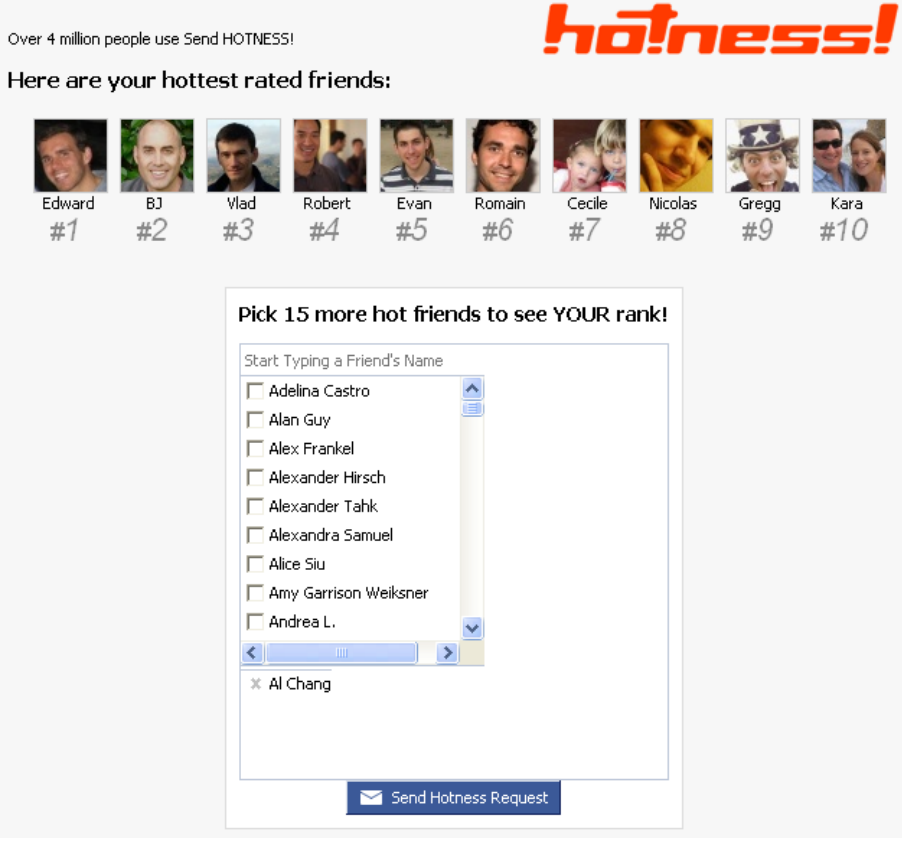

Exhibit 3. Screenshot of Send Hotness

As with other categories, the Reveal and Compare applications on Facebook leverage similar persuasion dynamics. In this case, when using a Reveal and Compare application, a user needs to compare groups of friends to reveal who is more attractive, to find out who shares which hobbies, or to match single friends. And the final comparison results are decided by the whole user group. Comparisons are framed in two typical ways: (1) to rank order a list of related items as *Likeness* and (2) to make an either/or decision between two friends on a provocative topic like *Compare People*. Please see Exhibit 3 for examples of the Reveal and Compare pattern.

Like the first category of Provoke and Retaliate applications, Reveal and Compare applications allow users to take actions on the other uses. Thus, Reveal and Compare applications also gain persuasive power from the norm of reciprocity and cognitive dissonance, as described previously.

Moreover, Reveal and Compare applications initiate interactions with an emphasis on interpersonal relationships. When using Facebook applications like *Send Hotness* and *Perfect Match*, users have to rank their friends and wait for friends' ranking of themselves to refine their own rankings in hotness or perfect matches. This persuasive pattern introduces the need to belong [17], [18] as additional engagement motivation because Reveal and Compare applications can effectively help to form and maintain active interpersonal relationships for users.

At the same time, Reveal and Compare applications also form a basis for social validation by the requirement of feedback and interaction. This social validation basis is especially efficient, as users have to rely on the reactions from their personal network to reveal their own attributes.

2.4 Group Exchange (Pattern 2B)

The fourth native persuasive pattern in Facebook we call Group Exchange. Group Exchange applications allow users to create and share objects collectively. This genre includes *SuperWall, FunWall*, and *Quizzes*. The successful applications in this genre have both broad reach and high engagement. The Group Exchange pattern is successful in part because of the confluence of several powerful factors: impression management, reciprocity, social validation, and context variables like feedback and applause. We can examine each of these psychological factors in Group Exchange applications. (See Exhibit 5 for screenshots of *SuperWall* and *Quizzes*.)

Like Expression applications, Group Exchange applications allow users to create artifacts. But unlike Expression applications, these artifacts are created collectively. Because these artifacts are created through public interactions, they can resemble a play. And much like Goffman's original performance analogy for impression management [19], the Facebook user is an actor shaped by the environment and audience trying to provide performance consistent with his or her goals. Impression management theorizes both that people are motivated to control how other see them and that they create their identities through interactions with others [20]. This theory aptly describes why users are so interested in Group Exchange applications like *SuperWall*.

Exhibit 4. Screenshot of SuperWall's Profile Box

Group Exchange applications go beyond simple expression. Like Provoke and Retaliate applications, users can initiate an exchange with a friend. By the norm of reciprocity, the friend is likely to be motivated to respond.

Moreover, Group Exchange applications ask a community to contribute to and engage with the artifacts. The conversations that ensue crisscross from one Profile Page to another, leaving a trail of communications. Who posts on a user's wall and what a user posts on other peoples' walls form a basis for social comparison and social validation. The Group Exchange pattern weaves together these various psychological dynamics in one simple user experience.

Perhaps most importantly, though, Group Exchange applications convey a sense of fun and lively community. In a real way, *SuperWall* (and the functionally similar *FunWall*) allows for many-to-many communication. The opportunity for feedback and interaction increases concerns about one's social appearance [21], [22], [23].

These psychological factors are mutually reinforcing. Reciprocity reinforces impression management, and vice versa, because they both tap the fundamental need to be liked. Feedback reinforces impression management. The cluster of interacting factors explains why Group Exchange applications have both broad reach and high engagement.

3 Adapted Patterns

As described previously, our research identified a second class of persuasive patterns on Facebook. These patterns match closely what happens outside of Facebook, so we called them *Adapted Patterns*. In other words, applications that follow the adapted pattern take functionality that was designed for other contexts (e.g., desktop software, web sites, video game consoles, etc.) or techniques that were developed long before Facebook, and adapt them to the social context of Facebook. For example, many Facebook applications use leader boards and status levels to foster competition. Meanwhile, many applications include deceptive advertising such as fake buttons and navigational elements that are really paid promotions to install other applications.

3.1 Competition (Pattern IIA)

Competition is an adapted pattern we identified in our Facebook analysis. For example, several popular competitive games outside of Facebook have become popular on Facebook. Games like Scrabble, poker, and video games are adapted to the online social context. In this genre, *Scrabulous*, *Texas HoldEm,* and *JetMan* are all in the top 20 applications. (See Exhibit 5 for examples of this pattern.) Competition motivates engagement in two ways: (1) internally, by tapping a user's need for cognition, and (2) externally, by tapping a user's need for social status [24], [25].

The primary motivation for Competition applications is the same as the motivation for traditional games: the desire to satisfy the need for cognition [26], [27]. Individuals differ in cognitive motivation, and those who have high need for cognition enjoy cognitive activities and engage in them when given the chance. Since Facebook users often visit the site many times daily, games on Facebook offer a convenient way to satisfy this need.

Facebook Competition is highly social. Users can easily invite friends to *Scrabulous*, they can play *Guess Who?* using information about common friends from Profile data, or play poker against real people (not bots or pseudonymous opponents). Identity warranting—proving that a person is who she says she is [28]—exists for the first time on a massive scale online on Facebook. Therefore, the motivation to achieve status and positive reputations on Facebook is higher than elsewhere online.

In addition to applications that fit in the Competition pattern, native applications increase engagement by creating the opportunity to compete for social status. In general, status attainment is a process whereby individuals mobilize and invest resources for returns in socioeconomic standings [29]. *Hugs*, *KissMe*, and *Bless You*, Provoke and Retaliate applications, have leader boards and achievement levels to grant status to users.

Exhibit 5. Screenshot from Texas Hold Em

3.2 Deception (Pattern IIB)

The second adapted pattern is what we call Deception. Facebook applications that fit the Deception pattern have fake buttons and navigational elements that are really paid promotions to install other applications. Deception, "a deliberative attempt to mislead others" [30], has been of interest to researchers and practitioners for centuries [31]. Deception exploits and undermines the trust earned by Facebook to achieve the purposes—usually financial gain—of the application developers.

Unlike the other patterns, no top application is based purely on deception. But as a secondary element, deception is quite prevalent on Facebook. For example, the *Compare People* Profile Box is full of traps. Each of the text links ("Write a testimonial," "Do you trust Jane?" and "Jane's social profile" and even "Check your rankings") is a call to install another application, not a link into *Compare People*. The developers of this application are misleading users to install these other applications. Other deceptive techniques include fake Facebook buttons, advertising embedded in content or navigation.

The ease and prevalence of deception on Facebook exposes some important psychological insights into the operation of Facebook applications. Social validation, deference to authority, and escalation of commitment all play roles in compliance to even deceptive actions. We discuss each psychological dynamic briefly below.

First, social validation plays a role in the Deception pattern. The invitation to install a deceptive application comes from a trusted and liked friend. Before users

install the application, they may even be presented with the fact that many of their friends have installed the application. Based on social validation, people may decide how to respond based on the behaviors of others rather than making their own independent assessment [32], [33].

Many of the applications that use the Deception pattern are visually similar to the Facebook interface. In this way, through visual similarity, these applications gain authority [34], [35]. The specific buttons that are deceptive match typical Facebook buttons, and so it is unsurprising then that many users blindly click on fake Facebook buttons and navigation.

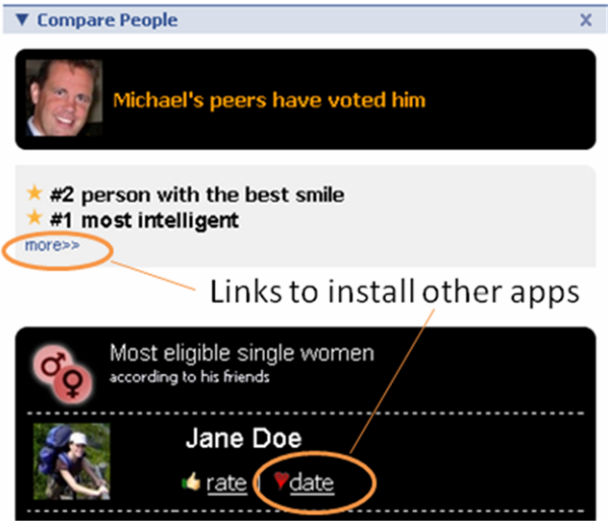

Exhibit 6. Compare People

Deception applications use simple navigation paths to escalate commitment [7]. The invitation coming from a user's friend offers a simple choice: install the application to find out why your friend invited you or miss out. In order to install the application, the user is again faced with the same choice again: invite friends or miss out. Upon reaching the Canvas Page after finally installing the application, the most deceptive applications have just a single call to action. This action is often paid-per-click advertisement. At this point, the user should be skeptical. But many click onwards in futile hope to recover their prior investment of their time.

3 Discussion

In this section we present the relative impact of the various persuasion patterns in Facebook, based on our analysis of the top 100 applications. We've excluded Deception as a pattern because it is not a primary pattern in Facebook. In addition, two applications in the top 100 (ranked in the mid-90s) were in foreign languages and were not coded. The results are in Table 2. We find three especially notable trends:

Table. 2. User Behavior by Pattern in December 2007

	Provoke and Retaliate	Reveal and Compare	Expression	Group Exchange	Competition
Daily Users	5,441,000	8,096,000	5,005,000	11,095,000	2,231,000
Number of Applications	23	26	26	14	9
Users Per Application	236,561	311,379	192,502	792,479	247,929
Installs	83,796,774	142,029,363	99,355,250	84,386,158	15,913,200
Percent Active	0.065	0.057	0.05	0.131	0.14

1. ***A small number of Group Exchange applications reach many users and are highly engaging.*** Although only 14 applications in the top 100 are true Group Exchange applications, these 14 applications are used by 11 million people daily—the most of any category.
2. ***Reveal and Compare applications have a large reach but a low engagement.*** Reveal and Compare applications have been installed 142,000,000 times. However, only 5.7% of these users are active on any given day. This retention rate is the lowest of all the patterns.
3. ***Competition is highly engaging within a niche.*** Competition applications engage the highest percentage of their installed base: 14.0% are daily active users. However, they have the smallest total number (9) of applications of any pattern.

Our analysis of the top 100 Facebook applications in December 2007 shows that six patterns of persuasion account for the most successful applications on Facebook. In turn, these patterns can each be explained using psychological dynamics. Some patterns involve novel combinations of these dynamics that appear to be native to online social networks, whereas others are adapted patterns from other contexts. Interestingly, each pattern promotes different levels of adoption and engagement.

Other online social networks, like MySpace and LinkedIn, differ in important ways. For example, each network targets different user segments and may have different meanings to the connections between users and different ways to communicate. Even on Facebook, the composition of users is changing and new features are being launched regularly. Hence, the patterns that we identified may not work precisely as described here in other social networks. Even on Facebook, successful patterns may evolve as the platform itself evolves.

Still, this research shows that persuasion in online social networks follows regular, observable patterns. This conclusion has interesting implications. First, software developers can tap into these patterns to create applications that are more likely to

succeed. That some applications succeed and others fail is not based on pure chance; success can be learned and replicated.

Next, this current research points to potential research opportunities. Future empirical work should elaborate on patterns found in the different online social networks and track how these patterns evolve. Future theoretical work should try to explain how differing context drives different persuasive patterns. Future experimental work should try to establish causal relationships within these patterns of persuasion through experiments. As online social networks continue to grow in size and relevance in society, researchers should exploit the opportunity that these networks afford.

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A Systematic Framework for Designing and Evaluating Persuasive Systems

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Abstract. A growing number of information technology systems and services are being developed to change users' attitudes or behavior or both. Despite the fact that attitudinal theories from social psychology have been quite extensively applied to the study of user intentions and behavior, these theories have basically provided checklists or rules of thumb rather than systematic design methods or methodologies to develop software solutions. This article is conceptual-theoretical by its nature. It discusses the process of designing and evaluating persuasive systems and describes what kind of content and software functionality may be found at the final product. Seven underlying postulates behind persuasive systems, ways to analyze the user and the use context, and persuasive design strategies and guidelines are highlighted. Based on the works of Fogg, the article also lists techniques for persuasive system content and functionality, describing example software requirements and implementations. Some new techniques are suggested. Moreover, a new categorization of these techniques is proposed, composing of the primary task, dialogue, system credibility, and social support categories.

Keywords: Design, functionality and techniques, models and frameworks, strategies, theories.

1 Introduction

Interactive information technology designed for changing users' attitudes or behavior is known as persuasive technology [4]. Traditionally persuasion has meant "human communication designed to influence the autonomous judgments and actions of others" [20]. The Web, Internet, mobile and other ambient technologies create opportunities for persuasive interaction, because users can be reached easily. In addition, the Web and other Internet-based systems are optimal for persuasive communication, because they are able to combine the positive attributes of interpersonal and mass communication [1]. There are certain areas where persuasive technology could be especially useful. For example, health care software applications may be developed to motivate people towards healthy behavior, and thereby possibly delay or even prevent medical problems as well as ease the economic situation in public health care [9].

Persuasive systems may be defined as "computerized software or information systems designed to reinforce, change or shape attitudes or behaviors or both without

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using coercion or deception" [16]. In this definition, three potential, successful outcomes for a persuasive system are reinforcement, change or the shaping of attitudes and/or behaviors. A reinforcing outcome means the reinforcement of current attitudes, making them more resistant to change. A changing outcome means changes in a person's response to an issue, e.g. to social questions. A shaping outcome means the formulation of a pattern for a situation when such one does not exist on beforehand. In many cases a shaping outcome may have a higher likelihood of success than communication that aims at behavior change [11]. Different goals may imply the use of differing persuasion strategies and techniques.

Persuasive systems may utilize either computer-human persuasion or computer-mediated persuasion.[1] Admittedly, the concept of a persuader is relatively complex. As computers do not have intentions of their own, those who create, distribute, or adopt the technology are the ones who have the intention to affect someone's attitudes or behavior [4], [5]. Although computers can not communicate in the same way as humans, recent studies suggest that some patterns of interaction similar to social communication may be utilized in human-computer interaction [15], [6]. Computer-mediated persuasion means that people are persuading others through computers, e.g. discussion forums, e-mail, instant messages, blogs, or social network systems.

Despite the fact that attitudinal theories from social psychology have been quite extensively applied to the study of user intentions and behavior, these theories have basically provided checklists or rules of thumb rather than systematic design methods or methodologies to develop software solutions. Fogg's framework and principles provide useful means for understanding persuasive technology, but specifically for designing and evaluating persuasive systems they seem to be at a too general level [8]. This article, in spite of being conceptual-theoretical by its nature, aims at discussing the process of designing and evaluating persuasive systems as well as describing what kind of content and software functionality may be found at the final product. It is based upon our empirical work and conceptual analysis as well as related research. Since many of the presented techniques are based upon the framework of Fogg, the major differences to it will be highlighted.

Section 2 will define the underlying assumptions behind persuasive systems. Section 3 will discuss how different use and user contexts may be analyzed. Section 4 will define and describe various techniques for the content and functionality of a persuasive system. Section 5 will provide the conclusions of the article.

2 Fundamental Issues Behind Persuasive Systems

Based upon our empirical work and conceptual analysis as well as related research we define seven postulates[2] that need to be addressed when designing or evaluating persuasive systems. Two of these postulates relate how we see the users in general, two of the postulates relate to persuasion strategies, and three of the postulates address actual system features.

[1] The definition here differs from the definition by Fogg [4] who defines that persuasive technology is computer-human persuasion only.

[2] One might also call these as underlying assumptions or our biases.

Our first postulate is that *information technology is never neutral*. Rather it always influences people's attitudes and behavior in one way or another. Moreover, people are constantly being persuaded in a similar manner to how teachers persuade students in schools, and there is nothing bad in it in itself. This also means that persuasion may be considered as a process rather than as a single act. Persuading a user is a multi-phased and complex task, and different factors, such as the user's goal, may change during the process. For instance, in the beginning of using a pedometer a user might be simply interested in the number of steps but after using the device for a while (s)he may get more interested in burning calories. Persuasive systems should be able to adapt for this kind of changes.

The second postulate is that *people like their views about the world to be organized and consistent*. This is based on the idea of commitment and cognitive consistency [2]. If systems support the making of commitments, users will more likely be persuaded. For example, a user may express greater confidence in his or her decision to exercise regularly after one has bought a gym membership card. The idea of commitment also implies that persuasive systems could provide a means to make private or public commitments for performing the target behavior. This can be implemented, for example, by offering an easy way to send a text message or email for one's relatives, friends, or colleagues.

Cognitive consistency becomes important, because inconsistency may motivate for attitude change [20]. Psychological inconsistency disturbs people and they easily want to, perhaps even feel obliged to reorganize their thinking and restore consistency.[3] Inconsistency may exist between attitudes and behavior, attitudes towards other people, attitudes towards objects and other people's attitudes towards the same objects [20]. The inconsistency must be represented and brought to the attention of the receiver. If a person finds the inconsistency unpleasant, (s)he will accept personal responsibility for it, and then cognitive dissonance will occur. The dissonance has to be powerful enough, however, to motivate the person to engage in an attitude or behavior change in order to restore cognitive consistency [7]. The idea of cognitive consistency may be subject to criticism. Philosophically, people are not fully consistent in their actions but have to deal with minor inconsistencies every day. People also have to feel commitment before inconsistency creates dissonance. For example, if one feels that (s)he could reverse a decision at any time, (s)he is unlikely to experience dissonance. Also, if one believes that (s)he had no other choice but to behave inconsistently, (s)he may live with it. The idea of cognitive consistency can be used in persuasive designs in many ways, for example by offering information to a user that is inconsistent with his or her thinking. For instance, an application for encouraging to safe driving could ask users why they are speeding, if they are well aware of the fact that speeding is one of the main reasons for serious traffic accidents. Inconsistencies may also encourage a user to reflect the arguments presented, and shape his or her attitudes based on this.

The third postulate states that *direct and indirect routes are key persuasion strategies* [16]. An individual who carefully evaluates the content of the persuasive message may be approached by the direct route, whereas an individual who is less

[3] It should be noted that also correctness "drives" people [17]. People evaluate correctness by comparing their opinions to the opinions of others, for instance.

thoughtful and uses simple cues or stereotypes for evaluating the information may be persuaded through the indirect route. Direct and indirect processes may act simultaneously[4], and both strategies may be supported through numerous software system features. Direct persuasion has turned out to be the more enduring of the two [17, 13]. However, in the era of information overflow people are often forced to use indirect cues more often than before, because of the abundance of information to be handled. When an individual sees relevant cues, heuristics are triggered. These may also be called cognitive shorthands, shortcuts, or rules of thumb. Heuristics are normally derived from experience and may have some empirical validity. Heuristics are often socially shared, but in practice a heuristic is available only if there is a stored heuristic representation in one's memory [23]. This postulate implies that a user's personal background and the use situation have an influence on his or her information processing. When the user has a high motivation and a high ability, (s)he is more likely interested about the content of the persuasive message than when (s)he has a low motivation and a low ability. In challenging situations such as when being in a hurry, it is highly likely that one will use heuristics for processing the information.

The fourth postulate states that *persuasion is often incremental*. This suggests that it would be easier to initiate people into doing a series of actions through incremental suggestions rather than a onetime consolidated suggestion [12]. This implies that a persuasive system should enable the making of incremental steps towards target behavior. For example, an application for healthier eating habits could first encourage users to eat at least some vegetables at their meals whereas the system could later suggest filling half of the plate with vegetables. Oftentimes, a system should also encourage users to make an immediate decision rather than postponing it for a later occasion. For example, Web sites for preventing alcohol abuse could provide stories from people who have received bad consequences, such as memory problems or brain damages, because of alcohol abuse. From the ethical point of view, it is necessary that the overall goal is made clear at all steps of incremental persuasion.[5]

The fifth postulate is that *persuasion through persuasive systems should always be open*. Content that is based on untruthful or false information does not fit with the overall goal of user's voluntary attitude change. It is also very important to reveal the designer bias in behind of the persuasive system. For instance, simulations may bear great persuasive power but if the designer bias remains unclear for the users they may either loose some of their persuasiveness or they may end-up misleading their users.

The sixth postulate states that *persuasive systems should aim at unobtrusiveness*, i.e. they should avoid disturbing users while they are performing their primary tasks with the aid of the system. The principle of unobtrusiveness also means that the opportune moment for a given situation should be carefully considered. The use of persuasive features at improper moments, e.g. a heart rate monitor suggesting one to

[4] Our approach differs from the Elaboration Likelihood Model (ELM) [17] in the simultaneity of the direct and indirect processes, whereas it follows the Heuristic-Semantic Model (HSM) [23] in this matter. The ELM calls the direct and indirect routes as central and peripheral processes, whereas the HSM calls these as systematic and heuristic routes.

[5] The so called "foot-in-the-door techniques" [2], or at least how they are used in everyday practice, may not be considered as part of incremental persuasion due to the fact that the overall goal often is not revealed for the persuadee.

exercise when being sick or getting a reminder to do one's daily sit-ups when giving a presentation at a meeting, may result in undesirable outcomes.

According to the seventh postulate, *persuasive systems should aim at being both useful and easy to use*, i.e. to really serve the needs of the user. This includes a multitude of aspects, such as convenience, ease of access, error-freeness, high information quality, as well as positive user experience, attractiveness, and user loyalty. Quite understandably, if a system is useless or difficult to use, it is unlikely that it could be very persuasive. It should be noted, however, that the abovementioned aspects are general software qualities rather than specific for persuasive systems.

3 Analysis of Use and User Contexts

The process of persuasion has to be carefully analyzed both in given situations as well as in a larger context. We refer to these as use and user contexts.

Analyzing *the use context* requires a thorough understanding of what happens in the information processing event, namely understanding the roles of persuader, persuadee, message, channel, and context [16]. Persuasive communication produces a complicated psychological event in person's mind. Basically, a persuadee is a human information processor [13]. This information processing view emphasizes the role of attention and comprehension in the persuasion process.[6] In order for a person to be persuaded information must be presented, and the persuadee must pay attention to the argument(s) presented and comprehend it. After this the persuadee often yields to the position presented and retains (at least for some time), but in a successful persuasion the persuadee takes action to comply with the new position [13]. Persuasion-in-full occurs only when attitude change takes place. Changing a previous attitude is harder than originating or activating an attitude or the reinforcement of an attitude. Also if user's existing attitudes are based on one's personal experience (sometimes learned through a long socialization process), they are harder to change. In proportion, if user's existing attitudes are recently learned from other people, they are easier to change [11].

According to McGuire, in a persuasion situation the persuadee is ideally supposed to make optimal compromises among conflicting forces [13]. This principle has been criticized by Cialdini et al. [2], because it emphasizes the rational processing of arguments. Nevertheless, this is a relatively large part of the whole picture. Since persuasion is defined as changing the attitudes and/or behavior of others, the persuader is often trying to convince the persuadee of something. Drawing the line between convincing and persuasion is difficult. Persuasion relies primarily on symbolic strategies that trigger the emotions, whereas conviction relies on strategies rooted in logical proof and appeals to persuadees' reason and intelligence [14].

In addition to relatively straightforward information processing situations, such as learning, users may also be approached through larger contexts in their lives, such as

[6] The information processing approach and cognitive consistency approach differ from each other in that the cognitive consistency approach emphasizes that if people first change their behavior, e.g. through legal constraints, their attitudes will change later, whereas the information processing approach states that people first change their attitudes in order to produce a change in behavior [13].

a middle-age crisis or a loss of a loved one. Whereas use analysis basically only focuses on the question what information is relevant for a user in a given situation, the user may and should be approached also in a more holistic manner. This may be referred to as *the user context*. This context analysis in-the-large means analyzing user's needs, interests, motivations, abilities, pre-existing attitudes, persistence of change, cultural factors, deep-seated attitudes, social anchors and perhaps even the whole personality.

In sum, both the use and user contexts have to be analyzed. Otherwise it will be harder or even impossible to recognize inconsistencies in user's thinking, figure out opportune moments for delivering messages, and effectively use persuasion techniques. In addition to analyzing the use and user contexts, also analyzing the message and the persuader is needed. The complexity and potentially controversial nature of the message and the earlier (use) history of the persuasive system needs to be carefully understood.

4 Design of System Features

Fogg's functional triad and its design principles [4] provide the first and most utilized conceptualization of persuasive technology. A weakness of this model is that it does not explain how the suggested design principles can and should be transformed into software requirements and further implemented as actual system features. Yet, to be able to design and evaluate the persuasiveness of a software system, it becomes essential to understand both the information content and the software functionalities.

Requirements specification is one of the most central phases in software development. It covers the activities involved in discovering, documenting, and maintaining a set of requirements for the computer-based information system to be designed and developed [22]. Requirements are descriptions of how the system should behave (functional requirements), qualities it must have (non-functional requirements), and constraints on the design and development processes [22], [18]. A system's persuasiveness is mostly about system qualities.

System features may be categorized as providing primary task, dialogue, system credibility, or social support.

4.1 Primary Task Support

The design principles in this category support the carrying out of the user's primary task. The design principles in this category are reduction, tunneling, tailoring, personalization, self-monitoring, simulation, and rehearsal. See Table 1.

Even if the design principles in this category are based on the works of Fogg [4], there are also many differences to them. The key benefit of suggestion is meaningful content for the user rather than providing support for carrying out a process or making a task simpler to do. For this reason, it is tackled in another category. In our view, surveillance and conditioning are not acceptable means for persuasive systems. Oftentimes people can not choose whether they may be observed or not which easily leads to covert approaches. In a similar manner, operant conditioning oftentimes is not open. Moreover, we also tend to think that users act more or less rationally in the way how they form and modify attitudes on the basis of beliefs and values rather than performing behavior as a result of conditioning.

Table 1. Primary task support

Principle	Example requirement	Example implementation
1. Reduction A system that reduces complex behavior into simple tasks helps users perform the target behavior and it may increase the benefit/cost ratio of a behavior.	System should reduce effort that users have in regard to performing their target behavior.	Mobile application for healthier eating habits lists proper food choices at fast food restaurants [24]. Smoking cessation web site provides an interactive test which measures how much money a user will save with quitting.
2. Tunneling Using the system to guide users through a process or experience provides opportunities to persuade along the way.	System should guide users in the attitude change process by providing means for action that brings closer to the target behavior.	Smoking cessation web site offers information about treatment opportunities after a user has answered an interactive test about how addicted (s)he is on tobacco.
3. Tailoring Information provided by the system will be more persuasive if it is tailored to the potential needs, interests, personality, usage context, or other factors relevant to a user group.	System should provide tailored information for its user groups.	Personal trainer Web site provides different information content for different user groups, e.g. beginners and professionals. Web site for recovering alcoholics presents a user such stories which are close to one's own story.
4. Personalization A system that offers personalized content or services has a greater capability for persuasion.	System should offer personalized content and services for its users.	Users are able to change the graphical layout of an application or the order of information items at a professional Web site.
5. Self-monitoring A system that helps track one's own performance or status supports in achieving goals.	System should provide means for users to track their performance or status.	Heart rate monitor presents a user's heart rate and the duration of the exercise. Mobile phone application presents daily step count [3].
6. Simulation Systems that provide simulations can persuade by enabling them to observe immediately the link between the cause and its effect.	System should provide means for observing the link between the cause and effect in regard to their behavior.	Before and after pictures of people who have lost weight are presented on a Web site.
7. Rehearsal A system providing means with which to rehearse a behavior can enable people to change their attitudes or behavior in the real world.	System should provide means for rehearsing a target behavior.	A flying simulator.

4.2 Dialogue Support

The design principles related for implementing computer-human dialogue support in such a manner that helps users keep moving towards their goal or target behavior include praise, rewards, reminders, suggestion, similarity, liking, and social role. See Table 2.

Table 2. Dialogue support

Principle	Example requirement	Example implementation
8. Praise By offering praise a system can make users more open to persuasion.	System should use praise via words, images, symbols, or sounds as a way to give positive feedback for a user.	Mobile application which aims at motivating teenagers to exercise praises user by sending automated text-messages for reaching individual goals. [24]
9. Rewards Systems that reward target may have great persuasive powers.	System should provide virtual rewards for users in order to give credit for performing the target behavior.	Heart rate monitor gives a user a virtual trophy if they follow their fitness program. Game rewards users by altering media items, such as sounds, background skin, or a user's avatar according to user's performance. [21]
10. Reminders If a system reminds users of their target behavior, the users will more likely achieve their goals.	System should remind users of their target behavior during the use of the system.	Caloric balance monitoring application sends text-messages for their users as daily reminders. [10]
11. Suggestion Systems offering suggestions at opportune moments will have greater persuasive powers.	System should suggest users certain behaviors during the system use process.	Application for healthier eating habits suggests children to eat fruits instead of candy at a snack time.
12. Similarity People are more readily persuaded through systems that remind themselves in some meaningful way.	System should imitate its users in some specific way.	Slang names are used in an application which aims at motivating teenagers to exercise. [24]
13. Liking A system that is visually attractive for its users is likely to be more persuasive.	System should have a look and feel that appeals to its users.	Web site which aims at encouraging children to take care of their pets properly has pictures of cute animals.
14. Social role If a system adopts a social role, users will more likely use it for persuasive purposes.	System should adopt a social role.	E-health application has a virtual specialist to support communication between users and health specialists. [19]

The dialogue support related design principles are partly adopted from Fogg's ideas on social actors (attractiveness, similarity, and praise) and media (virtual rewards). Reminders and social role suggest new design principles, whereas the idea of reciprocity was excluded from this framework because it is rather a characteristic of a user than a system feature.

Table 3. System credibility support

Principle	Example requirement	Example implementation
15. Trustworthiness A system that is viewed as trustworthy (truthful, fair, and unbiased) will have increased powers of persuasion.	System should provide information that is truthful, fair and unbiased.	Company Web site provides information related to its products rather than simply providing advertising or marketing information.
16. Expertise A system that is viewed as incorporating expertise (knowledge, experience, and competence) will have increased powers of persuasion.	System should provide information showing expertise.	Company Web site provides information about their core know-how. Company Web site is updated regularly and there are no dangling links or out-of-date information.
17. Surface credibility People make initial assessments of the system credibility based on a firsthand inspection.	System should have competent look and feel.	There are only a limited number of and a logical reason for ads on a company Web site.
18. Real-world feel A system that highlights people or organization behind its content or services will have more credibility.	System should provide information of the organization and/or actual people behind its content and services.	Company Web site provides possibilities to contact specific people through sending feedback or asking questions.
19. Authority A system that leverages roles of authority will have enhanced powers of persuasion.	System should refer to people in the role of authority.	Web site quotes an authority, such as a statement by government health office.
20. Third-party endorsements Third-party endorsements, especially from well-known and respected sources, boost perceptions on system credibility.	System should provide endorsements from respected sources.	E-shop shows a logo of a certificate which assures that they use secure connections. Web site refers to its reward for high usability.
21. Verifiability Credibility perceptions will be enhanced if a system makes it easy to verify the accuracy of site content via outside sources.	System should provide means to verify the accuracy of site content via outside sources.	Claims on a Web site are supported by offering links to other web sites.

Table 4. Social support

Principle	Example requirement	Example implementation
22. Social learning A person will be more motivated to perform a target behavior if he or she can use a system to observe others performing the behavior.	System should provide means to observe other users who are performing their target behaviors and to see the outcomes of their behavior.	A shared fitness journal in a mobile application for encouraging physical activity. [3]
23. Social comparison System users will have a greater motivation to perform the target behavior if they can compare their performance with the performance of others.	System should provide means for comparing performance with the performance of other users.	Users can share and compare information related to their physical health and smoking behavior via instant messaging application. [21]
24. Normative influence A system can leverage normative influence or peer pressure to increase the likelihood that a person will adopt a target behavior.	System should provide means for gathering together people who have the same goal and get them to feel norms.	Possibility to challenge relatives or friends to quit smoking from a web site via email or text message.
25. Social facilitation System users are more likely to perform target behavior if they discern via the system that others are performing the behavior along with them.	System should provide means for discerning other users who are performing the behavior.	A shared fitness journal in a mobile application for encouraging physical activity. [3]
26. Cooperation A system can motivate users to adopt a target attitude or behavior by leveraging human beings' natural drive to co-operate.	System should provide means for co-operation.	The behavioral patterns of overweight patients are studied through a mobile application, which collects data and sends it to a central server where it can be analyzed in detail. [10]
27. Competition A system can motivate users to adopt a target attitude or behavior by leveraging human beings' natural drive to compete.	System should provide means for competing with other users.	Online competition, such as Quit and Win (stop smoking for a month and win a prize).
28. Recognition By offering public recognition (for an individual or a group), a system can increase the likelihood that a person or group will adopt a target attitude or behavior.	System should provide public recognition for users who perform their target behavior.	Personal stories of the people who have succeeded in their goal behavior are published on a Web site. Names of awarded people, such as "quitter of a month", are published on a Web site.

4.3 System Credibility

The design principles in the system credibility category describe how to design a system so that it is more credible and thus more persuasive. The category of system credibility composes of trustworthiness, expertise, surface credibility, real-world feel, authority, third-party endorsements, and verifiability. See Table 3. The design principles in this category have been adopted and modified from Fogg [4].

The differences to the functional triad are that the ideas of fulfillment, ease-of-use, responsiveness and near perfection have been excluded from this category, because they belong to the postulates. Since personalization is very closely related to tailoring it can be found from another category. On the other hand, the key benefit of referring to an authority is to increase system credibility in a similar manner to other principles in this category. Undoubtedly presumed credibility, reputed credibility, and earned credibility influence users, oftentimes even more than the abovementioned principles, but since these can not really be represented as system features, they are excluded from here.

4.4 Social Support

The design principles in the social support category describe how to design the system so that it motivates users by leveraging social influence. The design principles that belong into this category, are social facilitation, social comparison, normative influence, social learning, cooperation, competition, and recognition. See Table 4. These principles have been adopted from Fogg's principles on mobility and connectivity. Kairos factors and the ideas in behind of convenience, mobile simplicity, mobile loyalty, mobile marriage, and information quality have been covered in the postulates.

5 Conclusion

This paper has presented a new framework for designing and evaluating persuasive systems. The underlying postulates behind persuasive systems were defined and the importance for a thorough analysis of the use and user contexts was brought into attention.

Although this paper is conceptual-theoretical by its nature, it has practical implications. It was proposed that persuasion principles should be considered mainly as requirements for software qualities, relating either to content or to functionality. Twenty-eight design guidelines, mostly based on Fogg's functional triad, were defined with software requirement and implementation examples. A new categorization of the principles was based on their key benefits, which makes them more practical for actual systems development. The suggested postulates, means for analyzing the use and user contexts, new categorization, and design principles may become especially useful in motivating and persuading users to reach their personal goals.

In the future, experimental work will be needed to demonstrate the framework's applicability in real-life design and usage situations. We invite other researchers to use the framework and its principles and help us further develop the framework.

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Digital Therapy: Addressing Willpower as Part of the Cognitive-Affective Processing System in the Service of Habit Change

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Abstract. We know much too little about how to design effective digital interventions to support sustained behavior change and improved well-being. The purpose of the present paper was to contribute in two ways. First, we want to contribute to current practice in designing such interventions. Second, we try to identify key research questions that could be a point of departure for a more detailed and comprehensive future research program. The propositions we suggest reflect that the construction of digital interventions should be seen as an iterative process which should take into account both "content" and "design" factors. However, we argue that intervention research and practical design experience is not just something that follows basic research at a polite distance, but rather is its inherent complement.

Keywords: Digital Therapy, Persuasive Technology, Willpower, Cognitive-Affective Processing System, Emotion Regulation, Ego Depletion, Implementation Intentions, Behavior Change, Health Behavior, Emotional Design, Interactivity, Successful Information Systems.

1 Introduction

The present paper addresses how psychological theory and research related to behavior change and maintenance, can be utilized in designing digital interventions. In particular, interesting questions are: How can interventions be designed not only to motivate clients to initiate change, but to maintain change as well? How important is it to provide additional just-in-time therapy and how can this be achieved? How can digital technologies be used to prevent ego depletion? How can digital interventions support the making of implementation intentions? How can digital technologies help detecting and preventing lapses and relapses?

It is self evident that digital interventions should utilize insights from cutting edge psychology in order to maximize effect. However, many would say, that it is of equal importance to acknowledge that in order to be effective, digital interventions must be able to reach the audience and hold the interest of the user over time. No doubt, the fact that the intervention is judged by the client to be effective in helping her achieving her ultimate goals (utility), may contribute considerably to this end. Nevertheless, we also need to capitalize on insights about how user interface and

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information technology influence upon both initial and continued use, and hence ultimate effect. Because we restrict ourselves to talk about the area of psychological change (e.g. behavior change and well-being), a specific focus will be on such questions as: How do you maximize adherence to digital interventions (stickiness)? What characterize successful information systems in this area? How do different information architectures influence user perceptions? How can (perceived) individualization and personalization be enhanced? How important is interactivity, and how can it be increased? It is not a purpose of the present paper to provide detailed guidelines for the design of digital interventions. Rather, this paper provides a foundation for design-decisions when developing such interventions.

2 Digital Health Interventions: Basic Insights from the Psychology of Behavioral Change

Proposition: The structure of digital health interventions should reflect the psychological chronology of the change process.

Personalized, interactive, digital media makes tailoring and individualization possible, that is, by providing information relevant to the phase of the change process that the individual client is in. Individualization can be achieved by designing a program that reflects the "psychological chronology" of the change timeline, but also by including feedback systems to ensure individualization of the change program. By collecting information throughout the change process, individualization is made possible. Hence, the amount of information, help and support that the client receives can be reduced and be more focused to the specific needs of the client. In other words, one can capitalize on the principle of reduction [1]. Reduction make target behaviors easier to achieve by breaking a complex activity into more manageable steps, and providing only task-relevant pieces of information. For example, complex goals may be broken down into specific sub goals or behaviors that may foster successful goal attainment. Additionally, and perhaps more importantly, the reduction implies that the information that the client needs during the change process is broken down into chunks that are presented to the client at the relevant time, stage, phase or even situation in the change process. This will increase the client's perceived utility of the program, a key factor for the use of any kind of media or communication channel. Also, since the content appears relevant and useful to the user, the likelihood of elaborated information processing will be increased.

Having modeled the "psychological chronology" of the change process that the client goes through, a natural next step is to lead the client through a predetermined sequence of intervention components, step by step. To some extent, this resembles the idea behind what has been called tunneling [1]. For the client, tunneling makes it easier to go through a process. He or she is not introduced to a web-based help-yourself library of information, but is instead "led by the hand" through the change process. The client enters the tunnel (i.e., starts the program) when they initiate the change attempt. By entering the tunnel they give away a certain level of self-determination in that information and activities are presented to him/her in a predetermined sequence. However, the principles of reduction and tunneling ensure

that the client is led through a predetermined change sequence and receives the most appropriate information, support and therapy at the right time.

Proposition: Digital interventions should be constructed to account for the fact that when people initiate a behavioral change, relapse is often the rule rather than the exception.

Large numbers of people try (hard) to loose weight, change their drinking habits, quit smoking, control their gambling, stop taking illegal drugs, take up regular exercise, adhere to their medication, and more. Some of those who try to change actually succeed. Nevertheless, if you try to change yourself in one of those areas, the odds of success are generally not on your side. On the contrary. Depending on the area of change, the methods used (and a number of other factors), relapse rates typically varies between 50 and 95%. For example, if you quit smoking without the use of any behavioral support or medicines, the probability that you are still smoke free a year later is about 3-7% [2]. Likewise, if you try to loose weight, your probability of one year of sustained weight loss is less than 5% [3]. We also know that large proportions of people with serious medical conditions fail to adhere to their treatment regimens, including taking their drugs as prescribed (for review see [4]). In, sum when people try to change their health behaviors (and other habits too), relapse appear to be the rule rather than the exception.

Proposition: Digital interventions should be constructed to account for the fact that motivation and self-regulation involves different psychological processes.

Relapse means that after a (short) period of successful initial change, you return to your full-blown pattern of the old habit. It seems obvious that in some cases (and we do not know how often) people actually choose to go back to their old habit as a result of comparing the new versus the old behavior [5]). In these cases we are not actually talking about relapse because people take up the old habit due to a change in motivation; in many ways this resembles the same process as when we establish brand new habits. In these cases we see something that could be denoted "deliberative relapse" stemming from a self-conscious choice [5]). However, because a vast majority of those who try to change, but relapse, try again (and again and again...), it is likely that for many, relapse is not primarily due to a change in (long-term) outcome expectancies (i.e. motivation) related to change. In contrast, many of those who try to stop smoking, drink less or loose weight, invest great efforts trying to resist temptations that could make the snowball roll and make the way for a full-blown relapse. In other words, they try to mobilize willpower, or stated differently they try to successfully self-regulate themselves. Hence while making a change attempt requires motivation – change maintenance requires self-regulation, that is “operations performed by the self to alter its own habitual or unwanted responses to achieve a conscious or nonconscious goal” [6].

Proposition: Digital interventions should be constructed to prevent ego depletion.

The inability to maintain a wanted, newly established behavior most often represents a self-regulation failure, i.e. an inability to exert self-control and thus acting out an impulse that runs counter to the person's values or long-terms goals [7]. In other

words, self-control is a necessary means to enable us to override undesirable thoughts, feelings, and responses, and to avoid temptation [8].

Temptations often come in the form of impulses. Such impulses are of course not always problematic, e.g. the impulse to drink a glass of water when you are thirsty. The impulses that are problematic are those that imply that living them out will be at odds with our personal (long-term) goals or standards. For example, the urge of having a cigarette may ruin your quit attempt and hence your highly valued, long-term goal of a smoke free life; the impulse of having a chocolate bar may be at odds with your long-term goal of loosing weight. In such situations successful self-regulation involves taking control of your actions and emotions, in order to ensure that you do "what is good for you" (in the long-term) instead of "what is good" (right now). Since relapse is so prevalent in behavioral change, this is oftentimes obviously not what happens.

Successful self-regulation is a multifaceted process. Unfortunately, many factors can contribute to a failure in self-regulation (for overview see [9]. One major account of self-regulation failure is an inadequacy in self-regulatory "strength". This implies that you are not able to mobilize (psychologically) what it takes to override unwanted thoughts, feelings or impulses [9]. According to this resource-depletion model of self-regulation a person at any time has limited amounts of generalized self-regulatory resources [9]. Accordingly, an initial act which requires self-regulatory resources, may be followed by a period of vulnerability, i.e. when self-regulatory resources are needed but depleted. Thus, if one, in this period of ego-depletion, is exposed to a situation (impulse) which requires effective self-regulation, then a failure in self-regulation is likely to happen because you are temporarily depleted on those resources (for overview see [6]).

People can be temporarily depleted or fatigued of self-regulatory resources, for example when they try to resist temptations, control their emotions or try not to act (automatically) upon their impulses [10]. For example, if you a few days into a smoking cessation attempt experience a problematic job situation (e.g. you get negative feedback from your boss) you may need to use self-regulatory resources to both cope with the resulting negative emotions and try to improve your performance. If you simultaneously or short after, are exposed to a temptation to smoke (e.g. is exposed to someone smoking a cigarette) then you are probably at risk to relapse because your self-regulatory capacities may be temporarily (partially) depleted.

Proposition: Digital interventions should address factors which cause slow oscillations in relapse proneness.

In order to understand the process of relapse, there seems to be a need for identifying the chronology of relapse risk forces, i.e. how the strength of the various relapse forces vax and vane throughout a change attempt. On the basis of much existing research it is likely that relapse proneness is both multi-faceted and follows a certain chronology. Hence behavioral change interventions should be designed accordingly.

More specifically, we know from certain areas that some relapse forces and risk factors may manifest themselves in slow oscillations in "relapse proneness" over time [11]. One framework (among many) that may provide an explanation on what causes these slow oscillations in relapse proneness is the cognitive-affective processes model (CAPS) [12]. In CAPS, the “know” is though to be specialized for thinking and it can

be characterized by words like "cognitive, complex, reflective, slow, develop late, attenuated by stress, and self-control". Related to behavioral change and maintenance this system may thus contain e.g. outcome and mastery expectancies, previous experiences with behavior, perceived social norms, personal values and goals, etc. Most psychologically oriented change interventions appear to address such cognitive processes. Hence we could say that they have contained components which have a psycho educational approach. This implies that they try to educate people who change about what to expect and how to handle difficult times. For example, you “learn” from for example self-help books to identify a goal structure, what the consequences of successful behavioral change are (likely) to be in the future "what is good for you"); your self-efficacy is boosted by persuasion (“you can do it”) or by means of progress reports, etc. You may also learn how (e.g. by means of cognitive behavioral therapy) to intervene on your thoughts, feelings and actions.

Proposition: Digital interventions should help people make implementation intentions.

An important characteristic of a digital intervention appear to be their potential help to prevent ego depletion in clients. An equally important characteristic would be the ability to offset the consequences of ego depletion (i.e. self-regulation failure) if and when it occurs. Webb & Sheeran [8] have shown that the formation of implementation intentions may help serve both needs.

Implementation intentions are sub-ordinate to goal intentions [13]. Thus, while a goal intention may be that “I will loose weight” an implementation intention is a statement of the form: “As soon as situation *y* occurs, I will initiate goal-directed behavior *x*”. By specifying the coping response (goal directed behavior), before the situation arises, one assumable passes control of behavior to specified cues (e.g. feeling an urge to eat a chocolate bar) to the environment. Time, place and situation hence are cues that automatically activate the relevant coping response. The idea is that this probably implies that the need for cognitive control is circumvented, a process called “strategic automatization” [8].

Additionally, when the client experiences temptations, i.e. close call situations in which the client is brought to the brink of relapse, the occurrence of relapse seem to be influenced by the clients coping responses. In this respect, the use of both cognitive and behavioral coping strategies seem to effectively prevent relapse in such situations (for overview see [14]), which is why behavior change programs typically aim to prepare people by improving their coping resources. It seems reasonable to expect that although interventions which improve the clients coping resources in general (pre- and post-change self-efficacy) may be justified, intervention elements which support adequate coping in close call situations would seem particularly promising.

Proposition: Digital interventions should offer instant, just-in-time therapy in order to prevent relapse due to sudden spikes in relapse proneness.

It appears important to take into consideration that profiles of relapse proneness often vary considerably across time, situations and persons (see for example [15,16]. Focusing the dynamics and consequences of “sudden spikes” in symptomatology and relapse proneness may provide important insight about successful change. In the CAPS framework such sudden spikes are conceptualized as being part of the "go

system" [12]. Sudden spikes in relapse proneness can be considered as parts of the "hot emotional system", specialized for quick emotional responding on the basis of situational (originating from outside or inside the individual) triggers. Such "hot spots" can characterized by such words as "emotional, go, simple, reflexive, fast, develops early, accentuated by stress, and stimulus control" [12].

These peaks in relapse proneness seem to be difficult to predict. They may occur suddenly and in many cases they disappear after a relatively short period of time. Hence coping with them can't wait until you have gotten home and have consulted your self-help material (or until next week when you have your next your group-therapy class). The peak in symptoms is a "close call situation" that must be dealt with "asap"; i.e. relevant help and support should be available whenever and wherever you need it. Thus, more effective digital interventions are likely to offer support or therapy which is available just before, during, and after a peak in relapse proneness.

Proposition: The just-in-time therapy that digital interventions offer should help individuals tackle the experience of negative affect.

The next question which arises is then of course what kind of treatment that should be available at the "close call" situation. Generally, it seems reasonable that the content of the treatment should reflect what the client experience psychologically during a peak in relapse proneness. In this respect it seems relevant to point to the fact that a considerable amount of research has testified to the important role that negative affect seem to play in relapses (for research on smoking and dieting see for example [17,18]. It seems reasonable to expect this to be the case in a number of different behavioral domains; hence negative affect seems to play an important role for relapse.

As a corollary, it seems pertinent to consider negative affect to be both as a proximal predictor of relapse and a mediator and/or index of the processes that yield relapse vulnerability (see for example [11,17]. Thus, in addition to its own unique contribution, negative affect seem to mediate and moderate the impact of a number of both pharmacological and non-pharmacological events and processes upon relapse proneness. A number of explanations which may possibly account for the causal mechanisms which may underlie the relationship between negative affect and relapse proneness have been offered (for overview see [18]. Although further research into these specific mechanisms is welcomed, it seems that we know enough to suggest that more effective behavioral change interventions probably should include some elements that can effectively help individuals tackle the experience of negative affect – whenever and wherever negative affect is experienced simultaneously with an urge to relapse.

One possible mechanism is that negative affect either signals and/or is a mediator/moderator of ego-depletion. Whatever the causal mechanisms are [19]. (Tice et al) a dose of positive affect could apparently be prescribed as the best medicine (in addition to sleep and rest) (see for example [19,20].

Proposition: Digital interventions should utilize recent insights from positive psychology.

A change process is often motivated by long-term goals that we have. People want to control their blood pressure, loose weight, drink less alcohol, stop smoking, get better grades, have a better marriage, etc. In many cases, the achievement of such long-term

goals involves that we must abandon choices and behaviors that normally give us pleasure and positive affect on a short-term basis (having a drink, having a cigarette, eating a chocolate, etc.). Hence in many situations effective change involves that behaviors which lead to the attainment of long-term goals (reduce your cholesterol level) override behaviors that relates to short-term goals (enjoying a fatty meal).

Often, the attainment of long-term goals are based on cognitions about "what is good for me", while the attainment of short-term goals are more often based on affections about "what is good". Accordingly, to be able to change successfully in the long run, we must regulate ourselves in the service of our long-term goals. As described above, this often involves effort, self-monitoring and vigilance. In particular in order to resist temptations, impulses or particularly demanding situations. Thus, in the middle of a change attempt we may feel "drained of change energy", or ego depleted. In such a situation the "change muscle" may have become tired or exhausted, and the change attempt is at risk for a breakdown.

Importantly, ego depletion, and a breakdown in self-regulation, often occurs in combination with negative emotions. Hence negative emotions may cause, contribute to or be an effect of self-regulation breakdown. Often, negative emotions are also caused by the fact that behaviors that we have valued cannot longer be performed (having a drink, having a cigarette, having a cake, etc.).

Consequently, the client would benefit from not only having a behavior change intervention, and support to self-regulate successfully, but also interventions that may help him/her to feel better, be more happy, and value life positively even after the behavior change has been initiated. The theoretical basis for such interventions can be found in the field of positive psychology. Positive psychology is an umbrella term for the study of positive emotions, positive character traits, and enabling institutions [21].

There is good reason to expect that people, who are striving to change important aspects of their lives, will benefit from positive psychology interventions. It is likely that interventions that install positive affect will both increase the likelihood that the change attempt itself will be successful and give the client a better life during the change process. Hence interventions should capitalize on what we know about "affect regulation" (we use the term to subsume the management of subjective feeling states in general). The reason is that affective states influence subsequent behavior, experience, and cognition [22]. So one function of affect regulation is to limit the residual impact of lingering emotions and moods on subsequent behavior and experience. Certainly, feelings provide important information to a person and serve to direct subsequent thought and behavior in mostly adaptive ways.

Future digital health and well-being interventions should include intervention elements that are based on a number of affect regulation strategies. These specific strategies would probably reflect one of four general classes of affect regulatory strategies: those strategies that are either behavioral or cognitive, and are focused on changing the situation or the emotion [23]. Most likely, interventions should aim at influencing both NA and PA. However, negative life events have a stronger impact on subjective feelings than do positive events [24] and NA is two to three times stronger than PA [23]. Additionally, change reactions and consequences (e.g. ego depletion and relapse) are often paired with the experience of NA. Still, the increase in PA is also an important goal of digital interventions, since people in their daily lives often try to induce or maintain PA [23].

3 Digital Health Interventions: Reaching and Holding the Audience

Proposition: Digital interventions should be designed with the explicit purpose of holding the interest of the user.

It takes time to change one's habits or personal characteristics. For example, people who quit smoking are at substantial risk of relapse for at least one year after quitting. Hence to be effective, digital interventions should be able to hold the interest of the user over time. Empirical studies have demonstrated this to be a potential serious short-coming digital health interventions (see for example [25,26].

So what keeps users coming back to a program (day after day, week after week, and months after months)? One could think of at least two main reasons. First, users have a primary need that is sought satisfied by initially taking up the program. This need is fuelled by the fact that the program is seen as a useful tool to help reach a valued personal goal (change in health behavior, well-being, etc.). The motivation for both initial and continued use may hence be the expected utility of use. Most probably, continued use is heavily influenced by experienced utility (which fuel expected future utility). Hence to ensure long-term use, digital interventions should be constructed to optimize subjective expected utility, i.e. to be judged by the client to help her to achieve her goal that motivated initial use of the intervention in the first place (more on this below).

However, media choices are affected by both individual needs for information and stimulation [27]. To better understand continued use of digital health interventions, research should consider additional motives to "instrumental" use, i.e. motives other than the expected completion of the initially intentional goals. Specifically, what are the "experiential" reinforces for continued use? To what extent do latent gratifications motivate continued or increased use? Consequently, it seems important to address more broadly the psychological (and social and cultural) needs that contribute to media choice and use. In other words, one has to search for the correlations between observed gratifications and the psychological origins of the satisfied need. Hence one must fully recognize that both affective and cognitive states influence media usage. In this context it seems important to take into account that the initially sought-after gratifications may be different from the gratifications that are actually received [27]. For example, there is every reason to expect that digital interventions (e.g. web based interventions) must fulfill user's expectations that use must provide entertainment and relaxation [28], and we would add positive affect (see above).

Proposition: Digital interventions should be constructed according to the principles on what constitute a successful information system.

There is an apparent need to more systematically approach digital intervention in the health and well-being domain as information systems. To this end, the Information systems success model [29] may offer a promising point of departure. According to this perspective, six categories of characteristics should be assessed to determine the success of an information system: 1) system quality, 2) information quality, 3) use, 4) user satisfaction, 5) individual impact, and 6) organizational impact. The system's quality refers to the technical accuracy and efficiency from which the information

system produces the information, and is generally assessed by means of e.g. response times, reliability and usability measures. Information quality refers to the system's ability to successfully convey the intended meaning (i.e. semantics). Measures of information quality assess the perceived quality of contents, accuracy, timeliness, relevance, etc. Finally, use, user satisfaction, individual and organizational impact; reflect the effect that the information has on the user. These categories can be assessed, for instance, by measuring the amount of time spent (e.g. on a website), user satisfaction ratings (e.g. confusing or clear instructions), instrumental support in decision making and responsiveness (e.g. behaviour change). Future design and research on digital interventions should address these issues more thoroughly.

Proposition: Digital interventions should be constructed to produce an emotional impact.

Can digital interventions be designed so that they are to use and understand, and also have an emotional impact? According to Norman [30] emotional design is dependent on a balance between three levels of design: the basic level, the behavioral level and the reflective level. The basic level is dominated by the physical features – look-and-feel, the use of images, sounds, colors, etc. Information processing at this level is considered to be automatic due to the fact that we from an evolutionary perspective are attracted to objects that are simple, symmetrical, harmonious, balanced and proportional. At the behavioral level one is concerned with how the use of the product (outside explicit awareness) is perceived by the client in terms of for example functionality, comprehensibility, user friendliness, and the physical perception of the program. At this level is considered of primary importance that the program provide feedback to the client (see below on interactivity). The reflective level is related to the construction of meaning of program use, on behalf of the user. Particularly important features are program and client identity congruency, the experience of personal touch (e.g. personalization) and mastery of program use (see above on successful information systems). We know much too little today about how digital health interventions could capitalize on "emotional design". But we know enough to suggest that "emotional design" is likely to contribute to initial and continued use, as well as effect of digital interventions. For example, increased interactivity seems to improve the emotional quality of the product [30].

Proposition: Digital interventions should be constructed to increase interactivity.

To the extent that interactivity can increase user involvement is must be considered a critical characteristic of a digital intervention. Most often change involves a considerable effort and involvement by the client. Although the change program will contain information, tasks and advices, successful change depend on the active involvement and participation of the client [7,31]. On the one hand this involves that the client comply with recommendations in terms of following the program closely; reading, thinking, doing, etc. as advised in the program. On the other hand, active involvement is necessary for effective self-monitoring to take place, selection of situations to be effective, appropriate handling of impulses to be initiated, etc. Specifically, for such change elements that are based on client input (feedback, progress reports, relapse prevention, etc.) to work appropriately, it is necessary that the client adhere and actively take part in the change program.

As discussed above, many changes require long-term maintenance in order to be successful. Furthermore, individuals must be able to gauge their progress against some frame of reference, which might include their own change plan (hold against their own prior history), the behavioral progress of others who are in a similar situation to themselves, or a regimen from a trustworthy source. In other words, efforts to change are likely to be successful when individuals receive timely monitoring and feedback on their progress. With such feedback, individuals can be motivated by their own achievements. They can modify their strategies and gauge the proximity of their goals. Research indicates that changes are much more likely to occur when interventions include a significant feedback component [32].

The effectiveness of feedback can be enhanced in three ways (for a more detailed description of these principles see [33]. First, the program should pay attention to motivators and reinforces that are personally relevant to the client (see below). Second, the program should make use of personalized self-evaluation and self-assessment techniques. Third, the program should stimulate the client to actively participate. For example, the client could be prompted to provide data about motivation, progress, etc. on numerous occasions before and throughout the program. On the basis on this collected user data, the program could provide three kinds of feedback; personal, normative and ipsative. The personal feedback provided to the client is based on his/her individual responses. For example, these types of feedback include the pointing out of the individual's risk status. The normative feedback is information of how an individual compares with others, for example how the client's risk status compares with others. Finally, ipsative (iterative) feedback is provided by representing information which compares the client's current and prior states. One example is that the client receives information of the development of the individual's risk appraisal over time (but also information on achievements, money saved, increased life expectancy, etc.). Hurling and colleagues [34] have provided empirical data which demonstrate the importance of interactivity in digital health behavior interventions. They showed that more interactive systems were judged by the client to be more engaging (increased user retention) created higher expectations for behavior change, greater satisfaction with motivation and improved self-perception related to behavioral change.

4 Conclusions

We know much too little about how to design effective digital interventions to support sustained behavior change and improved well-being. What we know is that cutting edge psychological theory and research is likely to represent a rich source of relevant knowledge. We have used this source to express 18 propositions which relate to the "content" and "design" of digital interventions. The list of propositions is by no means considered to be exhaustive or final. The propositions may help assist current design of digital interventions. They do, however, also represent research questions that should further developed and addressed to help establish a theoretical basis for the construction of digital interventions.

University people are often said not to be too concerned with "if things work in practice". Oftentimes we think it more interesting to discuss "if things work in theory". This was also, at least to some extent, the point of departure of the present paper. It primarily discussed how and why digital interventions designed to support

self-regulation in the service of behavior change should work "in theory". This endeavor was clearly inspired by the famous social psychologist Kurt Lewin's [35] saying that "there is nothing as practical a good theory". However, it is less well known that Lewin [36] also expressed that the best way to understand a psychological phenomenon is to try and change it. Hence intervention research and practical design experience is not just something that follows basic research at a polite distance, but rather is its inherent complement [37].

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The Persuasive Power of Human-Machine Dialogue

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Abstract. The persuasive power of live interaction is hard to match, yet technologies are increasingly taking on roles to promote behavioral change. We believe that speech-based interfaces offer a compelling mode of interaction for engaging users and are motivated to understand how to best present persuasive information using speech interaction. We present a study comparing the persuasive power of two speech-based information systems, one which uses a recorded message-based lecture presentation and another which uses an interactive dialogic presentation. We measure the persuasive power across both conditions using a survival task. We find that the dialogic system is significantly more persuasive than the lecture system. We also find that the dialogic system presents significantly (almost four times) less information than the lecture system. We analyze our results using three standard rank correlation methods. We point to limitations of these measures and propose a new metric which appears to be more sensitive for this task.

1 Introduction

Live, face-to-face interaction is inevitably the most powerful medium for persuasion. But for human-machine interaction, especially using new technologies such as cell phones and Interactive Voice Response systems, can we recreate some of the important persuasive aspects of live communication? In this paper we study the value of spoken voice presentation and contrast a *dialogic* presentation with a *lecture* presentation. In the dialogic presentation, the persuading system makes short utterances in response to the user's prompts. In the lecture presentation, all the information needed to persuade the user on one point is included in a message containing multiple short utterances. The presentation of information for persuasion is a growing area of interest in all sorts of domains, such as physical health, environmental consciousness, finance management etc. The wide range of applications for persuasive information presentation serves as motivation to examine the effects of interaction mode on persuasive power.

In our study, we measured the persuasive power of two speech-based interaction modes with 52 subjects. We compared two systems, one which used speech by playing recorded messages (output only), and the other which simulated dialogue with the user (with input also using the Wizard of Oz technique). Both systems contained the same set of sentences recorded by the same actress; they differed only in the way these sentences were grouped and presented to the user,

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and in the need for user prompting in the dialogue case. We used the NASA Moon Survival Task [8] as a method to measure persuasion and used four different methods for analysis. Using all four methods of analysis (three standard and one novel) we found that the dialogic system is significantly more persuasive with ($p < 0.05$) than the lecture-style system. We also found that the dialogic system presented significantly less information (almost four times less) than the lecture system.

We begin with a section on related work. We then discuss the Moon Survival task, followed by a description of the systems we designed for the study. We then describe how we measured persuasion through a detailed analysis of a new rank correlation method as compared to more standard methods. This is followed by the study design, results, discussion and conclusion.

2 Related Work

2.1 Elaboration Likelihood Model

The Elaboration Likelihood Model (ELM) has become an important model for understanding persuasive message processing [13]. The model describes two routes to persuasion - central and peripheral. In the central route, persuasion occurs as a result of effortful processing of information in a persuasive message, where one applies one's own knowledge to rationalize attitude change. Central processing often occurs when the information presented is considered personally relevant. Peripheral persuasion, however, occurs from a more low-effort attitude change, which happens as a reaction to external cues of a persuasive message rather than to the actual information presented.

In the long term, attitude changes due to the central route have been proven to have greater temporal persistence, stronger resistance to counter persuasion, and higher prediction of behavior than those changed via the peripheral route [12]. For example, psychology studies have shown that when subjects play an active role in arguing for or discussing an issue, their attitudes are more persistent than subjects who passively hear a communication about an issue instead [6]. This provides motivation to explore modes of interaction via speech-based interfaces that may potentially engage the user more actively.

2.2 Computers as Social Actors

Nass and Brave have worked on understanding how humans react to computer voices, synthesized and recorded [10]. They have looked at the impact of peripheral cues such as gender, personality, accents and emotion of computerized voices on self-reported measures of likeability, trustworthiness, informativeness, competence, credibility etc. of the voices. In all these studies, subjects tended to rate the synthesized voices in the same way as recorded voices, perceiving the voice as a social actor with social attributes [11]. This suggests that inherent cues

in speech can "humanize" an interaction with a computer voice and potentially encourage peripheral processing of persuasive messages. However these studies do not focus on the effects of actively engaging the user in dialogue as we do in this study.

2.3 Tailored Information

One benefit technology offers for information presentation is the ability to tailor information according to some characteristics of the user. This has been explored extensively using presentation of text information [5] [2] [3], and personalization of information and feedback has been shown to cause more positive changes, especially in health behavior. These results suggest that a dialogic question-answer based information system can show similar results by allowing users to "self-tailor" information they receive. The Digital Therapy Developer (DTD) [9] is a toolkit for designing behavioral change programs using interactive media that are tailored to an individual's psychological process of change. Although the DTD has been utilized for different types of interaction (web, e-mail, cellphones, text-messaging) there is no reported comparison of persuasion across interaction modes.

Information tailoring is also rationalized by the ELM [3]. Personal relevance increases one's motivation to pay attention to, comprehend and mentally elaborate on the information, thus leading to a more focused and effective communication. We believe that dialogic systems could encourage this same behavior by presenting short bits of relevant information through an interaction entirely guided by the user.

3 The NASA Moon Survival Problem

The NASA Moon Survival Problem is a problem-solving task widely used for measuring group decision making and persuasion [8]. In this task, the participant imagines that he/she is a member of a space crew and is scheduled to rendezvous with the mother ship, but the spaceship crashes on the moon 200 miles away. During the crash, everything is destroyed apart from 15 items, listed in Table 2. The participant is given the task of ranking the items from 1 to 15 according to their importance for survival on the moon. Although this task is commonly used to study effects within groups, in our study the participant was asked to do the task first individually and then with the help of an information system. The system was a confederate in the experiment, providing arguments for a particular ranking of the items of which only a subset was based on fact. We drew arguments for the system to use from previous versions of this experiment used to measure persuasion under teleconferencing conditions [14] [1]. The participant was asked to rank the items before and after his/her interaction with the system. We used this task to measure the persuasive force of the system on the participant's ranking of the items.

4 System Design

The information presented by both systems we designed was the same, differing only in interaction mode. We asked a professional actress who resides in the area to record four to six statements regarding each of the 15 items in separate clips. The scripts were written in the first person, as if the voice was stating a personal opinion. Each statement confidently stated some information about the item, or suggested a rank for the item relative to at least one other item on the list. For one system, we concatenated the four to six statements into one long audio clip and played this back as a recorded message about each item. In the other system, for every question a participant asked, exactly one relevant statement (of the four to six) was played back as a response.

4.1 Recorded Message System

The Recorded Message system (RM) was designed as a basic GUI with 15 buttons, each labeled with the name of one of the 15 items to rank. When a button was pressed, the recorded message containing four to six statements corresponding to the item was played back. (See Table 1 for the recorded message played for the *50 ft. of nylon rope*).

Table 1. Sample interactions for the RM and ID systems. Messages are identical, but grouped and presented differently.

Recorded Message System	**Interactive Dialogue System**
We can definitely make use of the rope in multiple ways. We could use it to scale cliffs. We can also, say if one of us gets hurt, tie our injuries together. We could find plenty of uses for this, so it should definitely at least be somewhere in the first half of the list, after the radio and pistols.	*Participant: What can I use the rope for?* *System: We could use it to scale cliffs.* *Participant: Where should I rank the rope on the list?* *System: We could find plenty of uses for this, so it should definitely at least be somewhere in the first half of the list, after the radio and pistols.*

4.2 Interactive Dialogue System

The Interactive Dialogue (ID) system utilized speech input as well as output. This system was a basic GUI with just two buttons, “Record” and “Stop” which implemented what appeared to be a push-to-talk speech recognition system. However, the recognition was performed using the Wizard of Oz technique. In order to access information, the participant could speak any question into the microphone. The question was sent over the network to the experimenter’s computer in an adjacent room. The experimenter selected the most relevant response from all of the recorded four to six statements for each item. This statement was played back on the participant’s machine. Thus, the responses played back in

the ID system were the exact same recordings that were used in the RM system, only they were played in shorter segments. A sample interaction for accessing information about the *50 ft. of nylon rope* is seen in Table 1.

In addition, the actress also recorded some filler phrases which the experimenter played back if no other phrases were appropriate, such as *"yeah"* or *"okay"*. There were also some clarification phrases, such as *"What did you say?"* If the question did not have an appropriate response (i.e. what's the weather on the moon), the experimenter would choose the response *"Hmm...I don't know."* Other than these fillers, the information presented in the ID system was a subset of the information presented in the RM system.

5 Persuasion Measures

5.1 Expert and Confederate Rankings

A published expert solution given by the Crew Equipment Research Section at the NASA Manned Spacecraft Center ranks the items in a particular order, shown in Table 2 [14]. Previous studies have considered the quality, Q of a solution as its correlation with the expert ranking (E), and have shown that participants generally start with a pre-interaction ranking close to E [14]. One measure of persuasion captures the participant's movement away from the expert between the pre-interaction and post-interaction rankings, or the decrease in quality of the solution.

The system (confederate) argued for a particular ranking of the items in the order shown in Table 2, which we call C. Another dimension across which we measure persuasion is the movement of the participant's ranking towards the confederate's solution when comparing his/her pre-interaction and post-interaction rankings.

Table 2. NASA Expert (E) and Confederate (C) rankings of 15 items

Rank	Expert NASA Ranking (E)	Confederate Ranking (C)
1	2 hundred-pound tanks of oxygen	2 hundred-pound tanks of oxygen
2	5 gallons of water	Signal flares
3	Stellar map (of moon's constellations)	Magnetic compass
4	Food concentrate	Food concentrate
5	Solar-powered FM receiver-transmitter	Solar-powered FM receiver-transmitter
6	50 ft of nylon rope	Two .45 caliber pistols
7	First aid kit with injection needles	50 ft of nylon rope
8	Parachute silk	First aid kit with injection needles
9	Life raft	Stellar map (of moon's constellations)
10	Signal flares	1 case of dehydrated pet milk
11	Two .45 caliber pistols	5 gallons of water
12	1 case dehydrated pet milk	Portable heating unit
13	Portable heating unit	Parachute silk
14	Magnetic compass	Life raft
15	Box of matches	Box of matches

5.2 Standard Rank Metrics

In order to assess persuasion, we want to compare the user's ranking with the expert and confederate, both before and after the persuasion event. We expect to see movement in the user's final ranking toward the confederate and away from the expert, compared to their original ranking. We can use standard rank correlation methods (Spearman Rank Coefficient, Spearman's Footrule or Kendall's Tau) in order to measure the similarity between two rankings. For a correlation coefficient $C(u, v)$ between rankings u and v, there is a natural distance measure $d(u, v) = 1 - C(u, v)$ which increases with distance between the rankings and is zero when they are the same. To assess the change in distance from the expert, we might compute $d(u^+, E) - d(u^-, E)$, where E is the expert's ranking and u^- and u^+ are the user's ranking before and after the persuasion event, respectively. In practice, user rankings are much closer to the expert's rankings than to the confederate's [14]. So the distance between users and the confederate is much larger than the distance from users to expert. It follows that the relative change in pre-post distance is larger relative to expert than confederate, and it is easier to detect the change with a statistical test relative to the expert.

In particular, the Spearman Rank Coefficient was used in previous examples of this experiment [14]. However, there are statistical problems with using parametric tests such as t-tests on non-parametric rank correlations in low dimensions such as we have here. In our application, the dimension is the number of items to be sorted, 15. Rather than a single correlation, an in-depth study of various rank measures in [4] recommends using multiple rank correlation measures. So we add two more commonly-used measures, Spearman's Footrule and Kendall's Tau [4]. Spearman's Footrule in particular was shown to have better performance on random rankings in low dimensions. There is still the problem of applying parametric t-tests to the rankings, since the latter are non-parametric. To guard against errors, we also ran non-parametric permutation tests [7].

5.3 A New Measure

We so far considered rank changes between expert and confederate. But neither are really satisfactory since we are interested in the movement away from expert *and* toward confederate. This suggests the development of a new statistic. One natural measure would be the cross correlation between the before-after rank difference, and the expert-confederate rank difference. i.e.

$$DL_i = \frac{1}{\lfloor n^2/2 \rfloor} \sum_{j=1}^{n} (c_j - e_j)(a_{ij} - b_{ij}) \tag{1}$$

where DL_i is the statistic for user i, c_j and e_j are confederate and expert rankings respectively for item j, and a_{ij} and b_{ij} are after and before ranks respectively for item j by user i. This distance measure is equivalent to (a constant multiple of) the following expression in terms of Spearman distances:

$$D_i = \rho(c, b) - \rho(c, a) - \rho(e, b) + \rho(e, a)$$

however, a weakness of equation 1 is that it weights different rank differences $(a_{ij} - b_{ij})$ by different weights (the $c_j - e_j$ weight). Using different weights has two consequences: the first is to reduce the tendency of the sum to a normal distribution - this is fastest when the sum adds identically-distributed items. The second is to weight the large rank shifts more heavily in the sum. This is reasonable if users make similar shifts in their own rankings. However, most users start with rankings fairly close to expert rankings. Making large shifts in the rankings of items (away from the expert) is presumably difficult for users since it fights their own intuition. So rather than using a full weighted ranking, we propose to use only the sign of the expert-confederate difference:

$$DS_i = \frac{1}{\lfloor n^2/2 \rfloor} \sum_{j=1}^{n} \text{sign}(c_j - e_j)(a_{ij} - b_{ij}) \tag{2}$$

We might be tempted to further eliminate distance information and take the sign only of $(a_{ij} - b_{ij})$. However, this disregards most of the usable bits in the distribution of user ranks, making statistical estimates much more noisy. Since the term distributions are concentrated at one, two or three values, it also impedes convergence of the sum toward a normal distribution. When we present our results and analysis later in this paper, we will compare the DS measure with the other standard measures we have discussed.

6 Hypotheses

Hypothesis 1: The interactive dialogue system will be more persuasive than the recorded message system. We hypothesize that by interacting with participants through a mode more natural and conversational, the dialogic system will be more persuasive than the message system.

Hypothesis 2: Participants will receive less information in the interactive dialogue system than in the recorded message system. Since the participants guide the interaction in the dialogue system through their questions, we hypothesize that they will hear less information than the participants using the recorded message system.

7 Study Method

7.1 Participants

Participants were recruited using services provided by the eXperimental Social Science Laboratory (XLab) at the University of California, Berkeley. The Xlab sends out a recruitment message for scheduled experiments to a database of regular volunteers. Subjects opt-in voluntarily via a calendar of scheduled sessions. There were a total of 52 participants, with 21 male (40%) and 31 female (60%). Of the participants, 46 were students (88%) and 6 were staff members

(12%). The average student age was 21 and the average staff age was 33. 28 participants were assigned to the ID condition and 24 to the RM condition in a between-group design.

7.2 Conditions

Recorded Message System. 24 participants took part in the RM condition in two one-hour sessions. In each session, 12 participants sat in a large room at laptop stations separated by dividers. Each participant worked individually and was isolated from the other participants.

Interactive Dialogue System. There were 28 participants in the ID condition. Each one-hour session consisted of only one participant who sat in a small room alone. The experimenter controlling the Wizard of Oz system sat in the neighboring room.

Although it would have been ideal to test both systems in identical conditions, some differences were unavoidable. The experimenter needed to control the Wizard of Oz system for each of the ID participants, so those sessions had to be conducted individually. However, limitations on usage of the XLab facilities made it impossible to test the RM system individually as well. For this reason, we attempted to create similar settings by isolating the RM participants with dividers and minimizing the distractions from others in the room.

7.3 Measurement Instruments

Persuasion Measure. We use and compare four methods to measure persuasion in this study: the Spearman Rank coefficient, the Spearman's Footrule, Kendall's Tau and finally the new measure DS. Because rank analysis methods are not robust to all types of data, it is common to use multiple methods for analysis.

Information Measure. We measure the amount of information heard by the participant by counting the number of statements that were played back by the system by reviewing logs of each participant's interaction. In the RM system, although the full message is played back at once, we count the number of statements made within the message, i.e. the oxygen message contains six separate statements.

Post-Session Questionnaire. After the study, participants were asked to fill out a questionnaire about their experiences interacting with the system. There were ten Likert scale questions with responses on a scale of 1 (strongly disagree) to 5 (strongly agree), in addition to seven open-ended questions asking them to describe their interaction.

7.4 Procedure

Each session lasted one hour. The conditions to be run at each scheduled time slot were predetermined by the researcher, so participants were automatically

assigned a condition when they signed up. They were not aware of the multiple conditions.

Anyone who was familiar with the task was turned away but given $10 for showing up. Participants spent five minutes reading over consent materials, and filling out a short demographic survey.

Next, participants were asked to imagine that they were members of a space crew whose ship had crashed, and that they had the responsibility of ranking the surviving 15 items according to their importance for survival. They were given a written copy of the instructions, a table in which to write their solutions, and an envelope with 15 slips of paper with each item written on it. They had plenty of desk space on which to move the slips around while they came to a decision. In both conditions participants worked alone and spent 10 minutes on the task.

After 10 minutes, the researcher collected their solutions. Participants were told that there was an actual optimal ranking of these items that was going to ensure their survival. They could now access some information regarding the items and how to rank them using a computer system. In the RM condition, they were told they could click on the GUI buttons to hear information about each item through headphones. In the ID condition, participants were told they could ask any questions about the items and how to rank them into the microphone and that they would hear a response through the headphones. The researcher demonstrated the use of the "Record" and "Stop" buttons. All participants were given a copy of written instructions as well. Participants kept the slips of paper to keep making changes to their orderings, but were not yet given a table to record their final solution. They had 20 minutes to interact with the system. In the ID system, the researcher listened to the participants' questions and chose appropriate responses from the short statement clips (as described in the system design section). However, participants were not told that the system was not automated.

Twenty minutes later, participants stopped and recorded their final rankings in a table. They were given 5 minutes for this task. At this time, they were reminded that their compensation would be scaled by their correlation with the optimal solution.

After this, participants were given 10 minutes to fill out the post-session questionnaire.

At the end of the experiment, participants were shown the expert solution. Those in the ID condition were debriefed about the Wizard of Oz system. Participants were paid $15 for their hour of participation, and in addition earned between $0 and $4 scaled by the average correlation with E of their pre-interaction and post-interaction rankings.

8 Results

8.1 Comparison of Systems

We first tested that there was no difference between the pre-interaction solutions across both conditions. This serves as a baseline to examine the changes seen

Table 3. Cohen's d effect size, normalized $(\mu_{id} - \mu_{rm})$, between RM and ID. Persuasive force is individually calculated using the four rank correlation methods.

Measure	Effect Size	t(50)	P-value (t-test)	P-value (Perm)
DS	0.5977	-2.165	$p = 0.0176$	$p = 0.0181$
Spearman Coefficient	0.5011	-1.813	$p = 0.0379$	$p = 0.0380$
Spearman's Footrule	0.5849	-2.125	$p = 0.0193$	$p = 0.0191$
Kendall's Tau	0.4612	-1.668	$p = 0.0507$	$p = 0.0527$

after the interaction. As expected, and consistent with previous studies [14], for all three correlation methods, with a t-test assuming equal variances, we saw no effect of condition on the correlation of pre-interaction and expert solutions.

We use three standard rank metrics and the new *DS* to analyze the persuasive force. As explained in Section 5.2, the standard metrics use correlation between the user's ranking and E only, but *DS* uses both E and C. We report the Cohen's d effect size for the persuasive force of both systems, $(\mu_{id} - \mu_{rm})/\sqrt{\sigma_{id} + \sigma_{rm})/2}$, where μ and σ are the mean and variance of the persuasive force in each condition. Results of a one-sided t-test assuming equal variances with $\alpha = 0.05$, and a Monte Carlo permutation test with 10 million random samples are in Table 3. With all four methods, results show that the mean persuasive force is greater in ID than in RM (normalized $(\mu_{id} - \mu_{rm}) > 0$), and this result is statistically significant with $(p < 0.05)$. The p-value varies across methods, confirming that some rank correlation methods may be more sensitive on this data.

8.2 Amount of Information Heard

Using a one-sided t-test assuming equal variances, we find that participants heard significantly more information (on average, 102 more statements) in the RM system than in the ID system, as shown in Table 4.

Table 4. Cohen's d effect size in amount of information heard measured between conditions

Effect Size	t(50)	P-value from t-test
3.223	-12.58	$p \simeq 10^{-17}$

8.3 Post-Session Questionnaire

We tested our post-session questionnaire results across conditions using a t-test assuming equal variances and $(\alpha = 0.05)$. We found that participants in the ID condition enjoyed interacting with the system significantly more than those in the RM condition, with $(p < 0.05)$. Participants in the ID condition also reported that they found the voice to be credible significantly more than those in the RM condition, with $(p < 0.05)$. We found no significant difference across the conditions in how useful participants found the system in helping rank the

items, how believable the arguments were, how much the system clarified doubts, or how they felt about changing their minds about rankings.

9 Discussion

9.1 Revisiting Hypotheses

Hypothesis 1: The interactive dialogue system will be more persuasive than the recorded message system. This hypothesis is supported by the results. When using all correlation methods, our results show that the ID system is significantly more persuasive than the RM system. The results also suggest that the new *DS* metric may be a more sensitive measure for this type of experiment, but further cross-validation is still necessary to evaluate the method completely.

Hypothesis 2: Participants will receive less information in the interactive dialogue system than in the recorded message system. This hypothesis is supported by the results. In the given interaction time, participants using the ID system heard significantly less information than those using the RM system. Therefore, the actual duration of time for which the ID participants heard persuasive messages was significantly shorter.

9.2 Future Work

Participants in the ID condition rated the voice to be credible more than participants in the RM condition. Several participant's questionnaire responses expressed surprise at the computer's relevant responses; this could be due to the novelty effect of interacting with a natural language speech recognition system. The results are promising, but we still need to validate these results with an automated system to eliminate any biases of the Wizard of Oz method, including experimenter bias, and the possibility that participants suspected the technique.

We are also interested in further validating our results in other contexts. Since different factors could affect the results, we are interested in replicating this experiment with different tasks in other domains (such as health) to further understand the relation between information presentation and persuasion.

10 Conclusion

In this paper, we described a study comparing the persuasive power of two speech-based interaction modes. We found that a dialogic style of presenting information is significantly more persuasive than a lecture style. Our results suggest new motivation for using dialogic, speech-based interfaces for the design of persuasive technologies. As promoting healthy practices continues to be an issue of concern, using appropriate technologies for persuasive information presentation in many domains looks promising. Specifically, persuasive technologies can play a significant role in suggesting, motivating and advocating certain behaviors. Our results show that dialogic, speech-based systems could offer an advantage to the effectiveness of such technologies.

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Designing Persuasive Dialogue Systems: Using Argumentation with Care

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Abstract. Persuasive dialogue systems that aim to change people's attitudes and behaviours have drawn much attention in recent years due to their great practical potential. Current systems rely heavily on argumentation and advice-giving to form their persuasive messages. Many findings in psychology, and some counselling intervention methods such as Motivational Interviewing (MI) dispute this confrontational approach. Our project sets out to investigate whether MI can provide an alternative way to develop a more effective system. In this paper, we discuss the limitations of the argumentation-based approach, review a number of argumentation-based systems, and present the results of an evaluation study which compares people's perception of the persuasibility of two argumentation-based dialogues and a MI-based counterpart. Our results show a higher perceived persuasiveness for the MI-based dialogue.

Keywords: persuasive dialogue systems, argumentation, motivational interviewing.

1 Introduction

Persuasive dialogue systems influence the users' attitudes or behaviours by communicating persuasive messages to the users. Current systems mainly use a combination of two forms of persuasive messages: advice and argument. While the former aims to educate and inform the users of new information, the latter aims to defeat the users' existing beliefs. We will refer to this combination of advice and argument as the *argumentation-based* approach. This choice seems reasonable considering they are the most common forms of persuasive messages used in consulting behaviour and discussions on behaviour change [1,2]. The logic of this approach is that people change their beliefs towards a new behaviour if they receive and accept information about the advantages of adopting that behaviour, the disadvantages of staying with the old behaviour, and suggestions to overcome their barriers to adoption and maintenance of the new behaviour [3,4]. These beliefs then change their attitudes towards the new behaviour, which in turn cause the adoption of the new behaviour. [5]. Despite its popularity, many findings in health communication research [6,7], psychology [5], and some counselling intervention methods such as *Motivational Interviewing* [8] dispute this confrontational approach.

In this paper, we will discuss the limitations of the argumentation-based approach in Section 2, review some of the argumentation-based dialogue systems to date in

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Section 3, and explain how MI can overcome these limitations in Section 4. This will be followed by a discussion of our experiment in Section 5, in which we compare people's perception of the persuasiveness of two argumentation-based dialogues and a MI-based counterpart. Section 6 will discuss two early MI-based systems, while Section 7 will summarise our findings and conclusions.

2 Limitations of the Argumentation-Based Approach

Despite a positive correlation between acceptance of an argument and change in beliefs and attitudes, especially when the argument is relevant, strong, and novel [3,4,9], acceptance does not guarantee change [5]. For instance, many smokers will accept arguments about the danger of smoking to their health, but they may still be unlikely to change their attitudes towards smoking.

In addition, the acceptance of the argument might also elicit beliefs that were not explicitly mentioned or intended. As a consequence, the argument can affect a hearer in a very different way from the original intention. For instance, the message "Detergent X is strong", which is intended to praise the effectiveness of X, might lead the hearer to infer that "Detergent X is also harmful to clothes", which is obviously not desirable for the goal of promoting X [5]. Clearly, such indirect effect is neither desirable nor controllable.

It is also common to see the persuasive argument met with a counter argument in the form of "yes, but…" [10]. By generating these counter arguments, the hearers are now persuading themselves of the opposite. The persuasive effect of this self-persuasion phenomenon through self-generated arguments has been found to be more powerful and to persist longer than that caused by a passive exposure to persuasive messages generated by others [11,12]. So, argumentation can potentially reinforce the hearers' resistance to change by constantly provoking them to generate counter arguments to the persuader's intended goal (e.g. "but smoking helps me to…", "but it's too difficult to…") [10].

Finally, a considerable amount of empirical evidence suggests that while persuasion through giving advice and putting forward arguments might be effective in the short time, there is a clear positive correlation between the number of confrontational statements and poor outcome in behaviour change some twelve months later [13].

3 Efficacy of Current Systems

In order to influence people's behaviours, it is essential to understand which factors cause people to behave the way they do. Theories of behaviour change that are developed to pinpoint these factors all agree that change is not an event, but a process (e.g. [14]). As people's motivation and readiness to change increase while their resistance decreases, people progress to the next stage (e.g. from not intending to change, to thinking about change, to making and executing some action plans) [14]. While the argumentation-based approach can be sufficiently effective for people who are in the later stages due to their low resistance and high readiness, it may be less suitable for

people who are in the early stages. Hence, this section will focus on systems that aim at people in the early stages.

Most current dialogue systems use simple dialogue models where the initiative of the dialogue belongs to the system. Depending on the user's stage of change, the system informs the user about the anticipated benefits of changing, sets goals for the user to achieve, or suggests solutions to overcome barriers to prevent relapse [15]. Overall, these systems show an improvement of this tailored advice-giving intervention method over their non-tailored counterparts or no intervention, but these effects are sometimes unclear. An evaluation of Jarvis's system that aims to increase walking time of older women found no significant difference in the overall proportion of women who increased their stage of change between the tailored condition and non-tailored condition, but did find a difference for women who were thinking about changing [16]. Evaluations of other systems such as [17-20] found a significant improvement of tailored interventions, while systems such as [21] found no improvement. Detailed findings of all these systems are shown in Table 1.

Table 1. Summary of the efficacy of argumentation-based persuasive dialogue systems

Authors	Targeted behaviour	Results
Turnin et al., 1992 [17]	Improve diabetes self-care.	Significant improvement in dietic knowledge of computer-aided instruction over no intervention. Some decrease in caloric excess, fat intake, and increase in carbohydrate intake. No improvement in caloric deficit.
Hyman et al.,1996 [21]	Decrease cholesterol and body weight.	No significance between the experimental and control group.
Friedman et all, 1996, 1997,1998 [18,19,20]	Increase medication compliance. Lower blood pressure. Increase walking time.	Medication compliance: improvement of 17.7%-18% in TLC, 11.7-12% in control Blood pressure: reduction of 5.2 mm Hg in TLC, 0.8 mm Hg in standard. Physical activity: walking time increased to 121 min/week in TLC, 40 min/week in standard.
Jarvis et al., 1997 [16]	Improve walking time in older women	No significant difference of increase in stage of change overall: TLC 69%, standard 62%. Significant difference of increase in stage of change of women in contemplation stage: TLC 88%, standard 62%.
Grasso et al., 2000 [22]	Improve diets	42% users had negative comments about the system's messages.
Mazzotta et al. 2006, 2007 [23,24]	Improve diets	Users rated the persuasiveness of the advice-giving messages 2.1 out of 5.

Recently, a number of systems attempt at a more flexible approach, where the initiative of the dialogue can be handed to either the system or the user. For instance, Grasso et al.'s Daphne system aims to improve people's diet by using arguments to inform the users, or argue against their arguments [22]. The authors see changing opinions of an individual as a conflict situation between two parties, and this conflict can be resolved using direct advice through the use of dialectic argumentation. The goal of the system is to increase the acceptance of its arguments by tailoring them to the preferences and values of the individual [22]. Examples of interaction between Daphne and a user are shown in Figure 1. Although the majority of users enjoyed interacting with Daphne and found it made them think about their diet, 42% found its messages *"irritating"*, *"imperious"*, *"personal and criticising"* or felt *"they were not listened to"*.

Daphne:	*Do you like cooking?*
User:	*Not especially. […] Cooking feels to me like a lot of effort for something (i.e. eating) that's over quite quickly. Also, I often feel tired at the end of a day's work and don't want to spend too much time in the kitchen.*
Daphne:	*You don't cook just because you have to eat! Cooking can be a very relaxing and interesting activity, better than watching TV!*
Daphne:	*Good choice, but maybe you should try to increase your target! (of bread intake) I would advice at least 6 slices per day.*
User:	*Gulp. It's the fibre polis. Do you have any idea how long it would take to eat six slices of said bread?*

Fig. 1. Examples of interactions between Daphne and a user [22]

Mazzotta and de Rosis's system also utilizes advice-giving to encourage people to improve their diets by providing personalised information to develop discrepancy between the users' goals and their existing eating habits, and to support self-efficacy [23,24]. Examples of messages generated by the system [24] are shown in Figure 2. The messages were based on a corpus of what someone would say to persuade an individual to change. The authors collected the corpus by asking people to write a short persuasive message given some information about the hearer and the targeted behaviour. Their evaluation study shows that users rated the persuasive power of such messages at around 2.1 out of 5. Users' comments were: *"people don't talk like that, unless they're lecturing"*, *"engage John [the persuadee] in the discussion, hear what he thinks"*.

Message 1: *You should try to increase the quantity of fruit and vegetables in your diet! They have proved to be very effective for one's health, which you seem to value greatly. I'm sure you can do it if you try.*

Message 2: *You do sport and look after your health with regular medical check-ups. Why don't you try to increase the quantity of fruit and vegetables in your diet? I'm sure you can do it if you want to.*

Fig. 2. Examples of messages generated by Mazzotta and de Rosis's system [24]

In summary, although argumentation-based tailored interventions were often more effective than their non-tailored counterparts or no interventions (see Table 1), the inconsistent results, the small magnitude of the improvement of the tailored interventions when it exists, and the negative comments from many users imply that perhaps the methods used can be improved further. Clearly, there is a need for more studies that aim to compare different communication styles.

4 Motivational Interviewing

MI is a directive, client-centred counselling style. It provides an alternative method to argumentation and advice-giving for eliciting behaviour change by helping an individual to explore and resolve ambivalence. It motivates an individual to change, while acknowledging that there may be reasons why he or she chooses to maintain a behaviour. It emphasizes the use of self-generated messages discussed earlier. It should be the client who highlights the arguments to change, not the counsellor [8]. The counsellor achieves this by avoiding argumentation, rolling with resistance, while expressing empathy using reflective listening, developing discrepancy between the client's goals and the existing behaviours using reflective listening and objective feedback. This approach clearly does not put clients in the position where they constantly try to defend themselves against the counsellor's arguments.

5 The Evaluation Study

Experimental Design

The aim of this experiment is to verify whether MI will be perceived more persuasive than advice-giving. The following hypotheses are posited:

H1: The MI approach is perceived to be more persuasive than the argumentation-based approach.
H2: Users who attend a MI session are more likely to revisit the counsellor than users who attend an argumentation-based session.
H3: There is a positive correlation between the perceived persuasion and intention to revisit.

To avoid any unexpected effect of audio and visual elements (e.g. image of the speaker can influence the perceived credibility of the message [25-27], we implemented a completely text-based experiment. All participants were shown a dialogue between a midwife and a pregnant woman called Jenny, in which the midwife tries to convince Jenny to give up smoking. After reading the dialogue, participants were asked to put themselves in Jenny's position and evaluate:

(1) How much they find the midwife: likeable, respectful, annoying, judgmental, empathic, helpful, and understanding.
(2) To what extent they would be persuaded by the midwife's words.

(3) To what extent they would like to come back to talk to her.
(4) To what extent they found Jenny's answers were what they would expect.

All questions were measured on a 7-point Likert scale (1 = not at all/never to 7 = very much/definitely). For question 3 and 4 participants could explain further the rationale for their decisions. Participants were randomly assigned to one of three groups:

1. **Motivational Interviewing (MI):** Participants read a dialogue written in MI style.
2. **Negative Framing (NF):** Participants read a dialogue written in advice-giving style with negative terms (i.e. smoking is bad). In the dialogue, the midwife uses the consequences of smoking on the baby to convince Jenny.
3. **Positive Framing (PF):** Participants read a dialogue written in advice-giving style with positive terms (i.e. not smoking is good). In the dialogue, the midwife uses the benefits of not smoking for the baby to convince Jenny.

The reason for using two argumentation-based dialogues is that many studies have shown mixed results of persuasive impact between negative framing (i.e. messages use negative terms) and positive framing (i.e. messages use positive terms) (e.g. [28,29]).

The following dialogue was used for the MI group. It was adapted from a sample dialogue in [30].

Midwife1: *It's great to hear about your flat! But I suppose we should press on, there's loads to get through at a first meeting. I wanted to ask you… do you know anything about smoking and pregnancy?*
Jenny1: *Yes, I do. It's not good. But I don't smoke much.*
Midwife2: *That's good. How much do you smoke, then?*
Jenny2: *I really don't smoke all that much. Maybe half a pack.*
Midwife3: *So you reckon you smoke around eight or ten cigarettes a day, then?*
Jenny3: *Yees, I suppose that's about right.*
Midwife4: *Do you know why it's not good for a mother to smoke?*
Jenny4: *Weeell, the baby doesn't grow as big – it doesn't grow as well.*
Midwife5: *You're absolutely right. The babies of mothers who smoke can end up smaller than the babies of mothers who don't.*
Jenny5: *I know it's not good to smoke in pregnancy, but things go well in most cases, don't they?*
Midwife6: *So do you know anything else about how smoking affects the baby in your womb?*
Jenny6: *No, I thought that was about it.*
Midwife7: *Shall I tell you a bit more about it? Would you like me to do that?*
Jenny7: *Yes please.*
Midwife8: *Well, when the mother smokes few cigarettes, she inhales a gas called carbon monoxide, that's the same poisonous gas… so the baby has carbon monoxide in her blood the whole time. This is not only poisonous for the baby but also prevents the baby from getting enough oxygen to breathe.*

The following was the NF dialogue. It was adapted from a sample dialogue in [30].

Midwife1: *It's great to hear about your flat! But I suppose we press on, there's loads to get through at a first meeting. I wanted to ask you…do you smoke?*

Jenny1: *Yes, I do.*

Midwife2: *How much do you smoke, then?*

Jenny2: *I really don't smoke all that much. Maybe half a pack.*

Midwife3: *Right. Well, smoking at all while you're pregnant is a really bad idea. Smoking is really bad for you even if you're not!*

Jenny3: *I knew that anyway.*

Midwife4: *That's right. Every time you smoke a cigarette, your baby will find it more difficult to breathe. It means your baby doesn't get enough oxygen to grow. But that's not the only problem. There's also a risk that your baby could be born prematurely and have a low birth weight. And of course, if your baby doesn't grow properly in your womb, that's a problem too. When you smoke few cigarettes, you inhale a gas called carbon monoxide, that's the same poisonous gas… so the baby has carbon monoxide in her blood the whole time. You could say you're actually poisoning your baby.*

Jenny4: *Mm, yes – that's not good.*

Midwife5: *I know this must be difficult for you, I understand what you must be thinking. I've met loads of mothers in this situation, so I really do know how you feel. But Jenny, couldn't you just try to give up smoking? You've got your baby to think of now.*

Jenny5: *But I really don't smoke all that much. Some days I only smoke three or four cigarettes.*

Midwife6: *Jenny, you might not think that so little can affect your baby, but it does. Why don't we make an agreement: how about if we say you'll try to cut back until I see you again, then we can talk about helping you to give up altogether. Shall we do that? There's a lot more that we have to get through today…*

Finally, the following dialogue was used for the PF group. It was adapted from the NF dialogue. The differences came in on turn 3, 4, and 6.

Midwife3: *Right. But giving up smoking will make you even healthier, it is even more important now while you're pregnant.*

Jenny3: *I knew that anyway.*

Midwife4: *That's right. Not smoking during pregnancy will help your baby get more oxygen, so the baby can breathe easier, so that she can grow properly and achieve her full potential birth weight. It will also decrease the chance of the baby being born prematurely.*

Jenny4: *Mm, yes.*

Midwife6: *Jenny, think about all the health benefits your baby will get if you don't smoke at all. Why don't we make an agreement: how about if we say you'll try to cut back until I see you again, then we can talk about helping you to give up altogether. Shall we do that? There's a lot more that we have to get through today…*

Participants

Forty-one participants completed the experiment. Participants were staff and students of the university. Data for two participants in the group MI and two participants in group NF were removed as outliers as their measures for persuasion and intention to revisit were more than 3 standard deviations (SD) away from the mean of the group and further investigation of their answers revealed their misunderstanding of the questions. The participants' demographics can be seen in Table 2 below.

Table 2. The participants' demographics

	MI	**NF**	**PF**
No of Subjects	12	12	13
Gender	9F 3M	8F 3M 1N/A	10F 3M
Smoking	8N 4Y	10N 2Y	12N 1Y
Has children	11N 1Y	10N 2Y	12N 1Y
Mean Age (SD)	27.09 (12.16)	26.92 (10.94)	25.92 (8.83)

Results and Discussion

Table 3. The results of the experiment

	MI		**NF**		**PF**	
	Mean	(SD)	Mean	(SD)	Mean	(SD)
Likeable	5.17	(1.34)	4.67	(1.23)	4.31	(1.60)
Respectful	5.42	(1.50)	4.67	(1.23)	4.38	(1.81)
Annoying	2.83	(1.34)	3.92	(1.73)	3.85	(1.99)
Judgmental	3.00	(1.71)	3.75	(1.06)	3.69	(2.29)
Empathic	4.42	(2.02)	4.00	(1.21)	3.92	(1.17)
Helpful	6.00	(0.89)	4.83	(1.64)	4.38	(1.98)
Understanding	5.00	(1.35)	4.17	(1.53)	4.23	(1.88)
Intention to revisit	**5.75**	(0.97)	**3.58**	(0.79)	**4.08**	(1.85)
Perceived persuasiveness	**5.58**	(1.24)	**4.25**	(0.97)	**4.08**	(2.10)
Jenny's answers were natural	4.50	(1.68)	4.33	(1.30)	5.42	(0.90)

The results of the experiment are shown in Table 3. All measures favoured the MI over both the NF and PF dialogue. Regarding our hypotheses, the MI dialogue was perceived to be significantly more persuasive and leading to a higher intention to revisit than both the NF (independent-samples T-test: $p<0.01$ with 95% Confidence Interval = 0.392 – 2.274 and 1.419 – 2.915 respectively), and the PF dialogues ($p<0.05$ with 95% Confidence Interval = 0.438 – 2.908 and 0.079 – 2.934 respectively). Hence, *H1* and *H2* are supported. The perceived persuasiveness of each dialogue was also found to positively correlate with the intention to revisit as postulated by H3 (Pearson = .672; $p < 0.01$). Hence, *H3* is supported. Considering that the participants found Jenny's answers in all three dialogues reasonably close to what they

would expect and there was no statistically significant difference in this respect between the three dialogues, we can argue that our findings are strong and reliable.

Our results also show that there was no significant difference between the NF and PF dialogue and they both scored about halfway on the scale regarding persuasion strength and intention to revisit. The measure of persuasion is highly similar to the results obtained by Mazzotta and de Rosis's experiment in which they compared a positive and a negative framing persuasive dialogue that promotes healthy eating [23].

Further qualitative analysis of participants' comments on their rationales indicates that participants found the NF dialogue *"too formal"*, *"like a lecture"*, pushy (e.g. *"last move was too quick"*), *"sensible advice but put across in a wrong way"*, the PF dialogue *"too direct, in a hurry, too much of agenda"*, *"bullying, too powerful"* or *"not passionate"*. The critiques we found for the NF and PF dialogue are considerably similar to the results obtained in [22] and [23]. On the other hand, the MI dialogue was considered *"good explanation"* and *"informed"*.

In addition, we also found a positive correlation between the perceived persuasiveness, and intention to revisit and the extent to which the midwife is perceived likeable, respectful, helpful, and understanding ($p < .01$; Pearson coefficient ranging from .529 to .753) and a negative correlation between the perceived persuasiveness, intention to revisit and the extent to which the midwife is perceived annoying, and judgmental ($p < .01$; Pearson = -.462 and -.655 respectively).

In summary, all three of our hypotheses are supported. This suggests that the MI approach is more effective (H1) and can lead to a higher intention to revisit (H2) than the argumentation-based approach. This is particularly important, considering the strong correlation between how convincing the counsellor is perceived and the likelihood of a revisit from the patient (H3). We acknowledge that our experiment did not measure direct persuasion (i.e. how much the participants actually changed their attitudes or behaviours). However, we argue that finding a message persuasive is perhaps the essential first step towards being persuaded by the message, thus it can be used as a good indicator of the actual persuasion strength of the message. Considering how realistic the participants found Jenny's answers, and the comments of the participants that clearly show their dislike of the argumentation-based approach, we believe that the findings of this study are promising and further studies that compare the efficacy of the two approaches are worth investigating.

6 Related Research

Although some researchers also acknowledge that persuasive dialogue systems "should move away from the paternalistic style of interaction" to a more client-centred style such as MI [31], and some studies have paid attention to various aspects of MI such as showing empathy [32] and developing discrepancy [24], there has not been any system that systematically utilises the MI approach and adheres to its spirit as far as we are aware. Two systems that aim to reduce drug use among perinatal women using a brief MI approach [33,34] have produced promising results. Overall, the systems were rated as highly acceptable, easy to use, and lead to a significant increase in readiness to change at post intervention and at 1-month follow-up. The systems were designed for a single 20-minute session only, and provide the users with

limited flexibility to lead the interaction. First, the system collects information about the users' drug usage. After the assessment, the system gives (1) feedback regarding the negative consequences of drug use that they reported, their self-reported readiness to change, and their drug use as compared to that of all adult women; (2) pros and cons of drug use and related change, in which the participants choose from a list of options of positive and negative aspects of drug use; and (3) a summary and query regarding the participant's interest in change, followed by optional goal-setting regarding drug use. Throughout the interaction, an animated character reflects the users' answers to "help to establish an atmosphere that is as similar as possible to that present during a motivational interviewing session". Since MI does not encourage the counsellor to push the patients to the next step when they are not ready, we argue that future MI-based systems will be significantly more effective if they allow the users to have more initiatives during each session, and support multiple sessions when and as the users need them.

7 Conclusions

The combination of argumentation and advice-giving has established itself to be the most commonly used persuasive strategy in dialogue systems to date. However, we argue that this argumentation-based approach potentially entails many limitations. To date, although tailored argumentation-based persuasive dialogue systems were often shown to be better than a non-tailored intervention or no intervention, the magnitude of the improvement was often small. These systems also received many negative comments regarding the way information is conveyed, but not the quality of the information. While we acknowledge that the limited success of these systems could be due to their specific implementation, users' demographics, or the targeted behaviour, we believe that *more studies that focus on comparing the argumentation-based approach and a more client-centred counterpart such as MI should be carried out*. Our evaluation study supports this argument. The results showed a clear preference for the MI-based dialogue over two argumentation-based dialogues written with either negative or positive terms. However, it is possible that each approach may be particularly effective for certain types of users (e.g. highly educated users vs. users with low education, or users who are in different stages of change).

We also believe that *it is possible to implement a practical MI-based system with the current technology*. Albeit an ideal MI-based system would have to allow the users to freely express themselves and reply accordingly, thus requires a substantial capability to process natural language, this is not a necessity. MI core techniques such as expressing empathy or reflective listening can be executed equally well by restricting the user expressivity to gain feedback accuracy. A study by Bickmore [32] showed that "greater empathic accuracy was more efficacious at comforting users even at the cost of restricting user input". The author even went further to suggest that sophisticated affect recognition and natural language processing technology are unnecessary. With a large enough corpus and machine learning, offering a minimal list of possible user utterances while maximizing the system's effectiveness is plausible.

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Categorization as Persuasion: Considering the Nature of the Mind

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Abstract. Categorization is inevitable in the process of designing persuasive software. Having said that, there has not yet been paid much attention to the role of categorization within the field of Persuasive Design. When a designer categorizes what elements should be part of the persuasive software he must always consider the user in order to achieve the most suitable categorization in relation to his intention. This article will show how theories of Epistemic Rhetoric and Cognitive Science both emphasize the role of categorization and how they supplement each other in an understanding of the user and how human beings categorize in order to comprehend and make sense of concepts. In a concluding example it will show how two furniture warehouses with seemingly similar persuasive intentions have chosen different categorizations that consequently result in different persuasive outcomes.

Keywords: Categorization, Persuasive Design, Epistemic Rhetoric, Cognitive Science, Comprehension, Basic-level Categories, Prototype Theory, Metaphors.

1 Introduction

Persuasion is a key term in the field of Persuasive Design and though various aspects of the term have been discussed, there has not yet been much focus on the categorization process which is inherent in a design process. This article will address this subject and thereby clarify how attention to categorization may help a designer make the appropriate categorization in relation to his persuasive intention. It will also show why it is important to consider the user already in the early stages of a design process.

The concept of categorization is relevant to persuasion, because persuasion is a process that is initiated from the very moment a designer starts choosing what elements are going to be present in the final design. At the beginning of the design process, the designer's choices already influence whether the user of the software is likely to be persuaded or not. In other words, the way the designer categorizes which elements should be part of the software and which should not is of great importance and must be considered right from the beginning of a design process.

Categorization can be looked upon from several perspectives and in this article we argue that the nature of the mind is essential to how we categorize. To consider the categorization and the user is not new in the field of HCI, but in the field of Persuasive Design there has not yet been paid much attention to a theoretical investigation of these aspects and their influence on persuasion. In relation to persuasion categorization is not

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just the explicit labeling of objects, as it would sometimes seem within usability theory. It is also about being aware of why we categorize the way we do and how this influences the persuasive potential. In that sense it is necessary to know that categorization is an essential part of human comprehension and to include this knowledge in the design of persuasive software.

In section 2 we present Epistemic Rhetoric which is the theoretical foundation of this article and a conception of rhetoric that is concerned with persuasion at all stages of a design process. Rhetoric is often seen primarily as a gathering of technical artifices, but Epistemic Rhetoric goes beyond this conception. In this section it will be shown how Epistemic Rhetoric attaches importance to the role of categorization. In section 3 we discuss how the user is an integral part of the design process. Section 4 is an outline of a rhetorical approach to an understanding of comprehension. Section 5 will show how Cognitive Science offers a useful theory about the nature of the mind and the importance of categorization that can supplement the rhetorical approach. In section 6 we present categorization methods from Cognitive Science that can be useful when designing persuasive software. In section 7 we will illustrate how different types of categorization will influence the persuasive intention. Section 8 concludes the article.

2 The Role of Categorization: A Rhetorical Argumentation

Rhetoric deals with the presentation of a case in a persuasive way. A classical rhetorical idea of working out the presentation of a case emphasizes that persuasion is a result of a process starting all the way from the idea and preparation phases until the finished product. In this article we will focus on the preparation.

The rhetorical name for the preparation stage is inventio. In the phase of inventio the designer selects the arguments – or more generally the elements of information – he wants to present. Inventio is particularly about finding persuasive elements, which can improve the case one wants to persuade about [4, p. 25]. The most important task in inventio is to choose what content to include in – and what to omit from – the presentation.

One of the objections that have been raised against B.J. Fogg's work [5] on Persuasive Technology is that his approach ignores the importance of the preparation stage [8]. Persuasion, in Fogg's terms, has been seen as a technique through which one can enhance usability in a persuasive direction by using principles from social psychology [1, p. 172]. But we agree with Per Hasle and Anne-Kathrine K. Christensen when they point out: "But it is in general not just the final step, but the entire route or process up to and including the final step that builds persuasion." [8]

After the stage of inventio the designer has to arrange the information he has selected in a persuasive way. The rhetorical name for this stage is dispositio. The tasks in both inventio and dispositio are closely related to categorization theory. The strategy of categorization used in the selection (inventio) and the arrangement (dispositio) of the information related to the case determines the character of the persuasive software – and another strategy of categorization would result in another piece of software. From an epistemic rhetorical point of view the overall character of the final

product is crucial to persuasion and that is why persuasion is inextricably linked with the way information is selected and arranged in a design.

It is worth noticing that the importance of categorization is also stressed in the fields of usability and information architecture. Like the epistemic rhetoricians these theories attach importance to the fact that user experience depends on categorization – and that a suitable categorization is requisite in successful software design. The idea that the whole process from preparation until the final product determines how the users experience the case is in fact the fundamental conclusion in Jesse James Garretts' work [6]. But also Louis Rosenfeld and Peter Morville, theorists in the field of information architecture, have observed the point that: "The way we organize, label, and relate information influences the way people comprehend that information." [14, p. 50]. But as we have argued previously there has not yet been paid attention to how categorization can enhance persuasion instead of just enhancing usability.

2.1 The Topics: A Tool for the Designer

To help the designer find out what is relevant to include in persuasively designed software, and to help him not to forget important issues and statements, rhetoric provides a "checklist", called the Topics. The Topics are a kind of "storeroom" where it is made clear and available what knowledge you already have about the matter and what is possible and relevant for you to ask for [12, p. 60ff]. In Edward Corbett and Robert Connors' [2] reading of the Topics, they describe its foundation as follows:

> … the system of the topics is really an outgrowth of the study of how the human mind thinks. The human mind, of course, does think about particular things, but its constant tendency is to rise above the particulars and to abstract, to generalize, to classify, to analyze, and to synthesize. The topics represented the system that the classical rhetoricians built upon this tendency of the human mind. [2, p. 85-86]

The Topics are a schematic outline of elements important for human comprehension and experience – for instance how to define and delimit the subject matter, how to enhance understanding through comparison, etc. They therefore make the designer aware of elements that are important for him to remember and which part of the information to stress in the design phase. This, however, is not merely or even primarily centered on the designer. The definitions must be understandable for prospective users, and in Persuasive Design they must also be considered in relation to their potential impact on persuasion. Similarly, any comparisons used should be enlightening and when possible persuasive for prospective users. The fact that the Topics are built on the tendencies of the human mind is what makes them useful. The classical rhetorical Topics are: definition, comparison, relationship, circumstances and testimony. However useful they are, the classical rhetorical understanding of the Topics needs an update. The Topics will be more useful if they take modern knowledge about human comprehension processes into account. This will be elaborated later in the article, where we will suggest a rethinking of the classical Topics.

3 The Role of the User

It is the designer who has to go through the phases of inventio and dispositio. Though these phases only represent the initial stages of the design process it is important for the designer to include the future user in his work. The rhetorical concept for this consideration is imitatio. Inherent in imitatio lies the idea that one must take into consideration whatever knowledge one can have of the future user in order to imagine the future understanding of one's persuasive software. In relation to this Hasle describes imitatio as: "Trying to imagine how future users will react to various features of the system to be developed". [7, p. 10]

In the fields of usability and HCI, various user tests are commonly used to achieve empirical knowledge about the user, which can enhance or even replace imitatio. This move however is expensive, time-consuming and at times unreliable – and therefore often unavailable. For that reason we should also try to utilize whatever can be gained from general and theoretical knowledge about the workings of the human mind.

By performing imitatio the designer can find out whether his communication is at all persuasive the way he wanted it to be. This can be done by looking at the arguments the design expresses, and comparing them to possible objections that the user might have. If the arguments are not strong enough, this must result in a change of the design. Another categorization must then be used in order to make the system persuasive. This means that a particular categorization creates a particular comprehension for the designer as well as for the user.

In order to prepare the designer to be able to make an impartial and concordant imitatio it is crucial to throw light on how the user comprehends the persuasive product. A good imitatio depends on the congruence between the designer's knowledge of human comprehension and how it actually is. In the imitatio process it is therefore helpful if the designer understands the nature of the human comprehension.

4 A Rhetorical Approach to an Understanding of the Mind

Epistemic Rhetoric offers an understanding of human comprehension. The main point is that we do not comprehend and make rational decisions from an entirely logical perspective. The narrow understanding of rationality as being logical, deductive and calculative is not adequate. Instead rationality must be understood in a broader sense. Rationality in the broad sense means that emotions play an equally essential role in our understanding of the world. Rationality is actually an inseparable combination of both logical and emotional characteristics of our comprehension. In the words of Jan Lindhardt:

> … as long as the rhetorical tradition has existed it has refused to recognize this separation between rationality and emotions. The two aspects are inseparable and it is therefore the case that we comprehend also through our emotions and that we choose also through reason [12, p. 82 – our translation]

The logical and emotional aspects in combination form human reason or rationality in the broad sense, and this means that emotions are not irrational; they are an integral part of rational decision-making. Neuroscientists have supported this view by making

neurological studies that show that emotions are an indispensable part of rational comprehension. Antonio Damasio points it out by saying:

> I suggest only that certain aspects of the process of emotion and feeling are indispensable for rationality. At their best, feelings point us in the proper direction, take us to the appropriate place in a decision-making, where we may put the instruments of logic to good use. [3, p. xiii]

It is necessary to appeal to rationality, meaning both the logical and emotional aspects, when you want to persuade about something. This is reflected in the rhetorical ideal that a designer must find an appropriate balance between the three persuasive appeals: logos (the appeal to narrow rationality), ethos (the sender's plausibility) and pathos (the appeal to emotions) in order to succeed in persuading the user. The division of the persuasive appeals is very useful when it comes to talking about their different characteristics in e.g. a persuasively designed system. The distinction between them makes it possible to distinguish between individual elements of persuasive software with respect to their ability to appeal to different aspects of the comprehension. In relation to categorization this means that in order to achieve persuasion the designer must categorize in a way that appeals to the broad rationality – including both logical and emotional appeals.

5 Cognitive Science: The Study of Mind and Understanding

So far we have described how categorization plays an important role in the making of persuasive software. We also have emphasized that an understanding of the comprehension of the user will be helpful in making persuasive design. Now we will investigate how research within Cognitive Science can be of help in elaborating the categorization process, which is crucial to achieve successful persuasion, and which is inextricably linked to how the human mind works.

Cognitive Science is a field which can be approached from many angles. In this article we will focus on the linguistic approach set forth by George Lakoff and Mark Johnson. Their empirical research focuses on how we use language and what this says about the underlying conceptual system of the mind. One of their main research areas is the study of how human beings always categorize. They state that in order to comprehend and make sense of concepts we categorize the experiences we encounter [9], [10].

Lakoff and Johnson describe categorization as "… a natural way of identifying a kind of object or experience by highlighting certain properties, downplaying others, and hiding still others." [10, p. 163]. The categorization process of the mind (expressed in the quote) resembles the explicit categorization which is made by a designer in the phases of inventio and dispositio. We believe Lakoff and Johnson would agree that the categorization made in these phases is important. To categorize is the way we make sense of objects and experiences and that is why the categorization process in the initial phases of a design process represents how the designer makes sense of the case he wants to persuade about.

Lakoff and Johnson point out that objects in the world cannot be set in one fixed hierarchy that has to be interpreted as the single "right way" to define the objects. Instead they say that categories are open-ended, which means that how we categorize an object depends on our purpose, which will vary [10, p. 122ff]. How we categorize

depends on three factors: that the mind is embodied, that thoughts are mostly unconscious and that we understand abstract concepts metaphorically.

That "the mind is inherently embodied" [11, p. 3] is an observation, which implies that the body is the basis for the categorizations we make. This means that our perceptual and motor systems play an essential role in shaping the concepts we encounter. The second main argument is that "thought is mostly unconscious" [11, p. 3] – meaning that thoughts operate beneath the level of cognitive awareness. The unconscious thoughts are all our automatic operations and implicit knowledge that shapes our conscious thoughts.

Their third main argument is that "abstract concepts are largely metaphorical" [11, p. 3]. Metaphors will most likely be used in situations where human beings are going to experience, comprehend, and explain concepts that are not tangible. In this process we use the metaphor which is to see something in terms of something else, from another domain. The domain we use in order to describe and understand abstract concepts in terms of, is a domain of which we have a bodily experience and this produce a better understanding of the abstract concept.

The metaphor can be seen in relation to how Epistemic Rhetoric understands comprehension and persuasion. The metaphor has an ability to combine logic and emotion and thereby appeal to the broad rationality. The metaphor is emotional in the sense that it evokes emotions by recalling sensory perceptions of the physical object [12, p. 83]. It is logical in the sense that the user needs the ability to perform inferences to understand the meaning of the metaphor. The character of the metaphor implies that it can potentially create an appropriate balance between the persuasive appeals and thereby be of use in creating persuasive software.

6 Rethinking the Topics

In this section we will rethink the classical rhetorical Topics using knowledge about comprehension from Cognitive Science. Corbett and Connors [2] suggest that the Topics are a description of how the mind works, but cognitive research indicates that the traditional Topics are not sufficient, because they seem to suggest that a concept could be defined by a fixed set of inherent properties. As we have discussed in the previous part, this does not accord with the way people actually categorize; Cognitive Science points in another direction. This is why we find it rewarding to see the Topics in a different light – by developing a complementary Topic. It is important for us to emphasize that this is a development of the Topics from our point of view – it is a result of our selection and weighting. This is not a total reorganization of the Topics. We only add concepts that are not present in the Topics today – but which we find useful, because they are built on a modern investigation of the human comprehension.

In the following we are going to present three different categorization methods: Basic-level theory, prototype theory and metaphors. They are all built on research in Cognitive Science and they are concordant with the results stated by Lakoff and Johnson. Because they are built on knowledge about how we actually categorize, we argue that they will be recognizable for users of persuasively designed software. But recognition in itself is not persuasive. When a designer wants to design persuasive software he has to know how to make a suitable categorization in order to strengthen his persuasive intentions.

6.1 Basic-Level Theory

The first categorization method we will address is called basic-level. To understand the principles of basic-level it is instructive to give an everyday example of how we categorize – in this case furniture. In a hierarchical structure the upper level would e.g. be "furniture", the next level "chair" and the lowest level "wheelchair". The upper level is called the superordinate category (the abstract level), the lowest level is the subordinate category (the specific level) and in the middle is the basic level.

But what is characteristic about the basic level? The concepts at the basic level have a kind of cognitive priority, because it is easy for people to distinguish one basic level from another – for example a chair from a table (both having the superordinate furniture) [11, p. 27]. What characterizes all the members of the basic level is the fact that they are the highest level at which we use similar motor actions for interacting with them. Lakoff and Johnson have described it as "a level at which we optimally interact with the world" [11, p. 30]. We have motor programs for interacting with objects at the basic level – we know how to interact with a chair, but not how to interact with furniture overall, because interaction with furniture can take place in various ways. The basic level is also the highest level at which we can get a single mental image representing the entire category and at which all members have an overall shape we can assign to them. In our everyday life we use the basic level as an unconscious understanding of how to interact in the world. [11, p. 27-30], [9].

Therefore, we recommend that the designer considers which parts of his information should be at the basic level – and then calls attention to these basic-level categories. The designer has to choose the appropriate basic-level categories in accordance to his persuasive intention. If this is done, the user is likely to recognize what to do and how to behave and this will strengthen the probability of persuasion.

6.2 Prototype Theory

Another categorization method is prototype theory and it is about which subordinate categories people find to be the most representative in relation to the superior category. A prototype is a member of a category "that [has] a special cognitive status – that of being a "best example"" [9, p. 41]. As an example we can once more take a look at the (basic-level) category "chair". Some of its subordinate categories are more preferred than others – when we think of a chair we think more frequently of a "dining table chair" than of a "dentist's chair". The prototype is the member of a category that we will think of first when we meet the category – but we do this quite unconsciously. Prototypes are those members that fit the closest to our bodily experience of the category. Reasoning with prototypes is indeed so common that we could not function without it. Whether a member of a category is a prototype or not cannot be answered with a yes or a no. Categories are not fixed, and neither are prototypes. Whether a member of a category is a prototype or not is defined in the light of our intention, of our culture, and our common knowledge.

We advise the designer to think about which members of his designed categories are prototypes – in the light of his persuasive aim. A designer could challenge the conventional prototypes by stressing some non-prototype members of a category – but only if this move would concord with his persuasive intention. A challenge of the

conventional prototypes can be useful if the persuasive purpose is to change the users' understanding of a stereotype - which is a prototype that we commonly agree on.

6.3 Metaphors

Contrary to the basic level and prototype theories, the metaphor is useful when the designer has to categorize abstract concepts, meaning concepts that are not tangible. An example of our metaphorical understanding is that we understand the web and our navigation in the virtual space as if we were acting in a physical space [13]. People talk about the web as if it was a physical space in which they move, even though they are aware the web is not a physical thing and that they do not move. This is not a random use of language – on the contrary it is motivated by the metaphorical status of our comprehension of abstract concepts.

Metaphors can be used in situations where the persuasive goal is not concerned with concrete objects like furniture, but abstract concepts e.g. values or qualities. As a designer you must think about what terms you describe the abstract concepts in – particularly that the terms reflect the special characteristics you want to call attention to according to your persuasive intention.

In relation to the rhetorical view on persuasion the designer must be careful not to describe the abstract concept in terms of a domain of which the user might have an emotional understanding of that contradicts the persuasive aim, because that would result in an undesirable appeal to emotion. An undesirable appeal to emotion entails that an appropriate balance between the persuasive appeals will not be attained with the result that persuasion is not likely to take place.

7 Concluding Example: The Practical Aim

Having presented these types of categorization, we will now illustrate how they can be put into use and how different types of categorization will have different persuasive potential. This will show how the categorization made by the designer in the preparation stages of a design process will appear in the final persuasive product.
As an example we will use the web pages of IKEA and ILVA, which are both furniture warehouses. The overall persuasive goal would seem to be the same, because they sell the same types of products, but the different types of categorization used on the web pages indicate a difference in persuasive intention.

ILVA (fig. 1) uses the superordinate category "items" and the first items listed are the basic-level categories: sofas, chairs and tables. These basic-level categories are divided into subordinates of the category, and it is done in such a way that the first type of furniture listed is actually the prototype. The longer down the list the items are listed, the least typical of the category they are. This type of categorization makes it easy for the user to find whatever piece of furniture he is looking for, and it indicates that ILVA has the persuasive intention of selling (individual) pieces of furniture.

IKEA does not focus on the pieces of furniture in the same way that ILVA does. IKEA (fig. 2) does have a category called "all products", which resembles the categorization ILVA uses, but IKEA also uses another basic level categorization, which has

Fig. 1. Screenshot from ILVAs web page [15]

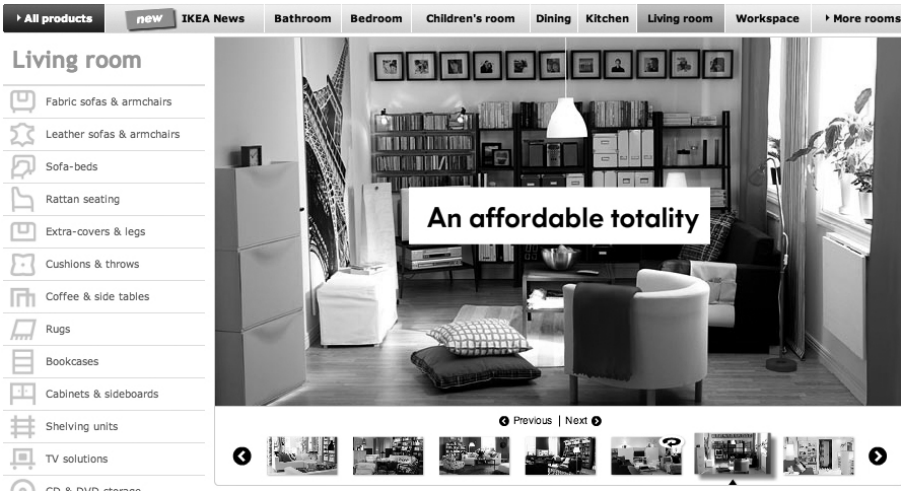

Fig. 2. Screenshot from IKEAs web page [16]

a conspicuous placement on the webpage. IKEA categorizes from an implicit superordinate category of "rooms" with the basic levels of bedroom, living room, bathroom, kitchen etc. explicitly represented in the menu on the page. When clicked at, pictures of the subordinate categories of e.g. "Living room" appear, representing different types and styles of the selected basic-level room. These subordinate categories are each represented by a sentence expressing an abstract concept. A picture of a kitchen is e.g. presented as the abstract concept "heart of the home" and a living room as "an affordable totality". The abstract concepts are represented in pictures of rooms that are physical representations of each particular concept. In this metaphorical categorization it is important that there is a coherence between the abstract concept and the picture, and that this metaphor appeal to the user. A metaphorical categorization

has the ability to appeal to the broad rationality, but the risk is that it can result in an undesirable appeal to emotion. The variety of subordinates for the "Living room" shows that IKEA is trying to match the specific metaphor that a user might find to be appropriate for his taste in living rooms. The rather large selection of rooms represented by different metaphors may be a good idea since the chance that a user will find a metaphor that appeals to him may be bigger.

By accentuating the basic-level categories of rooms in the design instead of the individual pieces of furniture, IKEA emphasizes that the rooms are the central categories. This focus on the rooms indicates that IKEA wants to persuade the user to buy a whole design solution for a room instead of just a single chair or a table, although IKEA actually sell individual pieces of furniture.

Both IKEA and ILVA have chosen their selected basic-level categories to be the first level in the navigation bar. This type of categorization makes it easy for the user to navigate the webpage. The use of different basic-level categories shows how the persuasive potential shifts according to the categorization, and this illustrates the importance of making the appropriate categorization. The metaphorical use of pictures of rooms is making the abstract concepts concrete and is a very well chosen type of categorization if the persuasive intention is to sell an overall design solution.

8 Conclusion

Designing persuasive software is a process with several phases. This article has emphasized the initial phases of the design process. They are important, because the categorization made in these phases will influence the character of the final software. The character of the final product is crucial for its persuasive potential and that is why categorization is inextricably linked with persuasion. When the designer has to make his explicit categorization he must take the future user into consideration. In the article we have presented a theoretical approach to this consideration by rethinking the classical rhetorical Topics.

We have added concepts to the Topics that makes them more sufficient in relation to how the human mind works, inspired by theory set forth by Epistemic Rhetoric and Cognitive Science. On this theoretical basis we have presented three categorization methods which accord to how we make sense of the objects we encounter.

These categorization methods are useful for a designer of persuasive software. When a designer wants to design persuasive software he has to make a suitable categorization in order to strengthen his persuasive intentions. The designer must consider how the categorization he chooses influences the final software and how to categorize in a way that suits his persuasive intentions. The concluding example shows how different types of categorization can be used to clarify different persuasive intentions.

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A Qualitative Study of Culture and Persuasion in a Smoking Cessation Game

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Abstract. To explore the issue of culture in persuasive technology, we identified strategies distinguishing individualist or collectivist audiences, and developed two versions of a prototype game. In this paper we report on a qualitative study of this game. The game concerned smoking cessation, and was set in a New Zealand context, where one version was designed for individualist New Zealand Europeans, and the other for collectivist New Zealand Māori. Our qualitative study involved people from each group playing each of the two games. Using a "think-aloud" protocol, we recorded player comments and reflections that show the effect of our design on their behaviour. The results of the study show the designs were interpreted differently according to the audiences playing them, and reveal detail about culture and persuasion.

1 Introduction

The kinds of attitudes people hold, and the behaviours they exhibit, are influenced by culture, so cultural beliefs play a large role in persuasion. To date, however, there has been limited development of persuasive technology (PT) [1] outside of countries characterised as having *individualist* culture. The distinction between individualist and *collectivist* culture forms one of the most important dimensions of cultural difference [2,3]. To explore this issue, we identified culturally-relevant persuasive technology strategies, distinguishing those targeted at use in tools for either individualist or collectivist audiences. We then developed culturally-relevant PT prototypes: two versions of a game titled *Smoke?* about smoking cessation. In this paper we report on a qualitative study of this game.

The design strategies we adopted in our game were contextualised within the cultural dimensions categories of individualism and collectivism. Our PT prototype, *Smoke?*, however, is contextually-based within New Zealand (NZ). One version is designed for an individualist NZ European audience, while the other is for a collectivist Māori audience: Māori are the indigenous people of New Zealand. In additional to approval from the University's Human Ethics Committee, our study was also approved by the Toihuarewa, the university's Māori academic forum.

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We have previously reported on aspects and background relating to our larger project background, including early ideas on using culture in persuasion [4], applying these ideas in the structure of a game [5,6], designing interaction for collectivist audiences [7], and on early playtesting we used to refine our game before conducting more formal studies [8].

The purpose of conducting an evaluation of our culturally-relevant PT *Smoke?* was to investigate if players would express different attitudes towards smoking after playing. At a more specific level, we were interested in finding out whether individualist players would find the NZ European (NZE) version of *Smoke?* more persuasive than the NZM version, and equally, whether collectivist players would be more persuaded by the NZ Māori (NZM) version than the NZE version. We adopted both a quantitative and qualitative approach in evaluation. The quanitative evaluation showed that the cultural distinction was significant, and we will report on those results in detail elsewhere. In this paper we present our qualitative evaluation.

2 Qualitative Method

Qualitative research methods have traditionally been employed in exploratory studies and in under-researched fields [9,10]. Our project fitted these criteria but, additionally, we were aware that the questions we could include in a quantitative survey could not identify specific cultural reasons for patterns of responses. Furthermore, the survey questions limited an investigation of whether the attitude shifts could be explained by players' appreciation of overt culturally-relevant references, or were related to more covert, deeply embedded cultural references in the game, by way of implementations of the design strategies. The survey responses also did not provide any insight into people's perceptions of the individual design strategies, so we could not examine how the strategies were being interpreted.

To address these concerns, we conducted qualitative evaluations of both versions of *Smoke?* using a "think-aloud" protocol, where pariticants played the game normally and without intervention, but verbally articulated their thoughts as they played. We involved eight players, half were of NZ European origin (E1, E2, E3, and E4), and the other half were Māori (M1, M2, M3, and M4), all in the age group we address: young adults. Four of our players were assigned to play the NZE version of *Smoke?* (E1, E2, M1, and M2) and the other four were assigned to play the NZM version of *Smoke?* (E3, E4, M3, and M4), making 2 participants in each congruous and each incongruous condition.

We have separated our discussion of the findings for each version of *Smoke?* into two sections. In §3, we cover findings for the NZE version, and discuss players' perceptions of our use of strategies we adopted for an indivualist audience: SELF MONITORING, CONDITIONING, and TUNNELLING, as described by Fogg. In §4, we discuss findings for the NZM version, and address players' perceptions of our use of alternative strategies we adopted for a collectivist audience: MENTORING, GROUP OPINION, HARMONY, and TEAM PERFORMANCE.

mentoring: tracking behaviour that users wish to change, in a similar way to the SURVEILLANCE strategy, but making this information available to other group members. The group members then act as mentors and help to keep users motivated to change their behaviour.

group opinion: providing users with the opinions of other ingroup members, or users similar to them, at moments when users are required to make important decisions related to goals.

harmony: presentation of social density cues to users. The cues serve to suggest to users that they are in a socially dense environment with members of their ingroup, in order to subtly promote *harmonious* actions that support the group's goals.

team performance: tracking the behaviour of individuals forming a group. It rewards or reprimands all members of the group on the basis of the actions of each individual which are related to a group behavioural change goal.

In both sections, we also discuss players' *Identification with the main character* and *Game acceptance*. We have structured the observations for players of each game in terms of the *congruent condition*, where the culture of the players matches the game's target audience, and the *incongruent condition*, where the culture of the players does not match the game's target audience.

To assist in interpreting the sections that follow, we now provide a brief outline of the game structure. *Smoke?* is a combination simulation/adventure game written in macromedia Flash to be played in a web browser. Players guide their avatar, MC, through a cessation trajectory, that is, from nicotine dependency to independency. (The name MC is an abbreviation for *master of ceremonies*, but also a common nickname in popular culture.) Players may experiment freely with both successful and unsuccessful quitting behaviours. The game takes about 30 minutes to play, and simulates 6 weeks, in a variety of scenes involving various places and other characters, such as Jade, MC's younger sister. Figure 1 shows the start of the first scene of the NZM version of *Smoke?*

3 Findings for the NZE Version

3.1 Identification with MC

In our earlier game playtesting and refinement we looked at how players' conceptions of their relationship with MC impacted on the way that they played. It is useful to comment on these conceptions at the outset, as they shaped our understanding of all the upcoming discussion themes.

Congruent: E1 tended to view MC as a representation of herself. During the game set-up, E1 chose personas for MC that she thought were similar to herself. Later in the game, at decision making points, she justified her decisions in terms of her own preferred modes of conduct: *I personally would [choose to call friends and organise an outing as a craving control activity], but she doesn't have very nice friends... so I think she should just have alone time to contemplate quitting (laughs).* E2 also talked about MC as a self-representation. For example, E2

Fig. 1. MC and her mother in the dining room

used reasons based on her own behaviours for choosing MC's chance activities: *My self esteem would be low [after eating a tub of ice cream] because I'm a bit self-image conscious.*

Incongruent: Like E1 and E2, M2 also talked about MC in a way that indicated self-identification. M1's identification with MC, on the other hand, would be better characterised as empathetic. During the game set-up, M1 chose personas for MC that she felt would be realistic for a current smoker (as M1 is a smoker herself). When she allowed MC to lapse, she felt sorry for MC, but was explicit that MC was separate from herself: *M1: Aww poor girl... sad.*
Administrator: Why do you think it is sad?
M1: Because she gave in... well, I gave in really. The conception of MC as a separate entity whose welfare M1 was concerned with is similar to the idea of ingroup members, which is characteristic of a collectivist worldview [11,12,3].

3.2 Self-esteem (Application of Self Monitoring)

An important feature differentiating the NZE version of *Smoke?* from the NZM version is the presence of a *self-esteem* score. This is an application of the SELF MONITORING strategy, as self-esteem is considered to be an individualist construct [12].

Congruent: Both of the NZ European players referred to the *self-esteem* score constantly throughout the game, and used it to guide their choices of action. For example, during a conversation with MC's mother in which MC's mother is somewhat sarcastic, E1 said: *This isn't a helpful conversation... it's pretty nasty... it's not really going to help, just make her feel worse about herself and go back to smoking.* E1 seemed particularly focused on keeping MC in a good

mood. On noting that Jake, MC's love interest, was having a negative impact on MC's self-esteem, E1 said: *He's really mean to her, so I don't really like him that much... I don't like this boy, she should get rid of him.* E2 also talked about MC's self-esteem more than any other status field. For example, referring to the effects of Jake's words and actions on MC's state: *Jake's negative comment would decrease MC's self-esteem right now. — He misses her. That's going to boost her self-esteem.*

Incongruent: Like E1 and E2, M1 also used self-esteem as a factor in decision making. For example, M1 explained her choice not to add Jake as a *control activity* in the following way: *Calling him as a support is no good because he's so rigid towards her... okay, straight up, her self-esteem would go low... I feel sorry for her.* Interestingly, however, M1 seemed less focused on the goal of making MC completely smoke-free, because she allowed MC to lapse 14 times during two weeks: *...but look, she's cut down dramatically, she doesn't have to quit smoking... it's like crash dieting, you can't like, have lettuce all your life.* Based on the lack of concern with MC's quitting, we theorise that M1 was using self-esteem less as a means to success, and more as a general barometer of how happy she was able to make MC feel. Since M1 did not conceptualise MC as herself, perhaps by keeping MC's self-esteem high, she felt that she was helping to maintain ingroup happiness levels, with MC as part of her ingroup. Unlike all the other players of the NZE version of *Smoke?* M2, did not discuss self-esteem or refer to its presence at all throughout the game.

3.3 Game Feedback (Application of Conditioning)

Related to the drive to increase self-esteem is the seeking of positive feedback, which is more acceptable than negative feedback in individualist societies [12,13]. In the NZE version, then, we tried to minimise negative game feedback.

Congruent: E1 and E2 both believed that obtaining positive feedback would be instrumental in keeping MC on track with quitting. For example, E1 illustrated a belief that it was important to keep self-esteem boosted, even at the cost of personal relationships, in this comment about MC's love interest: *I don't think she should talk to her boyfriend because he gives her negative feedback.* On encountering Hayden, a non-smoker character in the game, E1 said: *Look, this guy's good because he's already quit... that guy's really positive, maybe she should hang out with him and get buddies.* E1 voiced how she was using MC's happiness as a short-term goal aiding the larger goal of complete cessation: *...smoking produces endorphins, and so if she plays netball she'll naturally produce endorphins.* E2 chose activities for MC that she believed would avoid negative feedback. For example, she made MC go for a run (alone), and avoid a gym class because she thought that running with a friend might decrease MC's self-esteem, since MC was not fit. E2 also avoided cooking as a chance activity, since she thought it might lead to over-eating which, again, could have resulted in a drop in self-esteem.

Incongruent: Like E1 and E2, M1 appeared to choose actions for MC based on what she thought would keep MC in a positive mental state. For example,

she explained why she chose to have MC avoid her love interest at a club: *I don't want him to kill her night cos he's always so nazi to her.* In contrast to the others, M2 made no overt reference to the importance of keeping MC feeling positive. He focused rather on doing whatever he thought was necessary to keep MC from smoking. For example, he chose to make MC talk to a stranger at a club after MC had a fight with his love interest, because he noted that the fight had increased MC's temptation to smoke. Similarly, M2 tended to make MC listen to music as a control activity because it is what he would do himself in real life to soothe frustration.

3.4 Autonomy Focus (Application of Tunnelling)

We have tried to convey in the NZE version of *Smoke?* a sense of autonomy over the quitting process, particularly in terms of reliance on other people. The autonomy focus of the NZE version, in fact, serves as an application of the TUNNELLING strategy.

Congruent: E1 and E2 showed that they subscribed to a personal view of control over the quitting process. This is what we would expect because individualists have a more autonomous sense of control over their lives [11,12,3,14]. For example E2 stated: *...[quitting smoking is] definitely something you do on your own, no matter how much support you get, it's up to you.* At the same time, E1 said that MC's friends needed to "stop pressuring her", so she chose to make MC confront them about their lack of support, explaining that she wanted her friends to understand MC's position and take more responsibility in helping her quit. It is interesting to reflect here on E1's expectations of MC's friends because the idea of needing social support may seem like a collectivist expectation. Collectivists would be unlikely to adopt such an approach, however, as they would tend to minimise conflict and would not engage in confrontations for fear of disrupting group harmony [11,14,12]. E2, in contrast, was untroubled by MC's friends not supporting her. Her preference for completely independent decision-making is indicated by this comment about peer pressure: *MC should still have an independent decision... it's not up to MC's friend to make the decision.*

Incongruent: At one point in the game, M1 chose to have MC make up with her best friend. In justifying this choice, she said: *It's not her friend's responsibility. If MC wants to quit she has to do it on her own accord, and part of quitting, you know... of course there will be influential factors around you, so she just has to have the will power, it's like dieting. There's going to be people eating junk food around you, you just have to say no.* We can read M1's response in at least two ways. At one level, she is explicitly stating that MC needs to retain personal control over her choice, and that MC should not need to rely on others. This is a more individualistic tendency. At the same time, she chose to make up with the friend, even though she did not have to, and we can read this as a desire to minimise confrontation with other group members, exhibiting a collectivistic tendency [11,14,12]. M2's attitude towards MC's friends is similarly mixed. M2 claimed early on in the game that friends are important in helping MC quit

because friends can talk MC through the process. At the same time, when MC's friends offered MC a cigarette, M2 directly chose not to accept it. Yet later, when the same friend did not turn up to meet MC, M2 had the option to confront the friend about it, but chose not to, stating that confrontation was unnecessary.

3.5 Game Acceptance

Congruent: Both E1 and E2 seemed to understand all the concepts represented in the game content and narrative. While E1 did complain about the unhelpful nature of MC's social interactions, both she and E2 demonstrated in their choices that they gave preference to individual motives for action. At the very least, neither E1 or E2 seemed surprised by anything they encountered. This seems to reflect Hall's notion of the "hidden program" [15], by which people readily accept what they encounter if it is culturally familiar.

Incongruent: Most of what M1 and M2 vocalised seemed to indicate that they had similar independence-oriented motivations as E1 and E2. One way to reason about this interesting result is the effects of acculturation: both M1 and M2 had spent much of their lives in NZ European-dominated systems, and thus might have become adept at moving between Māori and NZ European identities. Another possible reason related to the "multiple identities" perspective is what Hong et. al. term *frame-switching*. This is the switching between cultural knowledge structures, choosing the one that seems more relevant and readily-available, if knowledge exists for more than one structure. Yet another factor potentially affecting the responses of M1 and M2 is the phenomenon termed "socially desirable responding", where people tend not to tell complete truths to save face, a behaviour which people of collectivistic orientations are more likely to engage in [13]. Additionally, Vatrapu and Quinones found that when the ethnic background of usablity evaluators matches the background of participants, evaluators are more successful in eliciting feedback [16]. The evaluator of M1 and M2 was clearly of European descent, and therefore not matched to their backgrounds. Supporting all of these potential reasons is the observation that, despite the verbal explanations proffered by M1 and M2, some of their actions, such as their avoidance of conflict, seemed to indicate the existence of potentially different motivations that they were not expressing.

4 Findings for the NZM Version

4.1 Identification with MC

Congruent: M3 maintained a self-identification view of his relationship with MC. For example, during the set-up phase, M3 explained how he was choosing MC's personas: *...I'll pick the things I wish I was.* Later in the game, he related instances in MC's life to his own: *this reminds me of a friend of mine who quit drugs. This kind of conversation happened with him as well... it wasn't helpful.* M4 also clearly identified with MC, and said that the way she played the game

came "natural" to her. Commenting on a particular part of the game, M4 said the following, illustrating a strong level of cultural identification with the game content: *This always happens to us Māoris.*

Incongruent: E3 initially identified MC as a representation of himself. As the game progressed, however, E3 pointed out that he was aware that he was not an intended target audience for the game:

E3: I'm assuming this is targeted towards Māori or Polynesians.
Administrator: What cues give you that idea?
E3: I guess the language
Administrator: Anything else?
E3: The family and stuff.

E4 openly said that he did not identify, and moreover, did not want to identify with MC, and claimed that he was just acting as a guide for MC.

4.2 Respect (Application of Mentoring)

A defining feature of the NZM version of *Smoke?* is the *respect* score, which serves as an application of our MENTORING guideline. With the *respect* score, we aimed to communicate a sense of group responsibility, which is of central importance in collectivist cultures [12,11,13,3].

Congruent: M3 said the following on noticing the presence of the *respect* score in the game: *Oh is he Māori? Because for Māori people this would be very important. Its like collective responsibility, you know? When one person does something everyone feels responsible, that's what it makes me think anyway.* M3 continued to check the *respect* score for the remainder of the game. While M4 did not comment directly on the *respect* score, she did state that she thought that MC's quitting success depended on how he was perceived by the whanau (family) and others, and not just by his own standards.

Incongruent: In contrast to M3 and M4, E3 viewed the status screen and commented: *General health... Whanau respect... Cigarettes smoked... is respect really that important?* Neither E3 nor E4 overtly referred to the *respect* score during the game.

4.3 Jade Status (Application of Mentoring)

Jade's presence, and particularly her status screen, is an application of the MENTORING strategy in the NZM version of *Smoke?*

Congruent: M4 found Jade's presence to be motivational and inspirational, and commented that what MC did had an affect on everyone, including Jade. She also illustrated a collectivist perspective on the interconnectedness of role-modelling and acting to serve the interests of the ingroup, by commenting about the opinions of the family [3,13,12]: *They are happy with his progress so he can keep on setting a good example for Jade.* M3 initially responded positively to

Jade's presence: *Oh she's so cute!* For the remainder of the game, however, M3 neglected to check Jade's status.

Incongruent: In complete contrast, neither E3 nor E4 found Jade's presence to be pleasant, useful, or motivational. On encountering a reference to Jade in the game, E3 said: *Who the hell is Jade?* Later on in the game, he said: *It didn't cross my mind to check Jade's status, I don't think anything I would do would change her status. I forgot about her.* E4 voiced his irritation at Jade's presence: *Surely when you crave a cigarette you want to just be alone and also keep doing things like touch [rugby] that can distract you and not look after kids and stuff.*

4.4 Moods + Opinions Box (Group Opinion and harmony)

The *moods + opinions* box is another unique element of the NZM version of *Smoke?* representing applications of the GROUP OPINION and HARMONY strategies. A common feature of collectivist culture is a consensus-oriented way of decision making [14,13,17].

Congruent: Both M3 and M4 made use of the *moods + opinions* box throughout the game. M4 said the following about the presence of other family members: *They give some positive feedback and can encourage you.*

Incongruent: E3, on the other hand, did not check the opinions at all, and when he was asked whether he was intending to check them answered: *Nah, not really, only if I think they are useful.* E4 did not check the opinions either, and commented about decision-making: *MC can decide what he wants to do.* Both E3 and E4 clearly preferred a more individualistic process of decision-making.

4.5 Sandwich + Tag Game (Application of Harmony)

The *sandwich game* and *tag game* are the minigames featured in the NZM version of *Smoke?*, and act as applications of the HARMONY guideline.

Congruent: M3 readily accepted the sandwich making task, and even become flustered by his performance: *Oh no, I can't even read it, oh I'm so bad at this... rye, rye, mayo, lettuce, was there lettuce? Tomato, I think there was tomato, oh my gosh, next person...* It seemed that M3 had taken the responsibility of making sandwiches for other family members willingly, and did not want to disappoint them. This is a classically collectivistic trait [18,14,13,19].

Incongruent: Both E3 and E4 specifically vocalised their dislike of the social nature of the *sandwich game*: *Why do I have to make the sandwiches? That's sucks... stupid game! Why does he need to make sandwiches for everyone, he can just grab lunch on his own!*

4.6 Social Density (Application of Harmony)

General social density is a theme of the NZM version of *Smoke?* representing an application of the HARMONY guideline.

Congruent: Neither M3 nor M4 found the constant presence of many NPCs to be particularly unusual. M4 in fact described their presence in the game as a built-in support system that made players aware of themselves and their relationships to others. She also said: *The family members make MC feel safe and less judged. ...family understand how difficult the quitting process can be and they will always be there to support you if you want to try and quit.* When he had to select a response for MC, M3 illustrated his own drive to avoid conflict and maintain harmony, and said: *I'm gonna pick this option as the others are quite defensive even if it's not true.* The constant presence of extended family is less usual in individualist cultures [3,11,17,13].

Incongruent: Unlike the Māori players, E3 and E4 found the presence of family members and other characters distracting. E4 said the following about family: *They can sometimes discourage and tease you and say that 'old habits die hard' and that 'it's not that easy to quit' or make comments and stuff like 'I wonder how long he will stay quit?'* On succeeding in making MC remain smoke-free for a year, E4 also illustrated his belief that quitting had an individual locus of control, and that other family members had had little, if any, impact on MC's success: *MC did it — now he can go celebrate!*

4.7 Opinions from Elders (Application of Group Opinion)

Another application of the GROUP OPINION guideline in the NZM version of *Smoke?* is the presentation of opinions from elder family members, because elder family members typically have a privileged position in collectivist cultures [13,3].

Congruent: In general, both M3 and M4 found the opinions presented to be helpful in guiding their decisions for MC. With respect to the grandmother's wishes that MC repair his damaged relationship with his cousin, M3 rationalised the grandmother's attitude, saying the following: *That's just normal, isn't it? I imagine my gran would talk to both of us.*

Incongruent: In contrast, E3 verbalised the unfairness of the grandmother's opinion while still choosing to resolve issues with the cousin. When questioned why he made MC take this course of action, E3 responded with the following: *I suppose it's the right thing to do.* In this case, E3 demonstrated a reliance on universal norms for guiding behaviour, compared to ingroup norms, which is more typical of individualists than collectivists [12,11].

4.8 Game Acceptance

Congruent: M3 and M4 responded largely in accordance with our design intentions for the NZM version of *Smoke?* in relating to a collectivist viewpoint. Apart from M3's lack of interest in Jade's welfare, M3 and M4's verbalisations during play highlighted that they understood the group-oriented motivations underlying the NZM version-specific elements of the interface and narrative. They specifically used the group-oriented interface elements during play, and factored group motivations into their interpretation of the narrative. In questioning after

the game, M4 even said that events in the game reminded her of events from her own life, and that the game was "the way it is in Māori culture".

Incongruent: In direct contrast, neither E3 nor E4 particularly related to the cultural assumptions underlying the NZM version of *Smoke?* They were confused by the group-centric interface elements and narrative details, and on occasion explicitly stated that they viewed issues of cessation to be more individual than group-focused. Indeed, both E3 and E4 became annoyed with the group emphasis built into the NZM version. It is interesting to reflect on the differences in reaction between the NZ European players of the NZM version, and the Māori players of the NZE version. A reason for the differences in reaction valence might be explained by the effects of majority and minority audience targeting. Minority audiences are accustomed to not being the intended recipients of much communication material, and are familiar with majority audience-targeted material. Aaker et al. found that when minority audiences encounter material targeted at them, they tend to respond to it more positively than majority audience members respond to material targeted at them [20]. In contrast, majority audience members respond more negatively to material targeted at minorities than minority audiences responses to majority-targeted material. E3 and E4's lack of acceptance of the NZM version is potentially explained by an absence of acculturation to Māori culture, because it is less accessible to the general public than the dominant, NZ European, representations of culture.

5 Conclusions

The qualitative evaluation allowed us to investigate players' immediate reactions to, and interpretations of *Smoke?* The players explicitly referenced notions of culture in their verbalisation, so we were able to definitively relate their impressions of the game to culture. We were also able to note where players explicitly interacted with guideline-informed game interface elements, which allowed us to rule out basic appreciation of overt cultural references as a main reason for attitude change. Players had more positive responses to the game version that reflected their cultural background, and had either mixed, or more negative responses to the game version that did not reflect their cultural background. Of course, the limitation of our evaluation is the small sample of test participants may not have been representative of typical members of individualist and collectivist cultures.

Both the NZE and NZM versions of *Smoke?* were informed by different combinations of PT design strategies. While a quantitative evaluation did not allow us to isolate and assess the effectiveness of any one individual guideline, this qualitative analysis provided us with a much better insight into players' responses to the strategies. The qualitative insight, however, was specific to our prototype, as the players were reacting to our *Smoke?*-specific implementations of the strategies, and not the strategies themselves. Working within these constraints, the qualitative evaluation participants overall perceived and interpreted the culturally-relevant PT design strategies implemented in the game as we had

hoped, and the Māori players even used many of the guideline-based game features to inform and enhance their playing of the NZM version of *Smoke?*

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Exploring the Acceptability of Delayed Reciprocity in Peer-to-Peer Networks

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Abstract. Using Peer-to-Peer (P2P) technology for distributing Television programs to many viewers simultaneously can only be successful if users cooperate voluntarily and massively. The current BitTorrent protocol only enforces instantaneous bandwidth exchange within the context of one video file. We explore ways to induce user cooperation flexible over time and over type of resources. Essential resources for a P2P system are: bandwidth, injections, moderations, and appreciations. Social exchange theory is taken as a background for addressing the inducement of cooperation in a P2P-TV system called Tribler. This theory helps to explain how the acceptability of delayed reciprocity can be influenced by the specificity of the exchangeable resources and by the relationship types between individuals. This paper presents the results from a study among 36 participants about the acceptability of delayed reciprocity in a P2P-TV system, under varying relationship types and specificity of exchangeable resources.

Keywords: User communities, quantitative research, social issues, theories.

1 Introduction

In previous work we concluded that Peer-to-Peer (P2P) technology is vital to the Television of the future, where *inducing* massive, positive, and voluntary cooperation among users is the most challenging problem [1]. As in existing P2P systems, P2P-TV may also suffer from selfish behavior of users who do not feel responsible to contribute. For example, users stop donating their upload bandwidth as soon as their download has finished. In [1], we listed 13 theories from social psychology, which provide clues for solving this cooperation challenge. The social exchange theory [2] was identified as promising for inducing cooperation in our P2P-TV system called Tribler (www.tribler.org). This theory states not only that when people give something, they expect something in return, but also that the resources exchanged need not be of the same type. Next to materialistic goods, appreciation is regarded as an exchangeable good as well. In [3] it is argued that the exchanged goods usually differ between 'exchange relationships' and 'communal relationships'. Exchange relationships can be found between two people who do not know each other and who have

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never interacted before. Their first interactions are typically based on mutuality and mistrust, accepting no delay in reciprocity. This is what the tit-for-tat rule of the BitTorrent protocol (www.bittorrent.org) is based on: instantaneous exchange of bandwidth (i.e. download for upload) in the context of one file. Communal relationships on the other hand, are based on trust and delay in reciprocity is acceptable. This relationship type can be found among long-term relationships, friends, and kin. In this paper we explore the principles from the social exchange theory to induce an increase in cooperation by exploiting communal relationships. The aimed cooperation is flexible over time and over resource type.

Variability of Reciprocity. The acceptability of delayed reciprocity may be influenced by many factors such as social hierarchy, shared history, age, and geographic distance. We will only take three variables into consideration for a P2P-TV system: **1) Relationship type**. Often, a difference is made between communal and exchange relationships. We chose to further specify this into degrees of separation (DoS), according to Milgram [4]. We define the 1st, 2nd and 3rd degree as communal and anything beyond the 3rd degree as exchange relationship. **2) Specificity**. Resources of the same type can be exchanged, but also of different types. The latter is often preferred in communal relationships, as it indicates interpersonal trust, while the former is often preferred for establishing a sense of justice in exchange relationships [5]. **3) Immediacy**. Reciprocity may be 'instantaneous' or 'delayed'. Immediate reciprocity is characterized by a minimum of obligation and a maximum of social distance. Delayed reciprocity is an expression of diffuse and generalized obligation characterizing kin or other close relationships of long standing. Here, one tends to be tolerant to the moment when and what is returned [6].

Exchangeable Resources. In P2P-TV systems such as Tribler, the following specific resources are available: **a) Bandwidth.** Users donate their idle bandwidth to others, helping them to speed up their downloads of movies. **b) Injection.** Users add new and unique movies to the system. **c) Moderations.** Users check, insert, and update content metadata in order to keep the content and metadata clean, correct, and free from intentional pollution. **d) Appreciations.** Users show each other appreciation for receiving resources or explicitly for the quality of shared content. Received appreciation adds to a user's online reputation, which is visible to all other users of the system.

2 Pilot Study

The pilot study was carried out to get a preliminary idea of the limits of the acceptable time delays under varying DoS and specificity. The 36 participants were 33 university students (seven female, 25 male and one unanswered) and their three supervisors. All participants except one knew and had experience with video websites/services such as YouTube, Tribler, Joost, and Google Video. Participants had to imagine belonging to a community corresponding to their own taste in movies and in which they could download movies from each other. Appreciation was not regarded as a resource that can initiate an exchange, but only as something to receive in return for another resource such as injecting a new and unique movie. The participants were divided in

four groups, each of which received different versions of the questionnaire. Each version had a different DoS. The participants were given scenario-based questions. A number of these questions will be discussed in the next section. It took the participants approximately 15 minutes to finish the questionnaire.

Results. In the first scenario, participants injected one movie at the request of a 1st/ 2nd/ 3rd/ Nth degree contact. The contacts would give bandwidth for three movies in return. Table 1(a) shows how long the participants would accept to wait for that return to start. It suggests that for DoS=1 and DoS=2 more participants accept delays of one day and longer, and that for DoS=3 and DoS=N more participant accept delays of eight hours and shorter. This seems to confirm the difference between communal and exchange relationships. In the second scenario participants have given bandwidth for one movie at the request of a 1st/ 2nd/ 3rd/ Nth degree contact. They wait 10 days for the return. Table 1(b) shows what they consider an acceptable resource in return. One participant replied he/she wouldn't help at all. The high acceptability for injection among DoS=1 to 3, the high acceptability of bandwidth among DoS=N, and the low acceptability of moderations among all DoS stand out in this table. For the first two resources, it seems that a taste-objective resource such as bandwidth is mainly accepted from exchange relationships (DoS=N) and that a taste-subjective resource such as injection is mainly accepted from communal relationships (DoS=1 to 3). In the third scenario, the participants had to imagine they have added moderations for 10

Table 1. (a) Acceptable time delay for when injection of one movie was donated and bandwidth for three movies was to be returned. (b) Acceptability of the returned resource for when bandwidth for one movie was donated and the return would take 10 days.

Group	Size	≤ 10 mins	30mins	1 hour	8 hours	1 day	3 days	≥ 10 days
DoS=1	9	3	1	2	0	1	1	1
DoS=2	10	2	0	0	1	2	2	3
DoS=3	9	4	0	3	0	0	0	2
DoS=N	8	3	1	0	0	2	1	1

(a)

Group	Size	Bandwidth	Moderations	Injection	Appreciations
DoS=1	9	3	0	4	2
DoS=2	8	2	0	3	3
DoS=3	9	2	1	4	2
DoS=N	10	6	1	1	2

(b)

Table 2. Moderation is given for 10 movies, injection will be returned, either with no delay for one movie or with delay accepted for three movies

Group	Size[1]	No delay accepted	Delay accepted	Average accepted delay (days)	σ
DoS=1	18	11%	89%	8.6	8.0
DoS=2	9	11%	89%	7.4	6.1
DoS=N	9	44%	56%	4.8	3.0

[1] Due to a mistake in scenario three, the group with the intended DoS=3 ended up in the group with DoS=1.

movies. They were presented with the choice between immediate return of one injected movie, or delayed return of three injected movies. When they chose the latter, they had to indicate how many days of delay they would accept. The results are shown in Table 2. One participant replied he/she wouldn't help at all. Another participant said he/she would accept that the given resource would never be returned. These two answers are left out of the results.

The results suggest that for DoS=N more participants preferred immediate reciprocity than for DoS=1 and 2. When they would accept a delay, they would wait 4.8 days on average. While for DoS=1 and 2 they would wait 8.6 and 7.4 days respectively.

3 Conclusions and Discussion

In this paper, we presented results of a pilot study into the limits of the acceptability of delayed reciprocity in P2P systems. Our results suggest that theories from social psychology such as the social exchange theory can be applied to new fields of technology, among which P2P technology. We believe that making people aware of the community they belong to and of the type of relationships between members will induce more cooperation in P2P systems, and more general in persuasive systems.

From the participants' comments we learned that *directionality*, as a fourth variable of reciprocity next to *immediacy, specificity,* and *relationship type*, is more important than we expected. Directionality may be 'directed at one person' or 'directed at the whole community'. Moderation for instance, is not directed at one other person but at the whole community. Participants felt less induced to cooperate for the benefit of the community than for a specific person. Directionality will be incorporated in a follow-up on this study among 300 participants, to be finished in May 2008.

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How to Build a Persuasive Web Application

Three Fundamental Feedback Loops

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Abstract. Successful web applications are able to influence the behaviors of their users. The top 40 facebook applications were analyzed to determine the most persuasive ways of achieving such influence. This paper presents a framework of feedback loops for this purpose and then applies it within the context of facebook.

Keywords: Persuasive technology, facebook, social networking, influence, behavior change, online communities.

1 Introduction

Persuasive technologies are able to influence user behavior by applying principles recognized in the field of Social Psychology [1]. They are pervasive on the internet, where an application's success is tied to its ability to influence the behaviors and actions of its users. For example, most applications grow by persuading users to recruit their friends as new users.

Social Networking. The ascent of social networks including facebook – with over 65 million users [2] – has provided researchers with an unprecedented opportunity to investigate the cues that effect behavior change. In May, 2007, the Facebook Platform was launched, allowing developers to create web applications that utilize the social graph. This has resulted in an explosion in the variety of options presented to the user and an increased ability to track user actions. For these reasons, facebook was chosen as the medium for this research.

Theory. User-application interaction is often modeled by control flow diagrams in which users move between states by performing specific actions. Often, these flows linearly transport a user from an initial state to a final state. While this is suitable when the goal is to influence a sporadic behavior, it has been demonstrated that to influence a regular behavior requires repetitive reinforcement [5]. Therefore, flows that effect regular behaviors tend to be recursive loops which are reinforced (feedback) at every repetition. Many papers have shown how web services can influence user behavior [3,4]. This paper continues in that vein by contributing a framework of three feedback loops that the most persuasive applications use specifically to acquire new users and retain engagement.

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2 Methodology

The 40 facebook applications with the most active users as listed by the Adonomics leaderboard [6] were sorted by percent active users and then grouped by theme. For each group, control flow diagrams were drawn to describe the user experience. Patterns in these diagrams uncovered three categories of feedback loops, as shown in figures 1-3.

3 Fundamental Feedback Loops

Growth Loop. The growth loop (Fig. 1) encourages the invitation of new users. In the *action* variant, the actions of current users automatically serve as invitations to new users. This is natural within social networks because one must register with an application before interacting with it.

This variant is commonly seen in applications which allow users to 'hug' their friends. The loop works as follows: 1) users 'hug' a friend; 2) the friend is notified of this 'hug' by an invitation to register with the application; and 3) the friend accepts the 'hug' by registering with the application. Such an application can grow simply by engaging its current users.

Because users are compliant [7], psychological tweaks can enhance this loop's persuasiveness. For example, telling users that they should 'hug' 20 friends can result in this desired behavior. Another strategy is to encourage users to be in the top quartile of the 'most hugging' users.

In the *viral* variant, current users must invite additional, new users to reach the application's functionality. *Viral* flows tend to grow faster than *action* flows because they ensure that the application has sent out a number of invitations proportional to its current user base. The request that a user recruit friends before interacting with the application is sure to discourage some users. Therefore, it is important to frame the required invitations as actions and to make the functionality sufficiently enticing to persuade users to send invitations.

This loop is is seen in instances where users send points to other users. For example, 'Send HOTNESS' requires a user to invite 15 friends before being allowed to see their own 'hotness score'. This incentive has proven powerful enough that many people do invite 15 friends, far more than making up for the users who leave immediately. Another application, 'Perfect Match' has used a variant of this loop. For every friend a user invites, a new 'perfect match' is revealed. In this sense, each invite can be seen as an action for which points are rewarded and automatically redeemed for additional functionality.

Frequency Loop. The frequency loop (Fig. 2) rewards frequency of usage and visitation. Since the monetary value of an application is related to page views, this loop is critical. There are two types of frequency to reward: frequency of visit and frequency of action.

Frequency of visit lends itself naturally to a points-based framework. Users are rewarded points for every visit within a set time period. These points can be redeemed for new functionality.

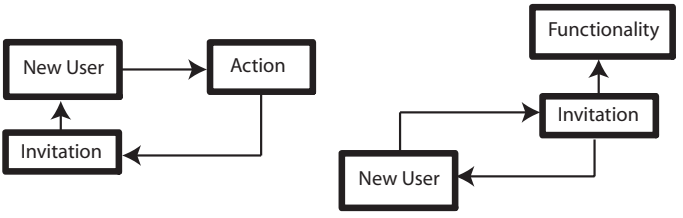

Fig. 1. Growth loops acquire new users by engaging current users. The *action* variant (left) might be implemented in the form of an invitation: "Someone has kissed you! Click to see whom." The *viral* variant (right) is seen through a dialog message: "When you have earned 100 points you will see your perfect match".

Frequency of action is rewarded by unlocking new features for surpassing a set level of usage. For instance, frequent 'SuperPoking' grants new actions. Alternatively, honorific badges can be granted to reward action frequency. 'Vampires' implements this by honorific, level badges corresponding to a user's points range Service-oriented applications can reward frequency of action by increasing the priority of service granted to the user. 'HotOrNot' does this by displaying the users' picture to suitors at a frequency related to the user's activity level, thus awarding the user with more attention.

Loyalty Loop. The two loyalty loop (Fig. 3) variants maintain user interest. Action-based applications often have *reciprocal* actions. In this variant, the norm of reciprocity leads the recipient to reciprocate [8]. Reciprocal actions (e.g. poke, kiss, etc.) can therefore lead to persistent loops. By notifying the user that they are the recipient of a new action, the application provides a call-to-action.

The second variant occurs when there is no a reciprocal action. Here, *time* is the hidden hand. These applications provide information to the user – for instance the user's rank in a ladder – that changes over time. Applications can prompt users to return by alerting them when their state changes. Few applications take advantage of this, presumably because notifications in facebook must be user-action driven. However, it would be powerful for 'Perfect Match' to suggest that 'an even more perfect match has been found'. All applications can use this loop through ceaseless iteration and a new-features roadmap, making it exciting for the user to see if their favorite application has changed.

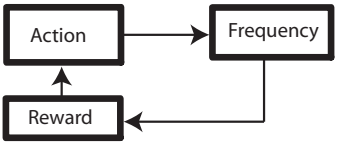

Fig. 2. The *frequency* loop rewards behavior. Representative dialogs are: "You are now a level 4 Werewolf!" and "Vote more and your picture will be shown more frequently".

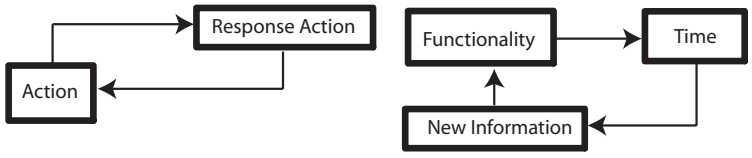

Fig. 3. Loyalty loops program long-term behaviors. The *reciprocal* variant (left) is the return of an action by another user, motivated by the norm of reciprocity. The *time-based* variant (right) is the result of action taken on the user by the application: "We found an even more perfect match!".

4 Future Research

This paper focuses on the acquisition and engagement of users There are a multitude of other desired behaviors that web applications seek to influence, each of which will have its own feedback loops analogous to those presented in this paper. Future research could develop new frameworks of feedback loops designed to elicit other desired user behaviors.

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"Hey World, Take a Look at Me!": Appreciating the Human Body on Social Network Sites

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Abstract. Social network sites (SNSs) such as Facebook have the potential to persuade people to adopt a lifestyle based on exercise and healthy nutrition. We report the findings of a qualitative study of an SNS for bodybuilders, looking at how bodybuilders present themselves online and how they orchestrate the SNS with their offline activities. Discussing the persuasive element of appreciation, we aim to extend previous work on persuasion in web 2.0 technologies.

Keywords: Persuasive technology, social network sites, web 2.0, persuasion, appreciation, recognition, fitness, bodybuilding.

1 Introduction and Background

Social network sites (SNSs) like MySpace, Facebook or Cyworld have attracted millions of users. These sites allow users to present themselves on a profile page, to establish visible friendships with other users and to exchange messages. Compared to other web 2.0 technologies, SNSs also tend to be better integrated in offline activities [1], which makes them a useful tool to help people change their lifestyles. Fogg [2] even states that in 2007, Facebook has been the most effective persuasive technology.

This paper investigates how SNSs persuade people to adhere to a lifestyle based on fitness training and healthy nutrition. The persuasive element we are looking at is *appreciation*, the recognition users get online [3] and the feeling of empathy people experience in their interactions with others who have had similar experiences.

Bodybuilding is an example of an individual-oriented sport that provides a contrast to the interconnectedness of SNSs. Bodybuilders use SNSs (in this case an SNS called BodySpace) as a support tool to adhere to their lifestyles based on training, diet and recuperation. On the SNS they present their physiques and exchange appreciation for their achievements in preparing and competing in bodybuilding competitions.

Our aim in this study is to start to extend previous work on persuasion in web 2.0 technologies [4, 5, 6] and help to inform the design of persuasive technology promoting sustainable healthy lifestyles.

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2 BodySpace: A Social Network Site for Bodybuilders

BodySpace (www.bodyspace.com) is an SNS with a current base of more than 125,000 gym users and bodybuilders. Similar to other SNSs, people can create a profile page to present themselves and establish publicly articulated friendships with other users. They can also leave comments on other people's profile pages or exchange private messages. The site has additional features that allow people to describe their goals and to monitor their progress using body and training statistics. For example, the progress pictures feature allows users to upload photos with a timestamp to create a visual history of their transformation as in figure 1a. Beyond that, BodySpace is integrated with a photo gallery, individual blogs, a discussion forum and an online shop for fitness equipment and food supplements.

Fig. 1. a) The progress pictures illustrate the participant's transformation from an obese to a muscular physique. **b)** The profile picture shows the participant posing after a victory.

3 Field Study

We used a qualitative approach to explore, how bodybuilders orchestrate the use of BodySpace with their offline activities. Our approach used semi-structured interviews and participant observation – both online on BodySpace and offline in bodybuilding gyms and bodybuilding competitions. We conducted 10 interviews with BodySpace users (3 female, 7 male; aged between 20 and 56 years). The interviews were conducted face-to-face, on the telephone and via email. We also collected data from the participants' BodySpace profiles, which included their personal descriptions, photos and a total of 1968 posted comments. The participants were recruited through a private message on BodySpace. Using a purposive sampling strategy allowed us to recruit bodybuilders at different stages of their careers, ranging from bodybuilders preparing for their first competition to bodybuilders who competed on a professional level. Two further face-to-face interviews were conducted with experienced bodybuilders who are not on BodySpace, as a way to verify our findings. We analyzed the rich set of data using a 3-step coding process [7] leading to various themes. In this paper we focus on the theme of appreciation and discuss, how appreciation offline in the gym and online on BodySpace relate.

3.1 Seeking Appreciation

The absence of appreciation offline was a common theme in the interviews: The group of competitive bodybuilders reported that only people who also went through the *"hell of preparation" (Bill[1], 27)* could relate to what they had achieved. Bodybuilding competitions are the most important place for appreciation where people present their bodies on stage in front of a knowledgeable audience. Despite the competitiveness in these places, most participants reported a sense of mutual awareness among bodybuilders for their hard work; but elsewhere they felt a lack of understanding by their friends, families, and often even by their gym peers. For example, two people reported negative remarks in the gym: a woman was criticized in her gym for not looking lady-like and a man was accused of taking steroids.

Similar to presenting oneself on stage in a bodybuilding competition, BodySpace allows bodybuilders to present themselves online - presentation being a prerequisite for receiving appreciation. One participant said: *"It gives us a place to post our picture for the whole world to see... Bodybuilders need to be noticed... It feeds our muscle ego, it motivates us" (Dave, 28).* The participants used profile pictures to highlight their favorite body parts, show themselves on stage (see fig. 1a), or to attract the attention of magazines to work as a photo model. Competitive bodybuilders used the progress pictures to document their progress in the preparation for competitions. One participant used the progress pictures to present her transformation from an obese body to a lean body, and then to a muscular bodybuilding physique (see fig. 1b). Before sharing the photos on BodySpace, she used them at home to remind herself of the progress she had made.

Self-presentation does not only take place on one's own profile page. Recent updates of pictures, goals and statistics are automatically featured on the BodySpace homepage. Some participants looked proactively for appreciation. They left comments on their online friends' profile pages, to let them know about profile updates, or how they performed in competitions.

3.2 Exchanging Appreciation

All participants had established connections with friends on BodySpace, ranging from 8 to 147 mutual friends. They reported a feeling of empathy through the connections with people who went through similar experiences, although only two participants had a friend on BodySpace, who they also met in real life.

The non-competitive bodybuilders in this study used the network as a resource to seek advice from experienced bodybuilders. The profile description allowed them to approach people for specific advice according to their achievements, which was seen as an advantage to more anonymous discussion forums. The appreciation they received, was either some form of advice or the offer to help based on more detailed information, together with a compliment on the progress they had already made, for example: *"Your transformation kicks ass! … Great Job!" (Catherine, 24).*

All participants on BodySpace used comments to leave compliments on other people's profile pages. Most comments were related to the body parts featured on photos

[1] The names of all participants have been changed.

or to the goals expressed on the profile page. Usually they contained a statement of positive reinforcement, e.g., *"Keep it up man! You'll look huge with an extra 8kgs of muscle on you" (Jarvis, 23).* Appreciating other people's achievements was typically reciprocal and led to the reception of a similar comment.

The highest form of appreciation was receiving a message that one's work is an inspiration or a role model for the other person. One participant stated *"Other female competitors telling me they want to look like me when they next compete - this blows me away!" (Monica, 35).*

The feedback of other BodySpace users sometimes even went beyond the mere appreciation of the bodybuilding achievements. Several participants reported that they received propositions online by other people of the opposite sex and the same sex.

4 Conclusions and Future Work

In this paper we have started to explore various forms of appreciation that bodybuilders exchange in a social network site and related offline environments. The BodySpace site is a tool to provide a permanent form of self-presentation and to connect individual athletes. Compared to offline environments, BodySpace provides an environment of enhanced mutual appreciation based on recognition and empathy.

This study highlights how an SNS like BodySpace allows experienced bodybuilders to exchange appreciation with peers, and in future studies we will look at how this works more generally – for example for new gym users or athletes in other sports. We have also started to explore the way in which sites like BodySpace work as persuasive environments that promote activities such as comparison and social learning. In future studies we will use existing theory on persuasion as a lens to further examine these themes.

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Digital Therapy: The Role of Digital Positive Psychotherapy in Successful Self-regulation

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Abstract. We are currently developing a digital positive psycho-therapy intervention. The intervention will be presented at the 3rd International Conference on Persuasive Technology 2008. By means of installing positive emotions, digital positive psycho-therapy may help prevent ego-depletion and hence increase the chances for successful self-regulation. This may turn out to be an important component in many health behaviour interventions. The current paper discusses some basic insights regarding how digital psychotherapy interventions can be designed and why they hold the potential to make a valuable contribution.

Keywords: Digital Therapy, Self-Regulation, Positive Psychology, Digital Positive-Psychotherapy, Behaviour Change, Health Psychology.

1 Introduction

Digital health psychology interventions are expected to play an increasingly important role as a public health tool, because of a number of advantages they offer over traditional intervention methods. A major problem with face-to-face delivery of interventions is that it is extremely resource intensive. In contrast, interventions delivered by means of digital media can be made available to most of the population for little more than the cost of development [1,2].Whereas the quantity and timing of information, advice and support that can be delivered face-to-face or in group counseling is very limited digital interventions can be accessible at all times and in most places (e.g. by means of mobile phones) and hence provide intensive and situational adequate advice and support [1,2]. Due to improved convenience and because they offer anonymity, digital interventions also provide an alternative means of reaching groups of the population that are often found to be reluctant to consult professionals concerning lifestyle problems [2]. Although currently delivered principally over the web, future digital interventions are expected to be increasingly flexibly accessible through mobile phones, mp-3 players, interactive digital TV, etc.

Since face-to-face counseling are often found not to be cost-effective, mass media (e.g. booklets) are often used to disseminate interventions more widely. However, the information and advice provided in printed media cannot easily be neither personalized nor individualized to the particular need and situation of the individual client, and may therefore be dismissed as irrelevant [3, 4]. Interactive digital interventions can also provide a rich, stimulating, engaging and actively supportive environment,

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with audiovisual illustrations, reminders, personalized feedback regarding progress and concerns, and opportunities to install peer-to-peer support and social comparison [5, 6]. Given the advantages of digital health psychology interventions, it is unsurprising that their use is proliferating very rapidly, although the technology to support them (in particular, broadband access) has only recently become widely available. To give just a few examples, internet-based interventions have been developed to help people stop smoking [7, 8, 9], lose weight [10], increase their physical activity [11] and manage chronic health problems [12]. The purpose of this paper is to discuss the potential role that digital positive psycho-therapy may play in digital health psychology interventions. The actual intervention is under development and will be presented at the 3rd International Conference on Persuasive Technology 2008.

2 The Role of Emotions in Self-regulation

When people attempt to change their health behaviour, such as quitting smoking, changing risky alcohol behaviour, starting dieting, or taking up regular exercise, they try to achieve long-term personal goals. Oftentimes, this implies that they have to control themselves, for example in terms of not having that cigarette, the chocolate bar or another drink. Hence we have to override an urge to do "what is good" right now in order to achieve "what is good for us" in the long-term. In order to achieve this we need to control impulses and urges, and the effective use of self-regulation strategies are crucial for successful goal achievement.

Our self-regulation capacity is however a limited resource and acting in a way that requires self-regulation may drain our resources and make us more vulnerable for a self-regulation failure at subsequent efforts of self-control. Self-regulation failure is most likely to occur when the person is depleted for self-regulatory resources, i.e. is ego-depleted. This is more likely to happen when people experience tiredness [13] or negative emotions [14]. In fact, negative emotions may cause, contribute to or be an effect of self-regulation breakdown. As a corollary, increased and sustained levels of positive emotions would be expected to facilitate the maintenance of health behaviour change processes such as quitting smoking or taking up exercising. But what could be the actual causal mechanism?

One possible explanation is offered by the "broaden-and build theory of positive emotions", developed by Fredrickson [15, 16]. This theory describes how positive emotions broaden people's thought-action repertories. Fredrickson [15] demonstrated that positive emotion induced in the lab caused negative emotion to dissipate more rapidly. Fredrickson & Joiner [17] have speculated that there exists an "upward spiraling" effect of positive emotion and broadened thinking: Individuals who experience positive emotions are more likely to find meaning in negative events, and this meaning-making in turn leads to greater positive emotion. Fredrickson, Tugade, Waugh, & Larkin [18] claim that positive emotions can momentarily broaden people's modes of thinking, which in turn can improve their ways of coping with a stressful experience. With repeated experiences of positive emotions over time, a style of such broad-minded coping might even become habitual and thereby build resilience against adversity.

To recover from an addiction like smoking or heavy drinking is stressful. Much research seems to support the idea that a breakdown in self-regulation in such areas is

more likely to occur when the person is experiencing negative emotions [14, 19]. The question that arises is thus how digital interventions for health behavior change can best include components that are capable to build resilience against self-regulation failure by enhancing positive emotions and making them last.

3 Development of a Digital Positive Psychology Intervention

During the last decade we have witnessed the development of positive psychology interventions that have shown promising results in terms of increasing and sustaining positive emotions. Digital positive psychotherapy includes exercises to increase positive emotions and making them last. The exercises and their rationale will be described further below. This digital positive psychotherapy intervention can both be used as a standalone intervention to increase well-being, and as a part of health behaviour change interventions to build resilience, improve self-regulation and enhance compliance. The exercises will be presented as an interactive diary, using tunneled [20] design in order to fit with the chronology in a change-process when included in a health behaviour change intervention.

In a 4-week experimental study Sheldon & Lyubomirsky [21] examined the positive emotion outcomes of regularly practicing two mental exercises: counting one's blessings (''gratitude'') and visualizing best possible selves (''BPS''). In a control exercise, participants attended to the details of their day. All three conditions produced immediate reductions in negative affect and only the BPS produced a significant increase in immediate affect. However the BPS exercise may be the most beneficial of them for raising and maintaining positive mood because the participants indicated greater identification with and interest in continuing doing the BPS relative to the others. With this in mind the first exercise in positive psychotherapy was called "Best Possible Life" and asks the client to visualize and then describe their ideal future life. The second set of exercises is addressing gratitude, and is based the on the study described above [21] described above in addition to Seligman, Rashid & Parks [22]. Seligman and his colleges tested several internet interventions in order to develop positive psychotherapy. In one such internet study five positive psychology interventions was compared with a placebo control exercise in a random-assignment internet study. One of the five exercises was "Three Good Things". The participants were asked to write every day for one week about three good things that happened to them and why they happened. In our digital intervention the clients will write about one or more good things that happened that day and why they happened. This exercise will be repeated several times trough the intervention. The third set of exercises is called Pleasant Activities and is based on cognitive behaviour therapy (CBT). CBT is an effective therapy for depression and anxiety disorders [23] and engaging in pleasant activities is an important component in CBT because when people do pleasant activities, they are more likely to have positive thoughts about themselves and their lives. Pleasant activities can also enhance social support as they often include social settings, enhance the level of positive emotions as well as self-efficacy trough mastery experiences.

Interaction with others is an important route to experiencing positive emotions [24]. Social contact and having close and supportive relationships with friends and

family, helps generate positive emotions [25]. To enhance social relationships, our digital positive psychotherapy intervention includes exercises like making a map over your social network, call a friend, give someone a compliment, do a pleasant activity with a friend and so on. These small exercises are thought to strengthen the clients feeling of belonging and support, and thereby generating positive emotions. Seligman [26] proposed that one way to enhance engagement and flow is to identify people's highest talents and strengths and then help them to find opportunities to use these strengths more. In one of the exercises tested by Seligman et al [22] participants got feedback about their highest strengths after completing the VIA –questionnaire. Then they were told to use a different strength in a new way every day. This exercise significantly lowered depressive symptoms and increased happiness compared with a placebo exercise, and the effect lasted for six months. A similar exercise is included in our digital version and repeated once a week in a three week period.

4 Conclusion

Successful health behaviour and psychological change requires the availability of self-regulatory resources. When people become depleted on such resources, a self-regulatory failure is likely to happen. Negative emotions seem to play a crucial role for ego-depletion. The installment of positive emotions, however, seems to prevent self-regulation failure. Positive psychology offers strategies to increase lasting positive emotions. However, at present the development and design of digital positive psycho-therapy interventions is in its infancy. We need more practical experience and rigid research to know more about how digital interventions can move the pendulum on the human emotional dashboard. We are presently designing a digital psychotherapy intervention that is based on what we currently know about self-regulation and positive psychology. The intervention will be presented at the 3rd International Conference on Persuasive Technology 2008.

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Finding Kairos in Quitting Smoking: Smokers' Perceptions of Warning Pictures

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Abstract. This paper studies Kairos, i.e. the opportune moment to persuade, through a smoking cessation experiment. We approached 101 people, comprising of 81 smokers and 20 non-smokers, on the streets of Palo Alto, California. The participants were shown five warning pictures related to the dangers of smoking as well as a control picture. The people rated each picture based upon how strongly they felt they were affected by the pictures. The results indicate that the opportune moment to show these pictures is not when the people already are smoking but rather much earlier. Quite interestingly, the affect of this intervention was stronger on women than men. The fact that the opportune moment seems to vary between individuals complicates the design of applications leveraging Kairos to a great extent.

Keywords: Mobile persuasion, Kairos, smoking cessation.

1 Introduction

Kairos has been defined by Kinneavy [3] as "the right or opportune time to do something, or the right measure in doing something". It has always been an essential part of rhetorics and it can be traced back all the way to the works of Plato and Aristotle [4]. The concept of Kairos is applicable for many information processing situations. One of the interesting examples is knowledge creation, where support for knowledge-related processes such as comprehension (i.e. creation of new tacit knowledge) and communication (sharing of knowledge) [5] should be provided at a proper moment. Within persuasion it refers to the opportune moment to represent a persuasive message [2]. It is especially beneficial in mobile persuasion as "[mobile] technology can travel with users wherever they go" [2] allowing, by definition, to "intervene at the opportune moments" [2].

We investigated Kairos by showing warning pictures about the dangers of smoking to people at different settings to see how they felt they were affected by the pictures. Our particular interest was whether there is a difference in the affect when a smoker is just smoking a cigarette versus when he has not had a cigarette for some time.

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2 Experiment

In the experiment people were shown five pictures related to the dangers of smoking as well as a neutral control picture (a house). The five pictures were picked up from the set of pictures that the European Union has intended to be used as warning pictures in the cigarette boxes affecting smokers within the EU. None of the pictures chosen for this study are particularly gender-dependent, e.g. pictures related to impotence or male infertility were dropped out. The respondents were asked to rate the pictures based on how strongly they felt they were affected by them.

Table 2 represents the hypotheses of this study. H9 is the key hypothesis and the other hypotheses relate to the opportune moment in stopping smoking.

Table 1. Hypotheses of the study

Hypotheses	Description
H1	The fewer cigarettes the smoker smokes per day, the stronger the pictures affect him.
H2	The less time the respondent has been a smoker, the stronger he is affected by the pictures.
H3	The pictures have a greater affect on those smokers who intend to quit.
H4	The pictures have a greater affect on those smokers who have quit before.
H5	The pictures have a greater affect on smokers who have a lit cigarette in their hands.
H6	Both genders are affected to the same extent through the pictures.
H7	The role of the opportune moment is greatest with pictures of an average affect.
H8	The affect of the control picture is independent from the opportune moment.
H9	Smokers close to an opportune moment are affected the most.

H1 and H2 have been derived from Webster [6], H3 and H4 from the theory of planned behavior [1], H5 from Fogg [2], and H6 from the fact that the selected pictures are not gender specific. H7 is based on the assumption that Kairos is not able to add the affect of those pictures which already are very affective or which are not affective at all. And finally, H9 is derived from Kinneavy [3], Kinneavy & Erskin [4], and Fogg [2].

47 females and 54 males participated in the survey (n=101). Most of the participants (n=88, 87.1%) were between the ages of 18 to 40. In general, both smokers and non-smokers perceived the pictures as affective. The mean of the five pictures on a scale of one to five was 3.46 for non-smokers (n=19) and 3.42 (n=81) for smokers.

Hypotheses 1 stated that the less the user smokes, the more he is affected by the pictures. Due to a low sample size we performed Independent Samples T-Tests by comparing those who smoked less than five cigarettes (n=20) to those who smoked more. Similar tests were performed to test the hypotheses H2 to H5. For H1 (how many cigarettes), H2 (how long the respondent had been a smoker), and H3 (the intention to quit) no statistical differences were found.

Quite interestingly, those who had quit smoking before (H4) were affected less than those who had not quit ($t=-2.721$, $p<0.01$). Perhaps those who had quit before knew they can quit (if they were able to quit before they can probably do it again). For this reason, H4 was not supported and in fact it could be just the opposite.

The hypothesis H5 stated that smokers are affected more when they have a lit cigarette in their hands. The results indicate that *smokers were affected more when they were not smoking than while they were smoking* ($t=2.922$, $p<0.01$). This finding is very interesting. Smokers may have felt disturbed as they were approached when smoking. Perhaps nicotine also plays a role in their answers. When they are smoking, i.e. they are under the influence of nicotine and dopamine rush, the smokers were not affected by the pictures. Nevertheless, H5 was not supported. Rather the case seems to be opposite to the hypothesis.

As opposite to hypothesis H6 (there should be no gender differences), gender seems to have a great effect on how people feel about the pictures. Women seem to be affected by them greater than men. Both male and female non-smokers seemed to be affected equally by the pictures. For male smoking seemed to decrease the affect of pictures (the affect of the pictures dropped from 3.400 to 2.916) whereas for female it increased it (from 3.520 to 4.0611).

H7 stated that Kairos effect is greatest with medium pictures (not too strong or not too mild). The greatest affect for smokers with one of the pictures was 4.14. The Kairos effect increased it to 4.55, but this increase was not statistically significant ($p=0.307$). However, there was a statistically significant increase on three other pictures: from 2.73 to 3.91 ($p<0.05$), from 3.10 to 4.09 ($p<0.01$) and from 3.69 to 4.64 ($p<0.05$). As the rating scale was from 1 to 5 we can easily see that these pictures were from the middle of the scale. As we do not have any pictures from the lower end of the scale (e.g. affect rated between 1 or 2) it is not possible to say how much they would have been affected. Thus, H7 is only partially supported.

H8 suggested that the control picture would not be affected by the Kairos moment. This was supported as there were no statistical differences between the groups.

The low sample size did not allow us to analyze H9 to the full extent. We wanted to find respondents close to Kairos, i.e. those participants who smoked only a few cigarettes per day (H1), had started smoking recently (H2), had the intention to quit smoking (H3), had quit before (H4), and who had a lit cigarette in his hands (H5). However, there were no such smokers among the respondents. So the results concerning H9 are only partial.

Hypothesis H5 suggested that the persuasive moment is when a smoker has a lit cigarette in his hand. In fact, it seems to be just the opposite. So to find a group closer to Kairos, we compared those who did not have a lit cigarette and who intended to quit smoking with the rest of the smokers. The size of this sample was still very low ($n=11$), and for a deeper analysis a bigger sample size would be needed. Nevertheless, the Independent Samples T-Test seems to indicate that the affect of the pictures to smokers in the Kairos group was much greater than to other smokers (4.16 in Kairos group vs 3.31 in other group, $p<0.05$). Thus, H9 is partially supported. The closer to the Kairos the smoker is, the stronger he is affected.

3 Conclusion

To some extent, the results from the experiment were surprising. It seems the smokers were affected more if they had not quit before, and when they were not smoking. This was exactly opposite to what was hypothesized. The study also provided some support to the hypotheses that smokers closest to Kairos should be affected the most and that Kairos effect is the strongest with pictures with medium affect. Also the affect of this type of intervention was stronger on women than men.

The Kairos moment for persuading smokers seems not to be when one has or is about to have a cigarette in one's mouth. In fact, this moment seems to be less effective than persuading in other times. The proper moment to persuade people to quit or reduce smoking may rather be when one is about to decide over going for a smoke. However, our data set did not enable us to investigate this at a deeper level.

This experiment studied whether the timing of showing warning pictures would have an effect on persuading the smokers. The results of this study demonstrate that *pictures do affect the smokers more in some moments than they do in other moments*. The relatively small sample limits the power of our study and makes it difficult to be more precise about the most proper moment for showing these pictures.

The key findings of this experiment are that smokers are not affected by warning pictures when they already are smoking. Rather they should rather be persuaded at other times. Moreover, the warning pictures seem to have a greater effect on women than on men.

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Exploring the Persuasiveness of "Just-in-time" Motivational Messages for Obesity Management

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Abstract. The healthcare industry in the United States is going through major challenges in terms of financial and human resources. One of the preferred ways to address this issue is to develop effective prevention systems so that the people can live healthy lives and in turn minimize the use of the medical system. Preventing diseases requires people to adopt healthy lifestyles. Advances in pervasive technology provide promising opportunity in developing such systems. Specifically, sending "just-in-time" motivational messages to help people make right health related decision has been pointed out as an emerging field of research. However, in order to persuade the users to take a healthy action, it is essential that the "just-in-time" messages are persuasive to the recipients. In this study, we explored persuasiveness of such messages by considering two of the five elements of a communication process with a focus on obesity management.

1 Introduction

The United States is facing an impending crisis to reduce its ever increasing cost of providing healthcare and serving an aging baby-boomer population [1]. Moreover, obesity and being overweight, which are the risk factors for many chronic diseases and disabilities, are increasing among adults and children [2]. However, obesity is preventable by changing one's behaviors related to eating healthy and being physically active. Recent scholars have proposed the use of pervasive technology to send "just-in-time" motivational messages for such behavior change [3]. Sending "just-in-time" information means sending reminders or messages to a person at the time and location of the event in order to assist the person in making appropriate health-related decisions. For example, when a person is at a restaurant, a message can be sent suggesting healthy meal options. A framework called Healthy Lifestyle Management Information System (HLMIS) to guide the development of such an information system was presented in Maheshwari et al [4]. Our research explores the persuasiveness of such messages by considering five central elements of a communication process: a source, a message, a channel, a receiver, and a destination [5]. In this short paper, we report our results on the first two elements i.e. a source and a message.

The first element refers to the source of a message. It is apparent that if a message originates from a source that is an expert or trustworthy, it is likely to influence the recipient. For an HLMIS to be effective, the users should find the system as credible

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as a healthcare expert. The study investigates the credibility of the information system by comparing how the recipients would respond to the messages received via interactive media versus the messages received from a healthcare expert. The second element of the communication process is a message. The language of a message is a very important factor. As described by Bettinghaus [5], there are plenty of strategies to add appeal in the content of a message. For example, the messages can be made appealing by adding an element of fear or emotion in the content. In this study, we divided the messages into four categories based on the inherent nature of the actions indicated in the messages. The categories are: a) messages with negative enforcement, b) messages asking for activities that require substantial effort, c) messages asking for simple activities, and d) messages suggesting equivalent healthy alternatives. Further, we investigated how these different message categories appealed the users.

2 Research Methodology

A survey was conducted to understand the persuasiveness of the messages. The survey instrument consisted of a questionnaire and it was carried out among the students at our university. The participants were presented thirty one messages (See Table 2, http://wfs.cgu.edu/chatters/home/persuasive2008.htm) that can appear on their cell phones and they were asked how they would respond to such messages. To understand source credibility, the questionnaire was divided into two parts. Half of the participants taking part in the survey were given part 1 and the other halves were given part 2. Part 1 asked the participants to assume that they received the messages through their cell phones, while part 2 asked the participants to assume that they received the messages from health care experts such as a doctor, a nurse and a dietitian. Besides, the messages in both the parts belonged to four message categories described above.

3 Results

Ninety nine students took part in the survey. All the tables depicting results are available at: http://wfs.cgu.edu/chatters/home/persuasive2008.htm. Table 1 depicts the sample characteristics (57.6% are males, 42.4% are females). The scale to measure the likelihood of the response was 1 to 5 representing very unlikely to very likely respectively. The first analysis was two-tailed independent samples t-test to measure source credibility with two groups: a) participants who were asked to assume that they received the messages from a health care expert, and b) participants who were asked to assume that they received the messages on their cell phones. Table 2 represents the results of the independent samples t-tests. A portion of Table 2 is depicted below in Figure 1. The independent sample t-tests for the thirty-one messages resulted into seven significant mean differences ($p < 0.05$) between the two groups and three marginally significant mean differences (p close to 0.05) between the two groups . Equal variances were not assumed for the significance.

Message	SMS Mean (SD)	Expert Mean (SD)	t	df	p
When you get a chance, just go up and down the stairs a few times.	2.92 (1.16)	3.44 (1.24)	-2.14	91.20	0.035
Good Morning! Please include some fruit in your breakfast.	3.33 (1.28)	3.91 (0.97)	-2.56	96.32	0.012
Do not take butter in breakfast today.	3.02 (1.37)	3.69 (1.20)	-2.60	96.70	0.011

Fig. 1. Independent Sample T-test: Comparing Source Credibility

Further, as mentioned in the section one, four message categories were created out of the thirty-one messages based on the inherent nature of the messages. Cronbach's alpha was employed in order to measure the reliability of the categories. All the alphas (see table 3) are higher than 0.80. Table 4 compares the responses to the content of the four message categories. A portion of Table 4 is depicted below in Figure 2.

No	Message	Mean	SD
1	Drink water (Assume that you have water with you).	4.11	0.97
2	Get some fresh fruits and vegetables. It will help you make healthy lunch and snacks.	4.05	1.05
3	Please avoid regular soda today and get water or diet soda	3.93	1.18

Fig. 2. Response to the Messages

4 Discussion

As mentioned in the results section, only ten out of the thirty one messages had significant or marginally significant mean difference in their responses from both the groups, however, it would be an overstatement that the participants found the messages received on their cell phones as credible as the ones from a healthcare expert. Further, out of the thirty-one messages twenty-nine messages had higher means for experts and two messages had higher means for SMS (Table 4). We statistically tested it with a binomial test and it can be concluded that the higher response to the messages from an expert was not random. The second analysis of the study involved investigating the difference in the response to the content in the four message categories described above. Fourteen out of the top fifteen means belonged to the messages that fall in the two categories: a) Messages asking for simple activities, and b) Messages suggesting equivalent healthy alternatives. Based on this finding, we can say that the content of "just-in-time" motivational messages should not include negative enforcement and complex activity suggestions. Here, the finding that the users prefer tasks

that are simple and does not require substantial effort poses a challenge as physical activities often require substantial effort.

5 Conclusion and Limitations

This study investigated the persuasiveness of the messages that can be delivered through an interactive media. The study found that the participants did not consider the messages on cell phones as credible as the phone calls from healthcare experts. Further, they preferred the messages asking for simple activities and suggesting equivalent healthy alternatives over the messages that ask the users to take actions requiring significant effort, and the messages that negatively enforce the users to take any actions. The study is subject to the limitation of assumption as the participants were asked to assume the location and time of the event for responding to the message. Besides, the study sample omitted people with low literacy skills and did not a include significant number of African Americans and Native Americans.

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BLB: A Persuasive and Interactive Installation Designed to Improve Well-Being

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Abstract. Well-being is a broad subject, which is described in this paper as: a personal balance of mental, social and physical being, influenced by life circumstances and life factors. These factors include emotions, engagement, life satisfaction, intentional activities and social network. The project described in this paper aims at improving well-being through the design of a persuasive and interactive installation for the home environment. After the investigation of well-being by means of a literature study, cultural probes and questionnaires, a concept was developed. This paper describes the design, implementation and evaluation of this concept. 'BLB', as it is called, encourages its users to seize the moment in order to increase their well-being.

Keywords: well-being, persuasive technology, intentional activities, interaction design, human-computer interaction.

1 Introduction

Well-being reflects how people rate the quality of their lives. Studies have proposed ways to improve well-being, for example doing regular exercises or looking at events optimistically [1]. However, the development of a consumer product implementing these activities to increase well-being has surprisingly remained unexplored. To fill this gap, a project was started with the goal to design a product that could help people to structurally and effectively work on their well-being. This was done through a design research approach – an approach combining product design and scientific research by starting the design from literature.

The choice was made to design for intentional activities within the field of well-being, and more specifically for 'seizing the moment'. Seizing the moment is explained as: unplanned self-performed actions that instantly increase well-being, with a lasting effect [1]. Hence the design goal was to design a product which helps singles, the target group, to consciously and intentionally seize the moment in order to increase their well-being. This will be done directly and indirectly by increasing their awareness of what makes them happy.

2 Idea Generation and Concept Development

For the idea generation and selection phase we used three germinal ideation methods, suitable when there are no existing solutions: classical brainstorming, mapping subtopics

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around a main topic; morphological analysis, for exploring solutions to a multi-dimensional problem; and KJ-method, to cluster aspects of a problem. The first two methods were used to produce ideas and the third to categorize and reflect on solutions. Found categories were: building up, reflection and advice. The use of forced-relations, to combine unrelated topics into an idea, and brain writing resulted in a total of more than one hundred ideas. To select the ideas, fifteen criteria were formulated based on literature studies, cultural probes and questionnaires [2]. These criteria addressed well-being, intentional activities, and seizing the moment. During the selection process, visualized in Figure 1, six remaining ideas were shown to four test persons of the target group. They were asked if they understood the purpose of the idea, if they would use it and if they thought it would increase their well-being.

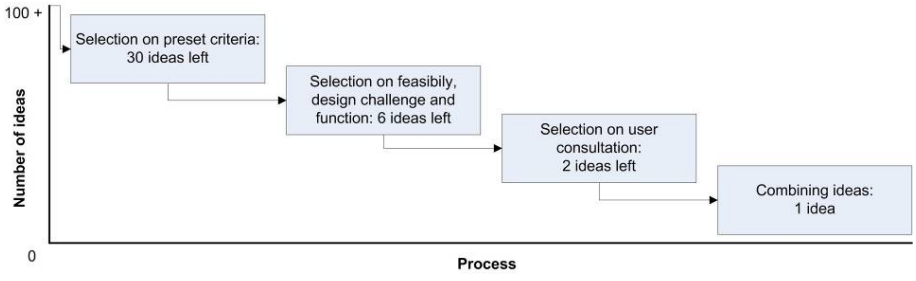

Fig. 1. A scheme of the idea selection process

This resulted in two ideas, the first is a practical advice clock, which gives a person feedback about ways to seize the moment and alerts him when friends are seizing the moment. The second idea, called 'wall bulbs', is an installation on a person's wall, meant to increase reflection. Both ideas interested the test group, so they were combined into a concept called BLB (pronounced as 'bulb').

BLB is an interactive installation used in-home. The bulbs resemble round containers in which users can place small artifacts or souvenirs. This placement can remind them of a location, person or activity that increased his or her well-being in the past and encourages reflection and/or action on that moment, potentially increasing well-being again. The installation consists of three types of bulbs: *personal, shared* and *receive bulbs* (see Figure 2). *Personal bulbs* are meant to support a goal or memory for the owner alone. Placing an artifact in the bulb or touching it will activate lights in and around the bulb (see Figure 2a). These lights will fade slowly over time. The light intensities of the personal bulbs display activities a user plans to do and activities he did. Another bulb-type is the *shared bulb* (see Figure 2b). This type has the same functionality as the personal bulb, but it is meant for activities or goals a person wants to share with his friends. The *receive bulb* (see Figure 2c) contains a display showing the picture of the artifact in a friend's shared bulb. All in all, BLB is intended to work as a personal encouragement to plan, reflect, and work on activities that increase a person's well-being, by seizing the moment. BLB can also provide inspiration for new activities through communication with friends, using and perhaps even strengthening existing social networks.

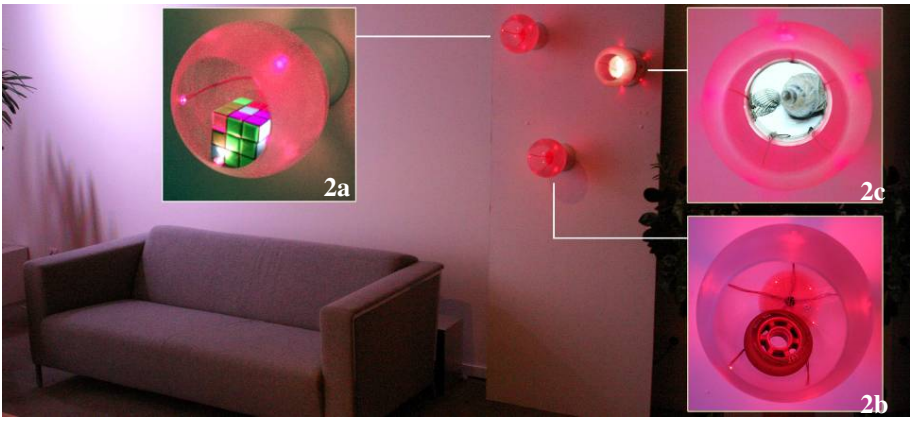

Fig. 2. BLB consists of bulbs placed on a wall, the personal bulb (2a), the shared bulb (2b), and the receive bulb (2c)

3 Implementation

BLB was implemented in a working demonstrator, see Figure 2. The bulbs consisted of sandblasted plastic spheres and wooden pedestals, the latter having integrated light buttons. Five LEDs were placed inside each bulb and five around its pedestal for feedback purposes. The personal bulb prototype was fully functional; it contained a button with which users could indicate that they had worked on an activity. After activation the LEDs faded slowly over time, which was programmed with Max/MSP using a Phidget interface. The shared and receive bulbs were partially functional. Communication between the two installations was done manually by the observers using a web server, while the LEDs worked the same as for the personal bulb.

Two walls with three bulbs each were implemented, in order to test two friends simultaneously in two different locations while using BLB.

4 User Evaluation

BLB was tested at the Homelab facility of the Philips Research Laboratories Eindhoven. In total there were 17 participants in the user evaluation (nine men, aged 34 on average and eight women, aged 29 on average), of which four were singles. Each test involved two separated participants, communicating trough the two BLB installations. One session took one hour, during which the users had to share artifacts with a friend and once they had to keep an artifact personal, ending the session with a semi-structured interview. The intentions of the user evaluation were to find out: 1) if BLB increased people's awareness of the things that make them happy, 2) if BLB encouraged the user to seize the moment, and 3) if the installation could contribute to the user's general well-being. The results can be found in Table 1. Interesting suggestions that came forward were to use BLB for autistic children, as reminder for activities, or for the elderly, as memory for good moments of the past.

Table 1. Results of the user evaluations of BLB, as user responses to the questions

Questions	Negative	Neutral	Positive
1: Increases awareness of happiness	29%	18%	53%
2: Encourages to seize the moment	29%	18%	53%
3: Contributes to well-being in general	0%	35%	65%

5 Discussion and Conclusions

Measuring well-being is difficult in a short project, because it is affected in long terms. Of course we had to make some assumptions, for example that the awareness of well-being and the execution of 'seizing-the-moment' activities are related and how they are related. Another assumption we made is that physical artifacts remind people of activities and intentions that are related to seizing the moment, instead of just the functions of the artifacts and related memories.

We concluded that the user evaluations of our concept called BLB gave a cautious but affirmative answer to the question whether BLB succeeded in facilitating and supporting people to work on and increase their well-being. Therefore BLB can be seen as one of the first products designed specifically for the increase of personal well-being, which opens up possibilities for the design of interactive, persuasive installations aiming at a broad and new topic, such as well-being.

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A Case Study on an Ambient Display as a Persuasive Medium for Exercise Awareness

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Abstract. In this paper, we propose a persuasive display to motivate walking exercise. The display is an ambient display that is originally daily object like a mirror, and provides information about one's exercise level on the periphery of a line of sight. The presentation is designed to have an unpredictable nature as well as competition/collaboration aspects with others so that he/she could continue the exercise to have a fun with it. We describe an initial case study on information presentation to demonstrate our approach's feasibility and effectiveness, where a mirror is augmented.

1 Introduction

People know the importance of exercise, but often fail to become accustomed. A pedometer and a weight scale are evolving to be network-enabled and thus to provide a service on a PC side. However, people need to run an application intentionally; if they lose interest in exercising they will stop *using* the system. So, we propose an ambient display technology to provide service in a passive manner. An ambient display is an information provision method that allows a user to obtain information at the periphery of human perception [4]. People can focus on their main tasks while *feeling* the presence of information. Furthermore, we consider that mere graph/number of a recent trend and diagnostic messages are not enough.

Our goal is to investigate motivational elements in an ambient display using a daily object. As a case study, we have chosen a mirror and focused on walking exercise. A mirror reflects physical objects appearing in front of it. People usually stay in front of a mirror for a period of time, and become inquisitive about their physical appearance by looking at a mirror. A mirror itself embodies a persuasive strategy, *suggestion*, i.e. intervene at the right time, since it allows a person to reflect his/her internal state. Also, a shareability facilitates a group of people to motivate each other. Even chatting about the information presented on the surface makes them aware of their health. In this paper, we describe our initial experience with an augmented mirror. Here, a daily result is explicitly presented to support reflection. Additionally, the notion of artificial life is applied to produce a pleasurable feature that lets a person interact with the system through daily walking.

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2 Prototyping Persuasive Ambient Display with a Mirror

2.1 Designing Ambient Walking Persuasion

We have specified four strategies for walking encouragement: pleasurable interaction through daily activity, day-by-day history of walking, an abstract form of a character's appearance and facilitating inter-personal encouragement.

We consider that an appropriate level of unpredictability is a source of pleasure, which attracts people to the display. We have utilized a flock of life-like characters to represent day-by-day history of walking, which we consider to be a clue for people to review the activity of a day, by which they can effectively develop strategies to get better results. A character indicates the achievement of a day. A daily goal is set to a certain number of steps, i.e. 8000. Besides that, the ratio of a day to the day before determines the size and the behavior of the character. If a day's result is better than the nearest preceding day, a user might feel satisfied even though the number of steps itself is small. On the other hand, a bad result should make him/her recall the day's activity compared with the day before, and contribute to the improvement of the next day's activity. Moreover, we have applied the notion of *swarm intelligence* to generate emergent and thus unpredictable behavior. A flock consists of the characters of a week or more. Each character autonomously moves in the screen based on internal and external states. Each character moves autonomously on the screen according to the *Boids* algorithm[3].

Drawing a realistic character, e.g. bird, might allow people to have intimate feelings and become more aware of the states. However, subjects with low motivations tend to refuse the system when characters do not grow or die, rather than watch their unhappy appearance[2]. So, we have decided to provide a character with an abstract form of appearance. Finally, inter-personal encouragement has been realized in a way that flocks for a group of users are presented in the same display. People may have feelings of cooperation or competition.

2.2 Mapping Daily Walking into a Boid

We have designed the shape and the behavior of an individual character, *boid*, so that they could reflect the healthiness of a person's body. A triangle shape is utilized since it clearly indicates the direction. The width of the triangle varies according to the ratio of a day to the nearest preceding day, while the area is constant. Figure 1-(a) illustrates the parameters and three examples of boids with (i) lower, (ii) equal, and (iii) higher ratio. The more a person walks compared to the day before (i.e. the bigger the ratio), the sharper the shape becomes (small w). The neighboring view of a boid is controlled by the other parameter. The behavior of a boid is determined by the perception of a small neighborhood[3]. Here, the view defined by distance ($dist$) and range (deg) gets longer and wider when the ratio is high. This comes from our general understandings that a person who exercises well and is thus active in mind is more able to sense external world. So, he/she can find more members of his/her group to form a flock as well as obstacles to avoid. Finally, the velocity (v) is proportional to the ratio, which allows a boid with high ratio to move faster. The reward for the daily goal is provided by the blinking color of the body.

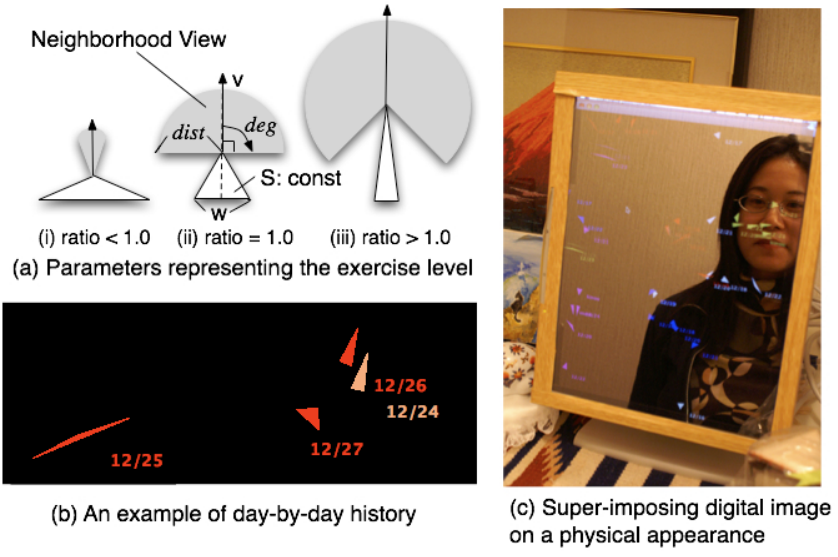

Fig. 1. The parameters controlling a boid's behavior and a scene of utilizing the display

2.3 Implementation

An augmented mirror has been realized by attaching a semi-transparent mirror board on an ordinary computer monitor [1]. Here, bright color behind is seen through while an object in front of the board is reflected in dark colored area (Fig. 1-(c)). Boids' positions are updated every 100 msec. In Fig. 1-(b), 4 days' history (from 24th to 27th December) is shown, where the bright color on 24th indicates that the number of steps exceeded the goal of a day. In this prototyping, we have utilized a pedometer that is commercially available. Everyday, a user manually registers the number of steps into the system. The displays installed in multiple sites are connected via the Internet for inter-personal encouragement.

3 Preliminary Experiments

In-house experiments have been conducted to investigate the acceptance on the concept. The system has been deployed at two homes and an office with totally 6 people. The ages range from 23 to 71 years old. The subjects were interviewed approximately once a week. Three to five weeks has passed since the installation. Although we have not yet confirmed significant improvement in the number of daily steps, 5 of 6 subjects have become aware of their daily steps. They were pleased when they saw the blinking boid, i.e. the daily goal was achieved. Some subjects went further when they took a dog for walk. Also, emergent behaviors of boids like chasing and skirmish were pleased, and the subjects looked to forward to seeing new ones. One subject disliked the disordered flock with a flat and isolated boid, e.g. labeled with "12/25" in Fig. 1-(b), since she likes to be a person with prompt action and self-organized. Then, she intentionally walked more than or equal to the day before to maintain "beautiful" flock. Moreover,

we have confirmed *reflection* of daily walking activities through the combination of the behaviors of boids and the physical appearance on the mirror surface. A housewife subject liked the expression based on the ratio of two consecutive days. She was satisfied with the increasing number even though the number itself is small because she is aware of shortage of exercise and the increasing is the progress for her. The members in distributed sites talked about their achievement in each group, which generates the atmosphere or *social pressure* to be aware of their steps. The comments obtained by interviews suggest that the reflection through the mirror works properly and the system offers pleasurable interaction, it enables day-by-day comparison, and it provides inter-personal encouragement.

4 Concluding Remarks

We have described our initial case study on a mirror as a persuasive medium to motivate walking exercise. The history of walking is presented using a *boid* animation so that a user could become aware of daily achievement and have fun with unexpected behavior of a flock. In-house experiments have been conducted to investigate the acceptance on the concept. The experimental results imply that the augmented mirror can provide a person with an opportunity to notice his/her level of walking exercise when he/she appears in front of it.

We are planning to conduct comparative studies with various aspects for more thorough evaluation. This includes 1) other forms of an ambient display, 2) the level of unexpectedness in the behavior of a flock, and 3) the reality of the character in terms of understandability, intimacy and emotion against a negative state. Furthermore, we will investigate the evaluation criteria of such an ambient persuasive system.

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Technology that Persuades the Elderly

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Abstract. This paper discusses what makes technology persuasive and what kind of technology is considered interesting among the elderly. Also, factors contributing to the choice between appliances are presented. For acquisition of information several qualitative methods were used. Among the factors making technology interesting were the support of safety, independency, memory and health, and bringing easiness and comfort to everyday life without forgetting expressing oneself and social issues. The elderly had several opinions on the usability. The study revealed some factors which were influencing the interest despite the qualities of an appliance.

Keywords: elderly, technology for the elderly, persuasion.

1 Introduction

In the future the elderly will be a large group of users and providers of technology. The ageing of the population makes demands on the designing of new technologies to suit to the needs and especially the wishes of the elderly [1]. The physical and mental abilities will set one side of the design criteria and the preferences of the elderly the other. There are many studies on the physical and mental abilities of the elderly but fewer on the emotional dimension. Therefore we were interested in exploring the preferences and other factors contributing to the persuasion.

2 Objectives and Methods

2.1 Objectives

The objective was to discover which technologies persuade the elderly, which purposes of use are considered interesting and which factors contribute to the choice between appliances. What kind of user experience the elderly had, was also studied. The surveyed themes and technologies intersected the shopping process which plays an important role in the independent living. Going shopping is multifaceted process and analogous to other transactions and processes outside the home.

2.2 Informants

The majority of the sessions was arranged with voluntarily entered participants of the University of the Third Age (UTA) in early 2007. They were two men and three women,

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three singles and a married couple, aged from 74 to 77 years. They were active and could be described as "go-go" elderly. There were all together six meetings with the group and several qualitative research methods were used. To widen the perspective in "slow-go" elderly we had one meeting with another group in year-end 2007. They were five couples participating remedial pair course in Senior Clinic of Oulu Deaconess Institute (ODL). Their age varied from 76 to 87 years. The spouses with poorer capacity would most probably have difficulties to live independently.

2.3 Methods Used for Acquisition of Information

Qualitative research methods are mostly used in the user experience research, and designing on system to the one user group can six informants be enough. [2]. Design process seeks for detailed, fine grained understanding of the target group [3], which is often achieved by observations and other contextual methods instead of quantitative methods like questionnaire surveys [4].

Focus group interview was used with participants of both UTA and ODL. The researchers conversed with the four present informants of UTA general aspects of the shopping process and, if they were using mobile phones, computer or internet. In ODL the researchers split the group in two to separate the spouses. The attractiveness and usability factors of technological appliances were discussed. One participant didn't attend the focus group because of poor health and cognitive capability.

The diary keeping was conducted with four informants for the fortnight between the sessions. The diaries were structured and focused on going shopping. [2]

Participatory observation in other words going into to social situation is another important way of gathering materials about the social world [2]. A researcher observed the each household shopping perishables in actual setting.

The peer interview forms focused on strolling in immediate surroundings were conducted by the researchers and delivered to the informants. The informants were asked to interview approximately five persons in their circle of acquaintances.

The brainstorming was conducted in two different line-ups [5]. First the group was divided in females and males to separate the couple. There after the whole group participated in ideating an intelligent shopping carrier.

The questionnaire was conducted by the researchers and posted to the informants after the sessions. The informants were asked to give the form to five persons in their circle of acquaintances. The respondents valued usefulness of several new technologies in their own life and also in someone's life with failing capacity.

3 Findings

Mostly the informants were interested in the technology and the general attitude toward technology was quite positive like in Northern Finland in 2005 [6].

3.1 What Made Technology Persuasive Among the Elderly

Technologies supporting the safety, independency and control of own life were considered persuasive. Among the informants and the elderly in general [7] the traffic was a setting of concern which technology could make safer. The elderly wished

welcome systems checking the house and also sensitive access control especially when the spouse is suffering from cognitive impairment. Such systems enable carrying on their existing lifestyle [8,9] and would support their autonomy [10] which were respected values. Technology should bring easiness and comfort to everyday life by helping with physical work and daily routines. The informants preferred embedded technologies to new devices. Some were attracted by real-time service information on mobile device. The informants wished technology to support long-term and temporary memory. Like the majority of Finnish and Danish elderly [8] they were interested in keeping themselves fit and would be persuaded by technology supporting the health, physical exercise and outdoor recreation. Social issues were important and technology should not isolate the users. Also, the possibility to express oneself was respected feature of an appliance.

3.2 Factors Contributing to the Choice between Appliances

There were several factors contributing to the choice. These factors don't provoke the interest of providing but make an appliance more attractive. The usability had a great significance for the informants. An appliance should be ergonomic, easy and light to use, work in all conditions and allow several ways of operation. In addition the informants respected the predictability of the operation. The systems and data transfer concerning money transfer and access control should be reliable. The favored user interface varied according to the personal preferences and abilities. The esthetics of an appliance added extra value. Also, the image question can contribute to the choice.

3.3 Other Factors Influencing on the Persuasion

The study revealed some factors, which are influencing on the persuasion of technology despite the qualities of the certain product. Like in earlier studies the factors increasing the persuasion were positive feeling and attitude, and the previous user experience predicted willingness to take new technologies in use [10,11,12]. The decline of the persuasion was predicted by depressed mood, tiredness and decline of cognitive skills, which causes decline in initiative and abilities of learning and concentration. The must of providing provoked resistance and antipathy against new appliances. The failing capacity of the spouse was effecting the decision making of the spouse with better capacity. It forced the spouse to take care of all the housework and so to familiarize with new appliances. The failing capacity aroused need for providing simpler appliances but sometimes also need for more complex ones. Some spouses hesitated to provide new appliances since they supposed the spouse with failing capacity would get frustrated because of not learning to master the new appliance.

4 Conclusions

The character of this study was qualitative and thus descriptive. Because of the qualitative approach the incidence between the opinions and factors concerning to the persuasion cannot be evaluated. Still the study pictures well the wide range of aspects contributing to the attractiveness of technology among the elderly.

The study revealed several factors contributing to the persuasion of technology among the elderly. Among these factors making an appliance interesting were the support of safety, independency, memory, health and physical exercise. The elderly were willing to carry on their existing lifestyle and they wished that technology would bring easiness and comfort to their everyday life. Also, expressing oneself and the social issues were playing an important role. They preferred embedded technologies to new devices. The elderly had several opinions on the usability and extra values like esthetics. The study revealed also some factors which are influencing on the interest despite the qualities of an appliance. These were individual differences in attitudes, user experience, abilities, and surprisingly strongly effecting capacity of one's spouse.

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Design with Intent: Persuasive Technology in a Wider Context

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Abstract. Persuasive technology can be considered part of a wider field of 'Design with Intent' (DwI) – design intended to result in certain user behaviour. This paper gives a very brief review of approaches to DwI from different disciplines, and looks at how persuasive technology sits within this space.

1 Introduction

Persuasive technology (PT) is an example of design intended to result in certain user behaviour [8, p.1]: it is strategic, with defined behavioural outcomes in mind. Broadly reviewing the idea of using design to modify behaviour, a spectrum of approaches emerges; a common factor is designer *intent*, and thus the term *Design with Intent* (DwI) can be used. This paper aims to explore briefly how PT fits in this context of DwI, as a background to understanding more about its boundaries and potential.

2 Perspectives on Design with Intent

Approaches to DwI have differing terminologies and philosophies, but techniques from one discipline may be applied usefully in another. For example, the authors' research is in ecodesign, creating and testing the efficacy of products which 'cause' users to operate them more efficiently, informed by perspectives from different fields.

2.1 A Review of DwI Across Different Fields

Affordances and Constraints. In HCI and product design, expressions of DwI relate to *affordances* and *perceived affordances*, as outlined by Gibson [9] (and developed by Norman [23, pp.9-11]): the interactions facilitated by a product, system or environment, and shaping users' perception of what actions are possible.[1] When the aim is intentional shaping of user behaviour, the term *behaviour-shaping constraint* is often used: constraints such as *forcing functions* (e.g. interlocks [23, pp.131-40, 203-6]), may be used alongside tactics such as selection of defaults [15] or making certain

[1] The slight disparity [20] between Gibson and Norman's definitions was later clarified by Norman [24]: his area of focus would be better termed *perceived affordances*.

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actions deliberately more difficult – *slanty design* [4]. Programmed learning, such as teaching machines [30], uses forcing functions to persuade users to solve problems.

Poka-yoke. In manufacturing, *poka-yoke* (Japanese: 'mistake-proofing') encompasses defensive design techniques developed by Shingo, originally intended to make 'zero defects' achievable in assembly processes [29]. In general, these can be classified as 'control' or 'warning' poka-yokes: control poka-yokes are constraints which force 'correct' behaviour – e.g. the bevelled corner on memory cards and 3½" floppy disks – while warning poka-yokes reduce errors by alerting users when an incorrect step or condition occurs. There is an overlap with persuasion techniques such as reduction, tunnelling and *kairos* [8, Ch. 3] in terms of making correct behaviour 'easier'.

Philosophical Approaches. *Behaviour-steering design* has been proposed by Jelsma [11], following Akrich and Latour's discussions of 'scripting' behaviour into artefacts [1, 16]. Jelsma gives an example of a dual-button toilet flush, scripting users to decide on their water usage [11]. Some 'design for behavioural change' research incorporates scripting [e.g. 18]. A *rhetorical* approach, outlined by Buchanan [6], holds that *all* design incorporates an argument or usage intention; as Redström [27] suggests, this may imply that all design is 'persuasive'.

Built Environment. Winner's question [33], "Do artefacts have politics?" is generally applied pejoratively to architectural examples, notably Moses' low parkway bridges [7] (preventing bus access, discouraging poorer visitors to a state park[2]). A ubiquitous example is the park bench with central armrest discouraging overnight occupation (e.g. by the homeless [19]). Approaches [e.g. 13] in the vein of Alexander's work [2], use *defensible space* [22], *natural surveillance* and *sociopetal* seating [31] to deter crime and encourage interaction. *Traffic-calming* draws from visual perception to shape behaviour, as does retail environment design: *planograms* [32], floorplans and *retail atmospherics* [28], can be used to route customers, persuading them to make certain purchases.

Digital Environment. Using architecture (of a system or space) to regulate user behaviour – *architecture of control* – has received much attention in digital contexts [14], where Lessig [17] popularised the "code is law" concept. The prevalence of *technological protection measures* (e.g. digital rights management) confirms that design promoting adherence to business models is on some corporate agendas; there is commonality with security, where the aim is to constrain user behaviour. Network architecture and *traffic-shaping* permit price discrimination [25], encouraging certain behaviours economically.

Other Commercial Strategies. Aside from advertising itself, DwI intended to extract greater value from consumers ranges from the reinforcement of the MOPy screensaver noted by Fogg [8, p.228], to the *razor and blades model*, where a product locks users into repeat consumable purchases. Electronic authentication, such as the *handshake chips* in some printer cartridges, extends this business model. Commercial DwI strategies also include *planned obsolescence* [26], persuading consumers to purchase replacements, and *anti-features* [10], intentionally degraded to persuade buyers to pay more for a 'better' model – 'artificial' product differentiation.

[2] Later research casts doubt over Moses' supposed intentions and the bridges' height [e.g. 12].

2.2 How Persuasive Technology Fits with DwI

Much PT research focuses on persuasion with intended *social* benefit – from encouraging exercise [e.g. 21] to reducing energy use [e.g. 3], but in the wider DwI field, the intent is often *commercial* benefit. The aims are not mutually exclusive: e.g. a recycling company persuading users to recycle can have both social and commercial benefit intent. Hence it might be sensible to consider *intended social benefit* and *intended commercial benefit* as orthogonal dimensions of the DwI space (Figure 1). Another aspect is whether the *impact on the immediate user* is 'helpful' (the third dimension in Figure 1): e.g. making it difficult to put a TV on standby embodies social benefit intentions (energy saving), but will inconvenience individual users. This area is shown in grey in Figure 1, and is likely to contain more controversial examples; 'intended social benefit' itself will also be controversial in cases where the intent is politicised.

The dashed line thus suggests an approximate domain for PT in the DwI space, at least based on literature to date: centred *on intended social benefit*, usually (not always) *helpful to the immediate user*, and possibly with *intended commercial benefit*.

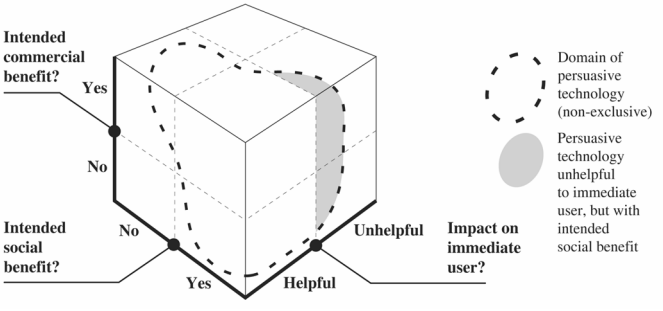

Fig. 1. Some possible dimensions of the wider DwI space, and how PT fits

The diagram only illustrates three possible dimensions, and does not address characteristics such as the degree of 'coercion' involved in a technique. This is a difficult semantic issue to consider definitively, since while 'persuasion' in a PT context is defined to exclude coercion [8, p.15], it is recognised that "the line between persuasion and coercion can be a fine one" [8, p.21]. In the wider field of DwI there are many examples (e.g. anti-homeless benches) where a more coercive intent is demonstrated. If, as Redström [27] argues, all design is persuasive, then coercive design may simply be an 'unethical' subset, with its boundaries inevitably subject to analysis [e.g. 5], debate and possible revision.

3 Conclusions

While brief, it is hoped that the above review of the DwI field forms a useful and interesting background for further work in exploring how PT fits in this context of designing behaviour change. The main contribution is perhaps to bring an awareness

of different DwI perspectives to PT researchers, with the possibility of informing or inspiring new strategies on further investigation.

Future work from the authors will expand on a range of persuasive design techniques for causing users to operate products in a more sustainable manner: selecting these, designing the systems, and testing their efficacy in user trials.

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The Influence of Gender and Involvement Level on the Perceived Credibility of Web Sites

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Abstract. This article discusses the influence of interaction effects of gender and enduring involvement level on the perceived credibility of Web sites. This article discusses results that show that the interaction effect between enduring involvement and gender significantly influence the perceived credibility of Web sites.

Keywords: Credibility, Gender, Involvement, Web Design, Computer-Mediated Communication.

1 Introduction

Advertisers and those providing online advice have a need to understand how Web users perceive credibility. Additionally, because advertisers target ads to specific demographics, any difference in how males and females perceive credibility of a Web site is important.

This study reports results that shows an interaction effect between gender and enduring involvement that influences perceived credibility While gender is discussed in a variety of studies related to credibility, it is primarily discussed in relation to how the source's gender influences perceived credibility There is little mention in the literature of differences in perceived credibility of Web sites between the genders of the Web site evaluators. Flanagan and Metzger [3] suggested that males rated both Web site credibility and message credibility significantly higher than did females. Additionally, the study showed a significant interaction effect where the opposite-sex credibility evaluations were higher than same-sex credibility evaluations. Females were shown to rate Web sites produced by women significantly lower than men do. The authors suggest a need to more precisely identify the factors that underlie these differences. The findings of this current study might provide some insight.

The theoretical basis of the current study follows Fogg, Soohoo, et al. [5] with regard to credibility. Additional concepts relevant to this study include involvement (enduring situational, and response) [1] [5], and focus (central and peripheral) [6].

2 Methodology

The experiment used the 2x3 factorial design used in the Ferebee 2007 study [2]. The study has two limitations. First, the study relies on a convenience sample, and second, the

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study used only one Web site topic (finance) for evaluation. Also, the interaction effect between gender and enduring involvement was an unexpected finding. Therefore, the study was not appropriately designed to consider factors such as the complex gender construct and additional participant details that could correlate with gender. It is hoped that future research can address these limitations.

3 Results

The study revealed a significant interaction effect for enduring involvement and gender, $F(1, 122) = 6.51$, $p < .05$ as shown in Table 1 and Figure 1. **M**ales with a high enduring involvement level had an increased mean perceived credibility score when compared to males with low enduring involvement levels. Females with a high enduring involvement level had a reduced mean perceived credibility score when compared with females that had a low enduring involvement level.

Table 1. ANOVA – Perceived Credibility = f (EI*Gender)

Source	Adj Sum of Squares	df	Adj Mean Square	F-ratio	p-value
Enduring Involvement x Gender	5.9857	1	5.9857	6.51	0.012
Within Groups (Error)	110.3089	122	0.9042		
Totals	116.2946	123			

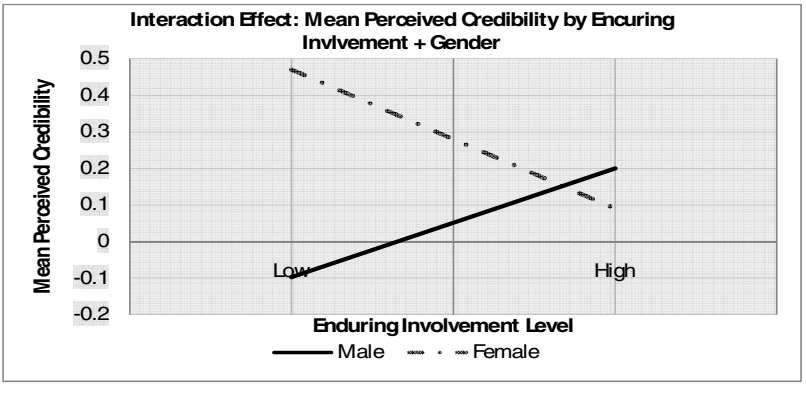

Fig. 1. Interaction Effects Plot for Mean Perceived Credibility by Enduring Involvement + Gender

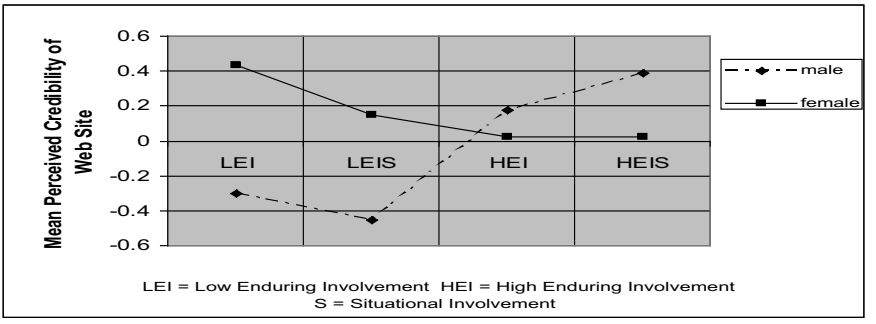

Fig. 2. Line Graph of Mean Perceived Credibility by Gender and Enduring Involvement and Situational Involvement

4 Discussion

The Ferebee 2007 study [2] shows that there is a significant influence of involvement level on perceived credibility, user focus (central or peripheral), and Web site elements noticed. However, when the influence of gender is introduced, the results become more interesting, and particularly relevant to persuasion for Web advertisers and online advisers. The results of this study support the findings of Flanagan and Metzger [3] that males rated both Web site credibility and message credibility significantly higher than did females. The current findings also support the conclusion of Flanagan and Metzger that gender differences in the Web site evaluators are meaningful in virtual environments.

An additional influence of gender is that Web sites are likely to be perceived as most credible by females with low enduring involvement and no situational involvement and by males with high enduring involvement and situational involvement as shown in figure 2.

The interaction effect of gender with enduring involvement further complicates how credibility is perceived .and poses unique challenges to those using Internet advertising and online services for persuasion purposes. While both males and females move to a focus on the message when situational involvement is introduced [2], the study does not show how involvement level and gender are influencing interpretation of that message. One implication that emerges from the study is that involvement level will influence perceived credibility differently on different types of Web sites. In terms of gender, For an information only Web site, it might be predicted that male and female perceived credibility will follow similar patterns. However, in task-oriented Web sites where users interact to obtain information or purchase services and products credibility perception might differ across gender..

Future research should focus on how involvement level is affecting the interpretation of credibility markers by looking at the cognitive processes of comprehension, attention, and inference [5[. Equally as important, it needs to be determined whether the cognitive processes of attention, comprehension and inference differ across gender for the HEI Web site user who experiences situational involvement with the Web site. This possibility needs to be explored through empirical research. In addition, this

study focused on financial Web sites. It will be important to see if similar gender differences in perceived credibility occur in different Web site subject areas.

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Embodied Agents on Commercial Websites: Modeling Their Effects through an Affective Persuasion Route

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Abstract. The effects of embodied virtual agents have been widely studied but too often without a theoretical model of such effects. This paper proposes and tests a two-step affective route of persuasion, based on perspectives from psychology and consumer behavior. Step 1 posits effects of the agent on affect. Step 2 posits effects of affect on a construct of website *stickiness*. The model is tested in an experiment. The construct of stickiness is validated and the affective route is partially confirmed.

Keywords: Embodied virtual agents, affect, website stickiness.

1 Introduction

Internet usage has been widening in the last decade and new patterns of user behavior emerge on Internet. A growing literature in man-machine interaction in general and particularly on man-virtual agent interaction, enhance modeling the observed effects of Internet Embodied Virtual Agents (IEVAs) on website user behavior. Embodied virtual agents are increasingly used, in various contexts, e.g. teaching, socialization, chats, and now on branding websites. However, to date many of their effects have been studied as simple empirical phenomena.

2 Theoretical Framework

Among the many issues raised by the explosion of internet, are the nature of the roles of a branding website, the way to optimize relationship to a brand online [1], and the different nature of media online [2], all related to the fact that Internet is properly a (multi-sensorial) "multimedia" media. We still are in our infancy in understanding and modeling the effects of the various sensorial cues available online. Among such cues are audition and vision. These cues generate emotional and cognitive reactions and may enhance persuasion through different cognitive or affective routes as it is shown in traditional communication context [3], with complex, little understood, affect-cognition interactions [4]. That includes the case of humans to humans, through non-verbal language [5]. We also note there is no consensus on the conceptualization of emotions, or on their role in human reactions [6]. Communication with an EVA therefore mobilizes theories in oral and visual communication. Nass notes that theorizing on such issue is vital to understanding man-virtual agent interaction [7].

A *virtual agent* is first a piece of software. It may perform different tasks, with more or less "intelligence". It can move, talk, give advice, and receive instructions.

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Above all, it can be made visible to the user and hence be called an embodied virtual agent. An IEVA can be considered not only as a virtual object constituting an element of design of a site, but also as a human or human-like counterpart. The characteristics of embodiment are crucial. Scholars highlight the crucial importance of agent's physical design [8]. An agent may effectively be characterized by its verbal and non-verbal language, by its voice, size, body, clothing i.e. everything that might generate affective reactions [9]. Therefore, embodied agents are both interface components and also objects that we treat like social beings.

When exposed to an electronic interface and/or an embodied agent, individuals react as if they were interacting with another social being, and more if the interface seems "natural", or credible [10]. In a number of works, the so-called "approach behaviors" in a traditional context, as studied in environmental psychology, are also observed for individuals exposed to an IEVA [11]. Human beings in general look for social contacts in a variety of situations of interaction. The role of affect in interacting with the interface may therefore become crucial. IEVAs might, through their social dimension, fulfill some innate "need for interaction", and hence impact behaviors and intentions of behaviors, as humans do in other service encounters, offline and online.

After a dominant cognitive paradigm in Communication, the Elaboration Likelihood Model posits that a receiver can actually form an attitude toward a target via a cognitive, conscious, rational evaluation-based, route (called central route), or via a faster, less conscious, affective (called peripheral) route [12]. Affect- or symbols-related research justify taking into account images affective and symbolic effects in persuasion processes [13].

It is therefore proposed here that animated images such as embodied agents can generate emotions and through them affect persuasion. Generating emotions, they can directly encourage approach behaviors or intentions. Indeed studies provide some support for this view, finding that IEVAs, like fixed images or real humans, do generate affective reactions and effects in term of persuasion, whether they may be positive or negative.. They impact attitudes, behavioral stickiness, and intentional stickiness [14]; and they are shown to be more persuasive than voice-only agents [15]. In all cases, IEVAs generate affective reactions and impact persuasion.

3 Research Model and Hypotheses, Experiment, Results

The research model shown in Figure 1 posits in a first step of the affective route, positive effects of an IEVA on affective reactions; and then as a second step effects of those affective reactions on online stickiness, that is, on approach behaviors in an online context.. The two steps are studied distinctively in two different sequences of multivariate analysis. Online stickiness consists of two dimensions and four components as shown in the Figure. Research hypotheses are also shown in the Figure.

A laboratory experiment was conducted in the France Telecom R&D Center. A total of 347 usable subjects, representative of the internet user population (age and gender) were recruited by an external agency. They were randomly assigned to one among two possible commercial websites and for each, into one of two possible navigation conditions: a website with no virtual agent (control condition), or with an agent (experimental condition: with a congruent agent or a non congruent agent). This is a 2 x 2 planned design – see Figure 2 for an example of one condition. The moderating effect of agent-website congruency is not reported here.

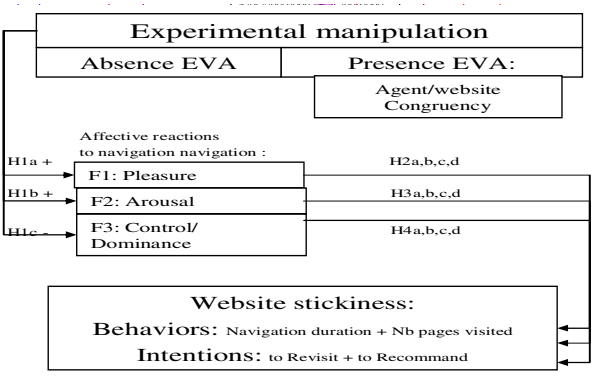

Fig. 1. Effects of EVAs on stickiness: Affective route of persuasion

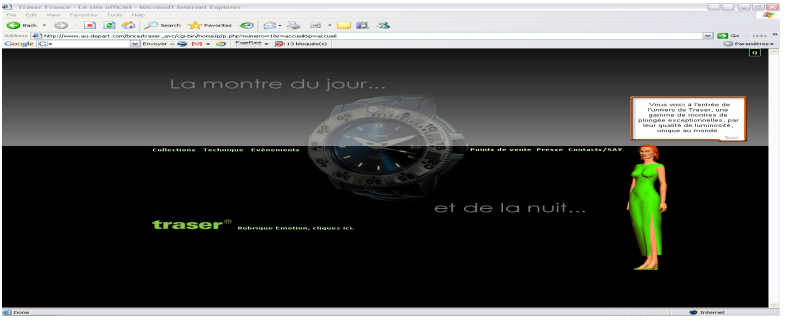

Fig. 2. Example of an IEVA tested on the watch site

Affective reactions are assessed with a 12 items measurement scale, with only 2 dimensions emerging: Pleasure and Dominance. Arousal disappears, hence hypotheses relating to effects on and of Arousal are dropped ($H1_b$, $H3_{a,b,c,d}$). The stickiness construct is validated with the two conceptualized dimensions emerging.

The presence of the agent has surprisingly no impact on Pleasure (MANOVA, p=0.42 for site1, p=0.47 for site2, both NS), nor on Dominance (p=0.096 site1-NS; p=0.19 for site2-NS). The second step of the route is partly validated, but on intentional stickiness only. Pleasure and Dominance have no significant effects on Behavioral Stickiness (Visit duration and Number of pages visited: H2a & H2b, H4a & H4b are disconfirmed). Still, we have observed simple effects of presence on Behavioral Stickiness, without the mediation of affect: that means, such effect exist but not through affective reactions. Conversely, Pleasure has a highly significant effect on intentional stickiness (H2c***, H2d***), p<0.001), and Dominance has a significant effect on one component of intentional stickiness ($H4_c$-NS on Intention to revisit; $H4_d$* (p<0.05) on Intention to recommend).

4 Conclusion and Limitations

We have highlighted that a comprehensive theoretical framework on man-agent interaction is missing and proposed a model which may explain some part of this interaction.

We test an affective route towards a construct called website stickiness; a construct which our research validates. Our findings are that IEVA presence does not impact on the two emotional dimensions of affect that emerge as important in this research. But these two dimensions do impact on the intentional element of stickiness. Such affective reactions convince users to stay in touch or affiliate with the site, but other drivers must lead them to actually navigate longer or more in depth [14]. We may therefore have ignored some important moderators in our study.

Limitations to our research are the agents are tested only in the context of a brand relationship. These, results may therefore not generalize to other contexts (e.g. games, social sites, etc.). We have also not tested the possible effects of the topic addressed by the agent; nevertheless research shows that this matters [16].

We should address the possible effects of subject-related variables such as, gender, subjects expertise with the tested interface, ICT-related Innovativeness, the Need for cognition vs the Need for emotions, the subjects age or gender, level of education. Agent-design-related variables might also impact, such as agent agreeableness, more specifically its gender, size, format (only head or all the body), its level of anthropomorphism, zoomorphism, or totally imagined, cartoon-like design; its non-verbal language cues, its voice and the many variables related to audio interaction. These last points also open a number of research avenues in psychology, and man-man and man-machine interaction.

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