Experience as Meaning: Some Underlying Concepts and Implications for Design

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ABSTRACT
As the current computing systems move from desktop and work settings into our everyday lives (e.g. mobile and ubiquitous systems) a growing interest is seen for designing interactive systems with experiential support. Some conceptual work already exists that tries to analyze and understand users' experience with interactive systems but in practice this is still not frequently used. Drawing on the concepts from the domain of art, this paper introduces a way to conceptualize users' experience as the meanings or interpretations they construct during their interaction with or through the interactive systems. We consequently apply this conceptualization in a design project where we use it at an early concept design stage for designing aware technologies in care-taking situations.

Keywords
Interaction Design, User Experience, Experience as Meaning, Aware Systems.

INTRODUCTION
In recent Interaction Design research a growing interest is seen in articulating the non-technical and subjective aspects of technology (e.g. Blythe at al. 2003, Jordan 2000). Our research is focused on understanding and designing for users' experience with or through interactive systems. Depending on the context and the domain of a system, goals of user-experience may vary from supporting users' quality-of-life and well-being (pleasure, satisfaction, trust, safety, etc,) to personal growth (e.g. challenges, fun, entertainment, etc.) to freedom of interpretation (e.g. personal connections, emotion, seduction, etc.). To us, user-experience design is a field that focuses as much on the experiential aspects (emotions, feelings, values, meanings, etc.) related to the system as on the technical and usability related aspects. However, so far applying the experiential support in the design process has not been really easy. Formal and scientifically oriented approaches for designing experience have proved to be unnecessary and insufficient (Gaver et al. 2003a). They often attempt to predict and rationalize certain human aspects, leaving more meaningful and critical subjective information unattended. Articulating user-experience for design purposes was till now mainly advocated by some reductive approaches that focused on design elements (e.g. Garret 2002, Hassenzahl 2003) and some holistic approaches based on philosophy and phenomenology (e.g. Dourish 2001; McCarthy, Wright 2004; Vyas, van der Veer 2005). In this paper we approach user-experience from an "artistic" point of view.

Some commentators (in Gaver et al. 2003a & Smith et al. 1996) suggest that Interaction Design is more an art then a science. Scientific and engineering oriented approaches used in the traditional HCI field may not be sufficient to approach the subjective nature of human experience. From the origin of modern mankind, art has been taking a special place in inter-human communication. Without going as far as defining art, we might state that a distinctive aspect of it is the intention of one human being (e.g., the "artist") to provide an artifact (and frequently a situation to go with it) that solicits some experience in other humans. Artists are generally aware of the fact that they cannot dictate the exact experience, but they have some aim and they use their skills and knowledge to reach that aim. The aim may be very vague (e.g. in post modernism) or may be very precise (e.g. in drawing a caricature that exaggerates a person's character). However, if the artist is completely sure of the experience of the audience, it will often no longer be considered art, but "simply" communication. Artists are often aware of the relative freedom of their audience in understanding (interpreting), valuating, and of behaving in relation to the created artifact. Artists frequently have no precise aim for the situations and cultures their artifact will be experienced in, or the timeframe their creation will live through.

Given this, artists will be creative. They need, and take, the liberty to express themselves in new ways, to develop unpredicted representations to excite, surprise, or challenge their audience or the executors of their scripts. In this way, the "consumers" of art will have "new" experiences, and will experience the product of artistic creation as new or unprecedented.

In this paper, we aim to draw out the underlying theories and concepts behind the 'experience' phenomenon and extend the scope of the experience-design field from problem solving to creative designing. We start by using Johan Sebastian Bach's creations for

solo violin and fictions written by Edgar Allan Poe and John Fowles as examples to explore and analyze how a piece of art is experienced and what role users' interpretations play in constituting an unfolding experience. Based on this analysis we provide four major concepts underlying the phenomenon behind having an experience with the technology. We then introduce a design framework - "experience as meaning", that conceptualizes users' experience with a technology as the meanings they construct. This conceptualization provides an account of understanding and designing for users' experience in interactive systems. As an illustration of its use, this conceptual framework is applied in a design project at an early concept design stage for building aware technologies in care-taking situations. We emphasize the role that our framework has played on the creative side of designing.

EXPERIENCING 'ART'

We believe that the domain of art can provide a useful metaphor for understanding the experience phenomenon. In fact all art forms are examples of domains where experience is the major concept of interest. Artists intend to create something. An actual definition of "artistic creation" could be the fact that the creator is not aiming at a certain shape, functionality, size, or whatever measurable (set of) attributes alone, but at a certain experience. The artist aims at the experience of meaning beyond the measurable attributes. This additional aspect of meaning may have many different images, ranging from emotions, to direct acceptance or rejection, from intellectual understanding to physical interaction. A creation may evoke pleasure, be rejected, lead to understanding of the artist's intentions, or to playful interaction.

In the first place this is the experience of the artist him/her self. But in most cases in our culture, the artist will focus on an audience, and consequently there will be an intention to evoke this type of experiences in others. The others may be "known" ("I write this especially for my friends") or completely unknown ("whoever will look at my painting in another century"). Some artists may aim at rather precise experiences ("the reader will be surprised"), some intentionally leave the experience to the audience (Post modernism).

In some domains of artistic creation there is a 3rd party involved: the performer. Play-writers, choreographers, composer, to name but a few types, write for actors, dancers, musicians, who will perform on their creations for an audience. And in most cases the acting out of the artistic creation is not a purely mechanical process. The performer will interpret (and in most cases add some intentions in the sense of improvisation and co-creation), and react to the situation (space, lightning conditions, acoustics, etc.) as well as to the audience. This means that the performer adds and probably shapes his/her own experience as well as those of the audience.

Finally, the members of the audience each will contribute to their own experience, in interpreting the work of art in relation to available knowledge, aspects of the current situation, current needs, and the actual intention regarding the experience of the work of art. In the following we provide examples from two different domains of art.

(I) Example Domain: Music

Johan Sebastian Bach (1685-1750) is generally considered one of the most gifted and creative composers in the history of Western music. One of the important characteristics of his music is his creative application of "polyphony", the art of providing several music voices to run simultaneously where each voice imitates or responds to the others, and where the musical whole is a process of consonant and dissonant chords that develops over time in a structure of tension and relief, where the progression is a surprise and yet fits expectations for those who "know" the language of Bach's style. Given the audience has some experience with the music of Bach or his contemporaries, there is a strong experience of enjoying the complex structure and pattern of the various voices. Connoisseurs are known to listen to the music, play it on their keyboards, or even read the printed score, to relive their own experience of this complicated fabric.

Maybe the most striking examples of this phenomenon are Bach's compositions for solo violin, solo cello, or solo flute (resp. BWV 1001-1006; 1007-1012; 1013). We take the first Sonate for violin solo in G-flat, BWV 1001, second movement: Fuga. On a violin a very capable player is able to play, with many restrictions, 2 voices at the same time, never more. Bach wrote this Fuga for a single violin. Even though he had a continuous supply of capable violin players to perform together, he composed a score that clearly intends to suggest 3 or 4 voices, but aimed at the restrictions of a single player.

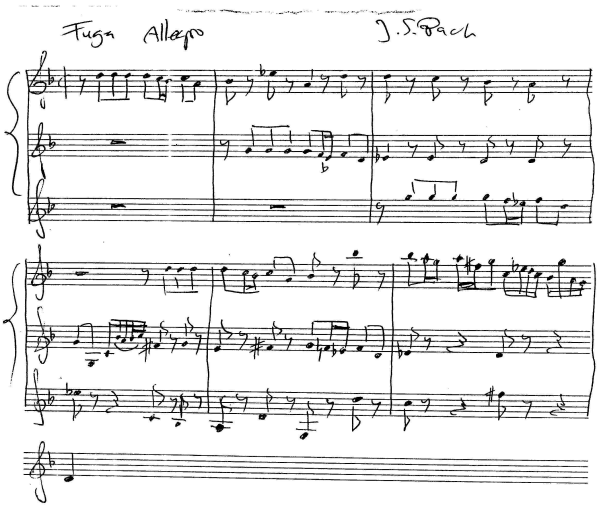

Figure 1. Transcript of Bach's work

We provide a transcript (Figure 1) we made of the original score – we gave each of 3 voices a separate line though Bach wrote them all in a single system for solo violin. Bach's original score, as well as any literal

transcription of it, is difficult to interpret even for professional violinists if they have not been educated in the way early 18th century violin parts are intended to be understood. Consequently, 30 years ago some famous violinists recorded the different notes that Bach indicated as sounding at the same moment, separately on different tracks that were subsequently combined to sound as they thought Bach intended. Many experts of that time considered this music to be unplayable.

This is what the various stakeholders may experience in relation to this piece:

- The composer (Bach) designed a fuga that consists (in the fragment we represent here) of 3 voices that imitate each other, starting at different pitch levels and according to the grammar that was "general" knowledge among musicians and music amateurs of that period. He intended a capable violin player could take the score and "suggest" the complete polyphonic structure by cleverly sounding notes after each other that were hinted to be sounding together. Bach clearly expected the player to solve many problems and to suggest the audience things that were objectively not there, by using dynamic differences, arpeggio playing of up to 4 notes to suggest 4-note chords, and hinting to prolongation of notes by intended irregularities in the beats.
- We (the authors of this paper) transcribed Bach's score to reveal the different parts that we interpret to be Bach's intention as a composer, not as a script of what should sound (though, as we indicated before, some world famous players used this type of transcriptions and a multiple track tape recorder to solve what they considered Bach's puzzle).
- An able violin player, educated in the current knowledge of 17th and 18th century violin solo literature interpretation, will take the score and add his/her own technical ability and artistic vision to suggest the 3 or 4 voice polyphony with a maximum of 2 notes sounding simultaneously.
- An experienced member of the audience will actively listen to the performance (whether life or from a recording) and construct mentally the intricate fabric of voices, knowing this is a fugue and understanding the limitations of a single violin player, and enjoying his success in "hearing" what is actually not sounding though it is intended.
- A capable reader of written music will enjoy reading the original score and reconstructing mentally the progression of the different voices like represented in our transcription, knowing that no violin player will ever be able to play literally what is intended but that he as a reader can still imagine hearing it because he "knows" and "understands" what the genius composer intended him to enjoy nearly 300 years ago.

(II) Example Domain: Fiction

Most literature creations contain information in verbal format. For any reader who understands the language used by the author, this information seems to be understood as it is intended. The experience of the reader may be in the emotions that develop during reading (or listening to someone reading aloud). Reading aloud, in itself, is a phenomenon where the reader interprets and acts, creatively adding his intonation and timing. However, authors of artistic writing will sometimes confuse the audience's understanding of the information: They may use language constructs or words that trigger multiple interpretations or even novel words that have not be defined yet. We briefly provide two examples here.

An obvious case of a creation that leaves it to the reader to construct his own version of the information is the novel "The French Lieutenant's Woman" by John Fowles. The novel ends with a final chapter (nr 60) as well as another (nr 61). These represent two alternative endings with completely different information that each trigger rather different emotions in most readers (probably something like sadness and relieve, respectively). In the case of some readers there will be a strong reluctance to choose. One of the authors did read both ends several times but refused to make up his mind, finally experiencing an accompanying emotion of regret not to know the end of the realistic story and re-living it now clearly as "just fiction". Interestingly, a movie with the same title, made in 1981 after the novel (screenplay Harold Pinter), showed another way to mix up the audience's information interpretation and the accompanying emotions. In the movie only a single story end is provided but the movie shows, mixed in time with Fowles' novel, the love story of the two main actors that reflects an interpretation of emotions and untold facts about the characters in the original novel. Again, members of the audience feel tempted to choose to "live" either the story of the lieutenant's woman (especially those who did read the novel first), or the story of the two movie actors that fall in love. Again, some members of the audience will choose to focus on Pinter's construct and enjoy his creation where the two intertwined stories are "just" objects for Pinter to play with.

In case of both reading the printed book, and attending the movie, each member of the audience will interact with the artistic creation and develop their interpretation and their emotional experience based on both the piece of art and of their own background and the current context.

The audience of fiction in many cases is aware of its nature and of the effect of interacting with it on their interpretation and emotions. In that case, readers will choose their literature based on the emotions they expect or hope to feel while consuming the creation. People who like horror stories might well buy a copy of one of Edgar Allan Poe's tales, fully aware of the

probable results of reading in the evening: an emotional state that will prevent them from sleep and make them be scared by unexpected sounds. People may feel very happy to travel to the cinema, stay in line, and pay for a movie ticket that promises them very sad feelings and a very confused understanding.

Like in the domain of music, in the domain of fiction people will experience their interaction and interpretation of a piece of art in several forms: In some cases they will immediately turn away ("reading this would cause a sleepless night") or be sold to the yet unknown ("a new Pinter movie! Let's go for it"). In some cases they will focus on interpreting or understanding the meaning ("why did Fowles provide two ends?"; "the actors fall in love because the script and the roles they play in it suggest they should, and then the script forces them to hurt their lover"). In some cases the viewer feels very emotional about the sad end of the story (chapter 60) and then feels really relieved because there is another outcome in chapter 61. Finally, the experience could have a strong aspect of activity from the side of the reader/viewer: reading the last chapters over and over.

In any case these different forms are never isolated types of experience. There always is a mixture of them, that is lived as a whole, though in many cases one of these "flavors" is the most distinct aspect of the overall experience.

IMPLICATIONS FOR DESIGNING TECHNOLOGY FOR EXPERIENCE

In fact, in the above examples there lay some important characteristics of the experience phenomenon. This nature of experience doesn't change much when we interact with technologies. From the above examples we briefly talk about four concepts underlying designing technologies to support users' experience.

i. Experience in Interaction

The examples suggest that experience is not in the information (or the actual art piece itself) but it is in the interaction (the way the piece of art is understood in the real environment). The Bach example shows that the fuga that was designed by Bach establishes certain experiences in the audience when they actually watch and hear how a single performer suggests 3 different voices on his violin, knowing the player has to overcome the physical impossibility by clever use of the acoustics and of well timed irregularities in dynamics and tempo. The Fowles example shows experience as evoked by confusing or contradicting information while the reader may re-read the alternative final chapters several times before making a choice, or, alternatively, is unwilling to choose.

The basic condition for an experience to come into existence is that experience occurs during the interaction (not necessarily the physical interaction) between the experiencer and the experienced object in the lived reality. Action and reflection of both the experiencer and the experienced object play a combined role in defining the quality to the experience. In the user-interface design, the product-centric approaches (e.g. (Garret 2002)) view experience as predefined, controllable element of the technology – this is a limited and somewhat insufficient view of the lived experiences. It is important to see experience as a dynamic process and an emergent product that is a contextually and socially constructed in the lived environment.

ii. Experience in Interpretation

Both examples show two different ways by which our interpretations can influence the experience phenomenon. First, a user's experience of an object can have influences from other people's interpretations. Second, a single object can evoke multiple interpretations amongst different users. As shown in the Bach example, the original piece of music interpreted differently by the composer, performers, readers, and the audience, and all contributing towards the construction of the eventual experience of the audience. The example of the movie after Fowles shows the interpretation of Pinter as a strong addition to the original, which results in a new piece of art that has been both heavily praised (interpreted as a creative linear solution to a bi-forked story) and strongly despised (interpreted as spoiling the original plot) by audiences who knew the original novel. Moreover, the interpretations of those who never did read the book will be of a completely different type.

During their interaction with the technology, users do not just passively receive information, but they actively construct meanings related to their lived environments using their prior knowledge, their sense-making and interpretation skills. The meanings that are constructed during the interaction with the system are a social and cultural products interpreted during our engagement. Boehner et al. (2005) noted that experiences related to, for instance, national pride, justifiable anger or shame, are social and cultural in origin. And since the technology is becoming part of our day to day lives, these social and cultural implications become central to our interpretation process (Sengers, Gaver 2005). As designers attempt to convey certain meanings through a technology it is the user who constructs the final meaning or interpretation relevant to the technology.

iii. Experience as what the designers offer and what users bring to it

From the examples two issues are apparent. First, a specific meaning (or interpretation) of an art piece is never guaranteed. The audience (in the examples, listeners and readers) based on their cultural, social and intellectual knowledge construct their meanings that may differ from the others. And, second, experts like Bach, Poe and Fowles can trigger certain experiences through the art piece. Bach's ability, for instance, to provide a feeling of listening to multiple voices with only using a single script that is incomplete for playing

shows that even if designers cannot control the experience they can certainly 'solicit' or 'guide' it. Readers of Poe's tales may know the general effects of reading his work on their mood, and, hence, may have expectations of the effect of reading a new story. Consequently they may decide not to read immediately before going to bed. Still, the experience of reading the story may have an impact after several hours, depending on the intermediating events in the reader's day.

This turn on user-experience emphasizes the pragmatic account coined by Dewey (1934). As Dewey suggests the overall quality of an experience depends on both the experienced object (built by the designers with some meanings attached to it) and the user. Skilled designers can to some extent influence the user's interpretations. In fact, several design strategies have emerged that attempt to exploit users' interpretations using ambiguity (Gaver at al. 2003b), reflection (Sengers et al. 2005), defamiliarization (Bell et al. 2005), etc. in the technology.

iv. Four forms of Experience

Experiencing is not a purely cognitive activity. People construct meaning by trying to put together what they have learnt in the past and what they feel, wish and think about their present situation. The Bach example clearly shows that art involves us, not only, cognitively (understanding how the script should be executed by a violinist), but sensually (reading a musical-score makes expert musicians internally "hear" the music), emotionally (being excited when you "hear" 3 different voices) and practically (many amateur violinists try to play part of the score). The example of the movie after Fowles' novel shows that knowledge of the original novel changes the understanding of the story (cognitive interpretation), as well as the emotions evoked. And knowing the original novel may trigger a sensual longing to watch the movie, or, depending on the individual person's context and history, a repulsion combined with a prejudice feeling that the own felt experience should not be spoiled. In the first case, the announcement of the movie may trigger a practical aspect of a new experience of calling a friend with whom the novel has been discussed in the past.

From the examples we categorize different forms of users' experience into four categories: Sensual, Cognitive, Emotional and Practical. These are the four inseparable and inter-related forms of human experience. However, their intensities may differ based on both the users and the experienced artifact, and the context in which their interaction takes place. Clearly these four forms of experience cannot be seen isolated from each other. In any case they are related, and for the individual person the experience remains a coherent whole. It is only for the sake of design that we want to be able to look at each of these separately as well as analyze how they combine and color each other. Designers should be aware if they intend to trigger a certain experiences in their audience (the users of their creation).

"EXPERIENCE AS MEANING" – A CONCEPTUAL FRAMEWORK

Recent approaches for designing and evaluating systems in Interaction Design have started using philosophical stances about how meaning is conveyed through a system (e.g. Sengers, Gaver 2005). Designers can never really design a system with an intention that users will establish the 'same' meanings that designers are trying to convey. In fact, during their interaction users actively construct meanings about the systems in the lived world, i.e. meanings emerge during users' interaction with the system. This emergence of meaning depends on both what system provides and what the users bring to the interaction. Taking this phenomenon in account, we conceptualize a user's experience with an interactive system as the meanings he/she establishes about the system. These meanings are not dependant only on the skills, knowledge and cultural background of the user but also the accuracy, preciseness and correctness of the system interface. However, it is important to consider the advantages (or disadvantages) of conceptualizing experience as users' interpretations or meanings.

All interactive systems support some sort of experience and they embody certain meanings. However, the subjective nature of experience makes it difficult for designers to fully understand the values and meanings that are conveyed during users' interaction. As a result certain values and meanings become implicit in the design of the system. As was shown in the examples that meanings are socially and culturally constructed, hence, by conceptualizing experience as meanings (for design and analysis purposes) would allow designers to understand how users construct and associate a specific meaning with the system. Additionally, by getting access to the users' meanings will allow designers to assess the social, cultural and other non-technical aspects related to the technology. Designers facilitated with such an understanding would be able to build interactive systems more effectively. At the other end, meanings, being a subjective and spatio-temporal phenomenon, differ from person to person and the context in which the system is used. This in a way challenges designers to come up with new ways of envisioning their designs.

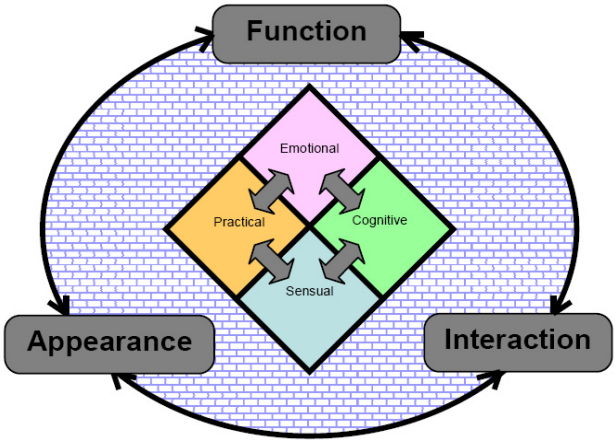

Figure 2. The Experience as Meaning Framework

Figure 2 shows our conceptual framework – *Experience as Meaning* – that is derived from the four underlying concept discussed in the previous section. Experience as Meaning is an account for understanding the experience phenomenon and applying this into design. It addresses three properties of an interactive system: function, interaction and appearance; and four forms of users' experience: sensual, practical, cognitive and emotional.

The framework is explained in three following steps,

1. Experience occurs during the interaction between the user(s) and the interactive system(s) in the lived environment;
2. Designers convey meanings (consciously or unconsciously) through the appearance, interaction and function of the system; and
3. User(s) constructs a coherent whole that is a combination of Sensual, Cognitive, Emotional and Practical forms of experience.

Function, interaction and appearance are the three inseparable aspects of any interactive system. Designers follow different user requirements and use design principles, for instance "form [normally] follows the function", to make decisions about the appearance and interaction mechanism of the system. It is very important from a designer's point of view that his system conveys the different *functions* it offers. Designers have to choose what objects are required to execute those functions and how they are structured or related and what actions can be done on them (van Welie 2001). *Interaction* (or dialogue) represents the language (modality) by which the users can express themselves to the system and it represents the dynamic behavior of the system regardless of the representation issues. One could say that dialogue provides ways of communicating with the system functions. *Appearance* (or form) is concerned with how the system is presented to the user and how the user can represent information to the system. These properties are the most sensible (visible, audible, etc.) aspects of the system. A good representation provides the base for the users on how to use the system (dialogue) and where to find the functionality (van Welie 2001).

During their interaction with the system, users construct a coherent whole using their interpretation and sense-making skills that is a combination of the sensual, practical, cognitive and emotional forms of experience. The *sensual* form reflects the sensations and the visceral level (see Norman 2004) reactions initiated by the sensory information (e.g. look and feel) of the system. For an individual user this form is related merely to the 'skin deep' attractivity of the system and it does not involve much cognitive support. The *practical* form of an experience results from conducting different activities towards, with, or through the system. The practical form consists of users' concrete actions and is related to the actual 'use' of the system. The *emotional* form bears the subjective evaluation of the situation. It is related to different emotions (e.g. joy, anger, disappointment, disgust, etc.) elicited during interacting with the system. The *cognitive* form is about comprehending a system's narrative structure, action possibilities, explanation of actions, expected results, etc The cognitive form of experience involves learning, interpreting and understanding the events and thus informs users what actions are required.

The Role of the Designer

In the last decade, designers of major corporations such as Philips, Nike, Apple, etc. have started using experience-design strategies in their product development life cycle. In one such example (Hekkert et al. 2003), where industrial designers attempted to envision the experience of using a copier machine by visualizing it as an activity of 'dancing with a partner'. In this particular case, the designers took an intended user experience ("dancing with the machine") as the major goal and a success criterion of their design activity. Innovative approaches like these are sometimes criticized by some philosophical (McCarthy, Wright 2004) and sociological (Sengers et al. 2005) design approaches, which believe that it is the end-users who guarantee a specific experience and not the original designers.

Designers, consciously or unconsciously, convey some meanings to the users by translating them into appearance, function and interaction mechanism of the system. However, there are no guarantees that the users will interpret the exact meaning the designer is trying to convey. The challenge here is to make designers capable of being able to articulate users' interpretations and hence the experiences with the system. Our conceptual framework uses an interaction-centered approach that focuses on how the meanings are constructed during the actual use of the designed system. It asks designers to envision the function, interaction and appearance of the system with respect to the sensual, cognitive, practical and emotional forms of experience. The *Experience as Meaning* framework includes tangible properties of an interactive system in

terms of function, interaction and appearance and intangible properties of users' experience in the sensual, cognitive, emotional and practical forms by which the user actually *constructs* an experience. The important point here is that designers have control over the tangible parts of this framework, which they can easily manipulate for design and analyses purpose. This framework challenges designers to explore the changes in the intangible parts by manipulating the tangible parts.

For designers, experience design is about being able to go beyond the instrumental aspects in designing systems and focus on the desirable possibilities. Our framework forces designers to think about not only on the functional and productivity related aspects but also the experiential aspects that are sometimes overlooked. During the conceptual design stages, questions such as, "how can we design the *interaction mechanisms* for the system that could lead to an *emotional* form of an experience?" or "how can we design the *appearance* of the system that could lead to a *sensual* form of experience?", will challenge the designers to generate design ideas that are not just related to the usability of the system. This framework in a way provides a qualitative notion of the relationship the users will have with the system and the context around them.

Envisioning users' interaction with the system is a key activity that designers follow in any design project. The validity of a designed product depends on how well its designers have envisioned this interaction. To envision one's experience does not only require well-formed understanding of the human and the system aspects but also a good understanding and consideration of one's context and the set of activities required to be performed on the system. It is sometimes helpful if designers have a framework or a lens to envision the required experiential support to be triggered via the use of the system. Having a conceptual lens like Experience as Meaning framework would help designers to find appropriate experiential design parameters by translating them into certain design features.

Since Experience as Meaning is an interaction-centered framework, the contextual issues are not neglected here. When designers try to envision a certain form of experience, for instance, the emotional form, they actually have to consider the context of users' interaction, which may include their relationship with others ('social' aspects), the physical environmental settings, the cultural and political situations (e.g. 'public' and 'private' settings), etc. These contextual issues will become clearer when we show a possible use of this framework in the next section.

FRAMEWORK IN USE

We report here a first empirical illustration of our framework in use. Two groups of design students working towards their European Masters degree in Ergonomics were involved in designing concepts of an aware technology that allows monitoring and communication. In this course the students were following the DUTCH design process (van der Veer, van Welie 2000) for designing their products. One group was involved in designing for elderly (age 65+) and another was involved in designing for young kids (age 3 - 5). The focus of these design projects was to creatively develop a device that may be in use in 5 years time, considering prospective North American and European users. In future these designs might be applied in Kindergartens, Elderly-care Centers or in other similar institutions. From a functional point of view, the device should be able to help caretakers (who might be at a different but nearby location) keeping track of the users' whereabouts and communicate with them for any instructions or help.

Since the intended user groups were vulnerable and required constant care, one of the additional goals of the concept design was to provide experiential support through the product. For the elderly and kids, being separated from their loved ones and living with strangers was emotionally challenging in itself. We were interested in finding out to what extent the designed product can support or improve these users' experiences.

During the teaching sessions, we (the authors) introduced our conceptual design framework to the students and allowed them to use it in their own preferred ways. Both groups started off with some in-depth interviews with the prospective end-users and professional caretakers – currently working in a similar type of environment. The groups then developed two personas: Thomas – a 3-year-old boy and Weerd – an 82-year-old lady, to have a constant user focus during the design process. They collected the most common attributes and behaviors of the potential users in their respective personas. Keeping these personas as the main focus of their designs they started brainstorming within individual groups to use our framework as a *checklist* for adding creative features and to provide experiential support. They tried to envision the implications on the functions, interaction and appearance of their design from the sensual, cognitive, emotional and practical point of views.

Appearance & Sensual form

D#1: Weerd may like wearing jewelries; the device should be in the form of jewelry

D#2: how about a Necklace?

D#1: but we also need the information related to her emotions and health

...

Interaction & Practical form

D#3: Weerd cannot walk properly so the device should be in a nearby place

D#2: a Necklace will solve this

D#4: but how does she interact with it? A Necklace would be hard to interact with

D#1: how about a Bracelet, she can easily see it and operate with it

...

Appearance & Sensual form

D#2: yes, Bracelet is a better choice. She would also feel attached with it

...

Function & Practical from

D#1: the device should also detect her heartbeats, temperature, etc. to send a report to the Doctor twice in a week

D#2: we can put sensors in the Bracelet to detect this info from her hand

...

Figure 3: Excerpt from a brainstorming session (D#i = Designer number i)

We asked the student designers to make a collection of their design ideas, any relevant information on their brainstorming sessions, design sketches and mock-ups that they develop while using this framework. Figure 3 shows a brief excerpt of one of their brainstorming sessions. It shows how the students focused on the combinations of different aspects of the system and the forms of experience. It also shows that the backward dependency of function, interaction and appearance helped them refining their design ideas. We categorized episodes from this session by the relation of designers' decisions considered (regarding functionality, interaction or appearance) intended to trigger users' experiences (sensual, cognitive, emotional, and practical forms).

Both groups came up with devices that can be worn on the wrist. Figure 4 is an example sketch developed during a group's brainstorming session. They used different sensing techniques to track users' movements, physical place, temperature, heart rate using different physiological and behavioral cues. In the following, we show what creative and additional values the individual groups added to their designs after using our framework.

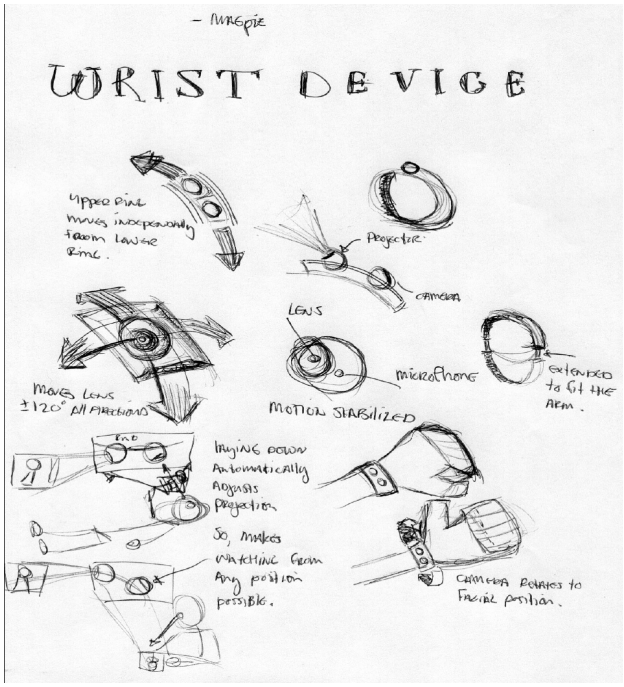

Figure 4. Design sketches developed by students

Device for Elderly:

- The design group thought of having a jewelry-like device on the hand of persona Weerd, since she would love to wear it and feel attached to it. And since the device is on her hand, help is available 24/7.
- The group thought that having a jewel as the device would be easily accessible through her hand and it would make her feel that "there is someone constantly looking after me".
- To avoid any cognitive load while interacting with the device the group used speech interfaces for communicating with the elderly.
- The device gets warmer when another elderly with a similar sort of device in his hands comes close to Weerd. This could provide some social and emotional pleasure of using the device.
- An assistive feature was added into the device that would remind the users to finish their daily rituals especially when they are on medication. E.g. at a certain time the device would sound "You didn't take your pills today!".

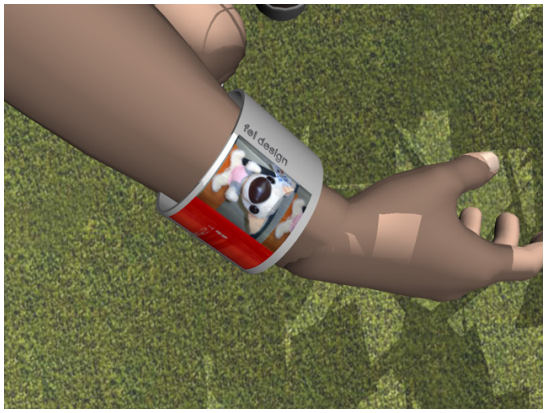

Figure 5. Design of the aware device for kids

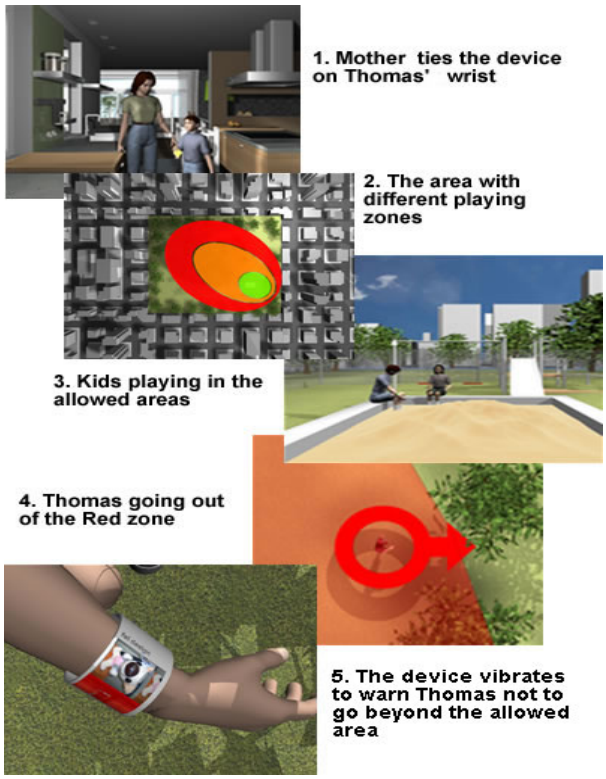

Figure 6. A mock-based scenario for Kid's Device

Device for Kids (see figure 5 for a mock-up):

- After getting familiar with the framework the design group added elements of playfulness in their design. Persona Thomas, being a "Bob-the-builder" fan, would like to have a toy-like device tied on his hand.
- The device also supports Thomas emotionally whenever he feels lonely by allowing him to see his mother's face on the 2D display screen of the wrist device.
- Educational aspects were added at the interaction level. E.g. on disobeying instructions about forbidden locations, the device would vibrate and the send a message implicitly and even show his favorite pet Fluffy warning him. And on subsequently obeying the instructions the device would permeate a nice smell (candy).
- A sense of freedom was inputted in to the device. Thomas being a creative 3-year-old would not like being repeatedly interrupted by the device hence the device doesn't work as an assistant to the kid.

Both design concepts support work-critical functions (e.g., monitoring) and, at the same time, allow interaction to educate and support play (in the kids device) and build social relationships with others (in the elderly device). The final design concepts were presented as a combination of interface features and mock-up-based scenarios, during a stakeholder evaluation. Some example screen-shots from a presentation are presented in figure 6.

DISCUSSION – THE FRAMEWORK

In design research, it is not surprising to think about product aesthetics, sensual and emotional products characteristics or other non-technical design criteria. In fact in almost all design fields, designers have been paying attention to these intangible aspects for a long time. What our framework offers is an analytical structure for envisioning users' experience. During the student projects of designing aware technologies, we discovered several interesting issues regarding the usefulness of our conceptual framework.

Based on the design sketches, brainstorming session transcripts, list of design ideas that we received from students and the final design concepts, we describe the usefulness of our framework in the following.

Creativity. The framework allowed designers to break through the limitations imposed by the engineering and scientific approaches and think about the broader aspects of human experiences for designing. In the case studies, some creative ways of establishing communication between users were devised taking into account the critical and more instrumental nature of care-taking situations. For instance, in the kid's tracking and communication device *educational* aspects were added by e.g. providing vibrations and warning messages from the kid's favorite pet to prevent him from going beyond the specified areas. This way the framework provided opportunities for designing systems with some creative possibilities rather then only focusing on the given problems (e.g. monitoring). Although the design groups in the early stages faced some minor problems with distinguishing certain aspects related to emotions, sensations, and aesthetics, over time this hardly affected their explorations in generating ideas.

Collaboration.
The checklist like nature of our framework initiated debates among the design team for making design decisions. We observed from designers' sketches and transcripts of brainstorming session that the checklist developed by the designers from our framework *provoked* and *inspired* these student designers to come up with creative design ideas. For instance, utilizing a combination "Interaction" mechanism & "Sensual" form of experience designers created vibrating effects to inform the kid not to go beyond certain areas. Similarly, utilizing combination such as "Interaction" mechanism & "Emotional" form of experience designers applied a facility of providing warmth (using heat actuators) in the elderly device to inform when some other elderly with the similar device comes nearby. Another example of designing the "Appearance" of the elderly device is shown in their brainstorming session in figure 3. The dependency of function, interaction and appearance of the system allowed designers to iteratively choose the suitable design feature. During the sessions all the ideas (creative or otherwise) were noted down and were later criticized within and during the inter-group communication. This especially added to the creativity aspect of our framework.

Beyond Instrumental.
An obvious suggestion to deal with tracking and monitoring in such a case would be to use surveillance systems and other mechanical devices. This suggestion could allow tracking of users but it neither supports users' well being and personal growth nor is it ethical (given the vulnerable situation of both user groups). Using our framework student designers dealt with the subjective and experiential aspects related to the technology use. As Gaver (2002) suggests, in some cases conveying information imprecisely may be as effective as providing the exact information through video and audio; however the imprecise information could have more emotional value then the complete information. Students came up with some sensual interaction techniques, e.g., in the kid's device using olfactory pleasure like smell to convey appreciation on obeying certain instruction from the device. In the elderly device they decided to use warmth to inform the user when another elderly with a similar sort of device approaches. This, not being 'just' information, elicits emotional feelings.

Socio-Cultural relevance.
The framework provided different ways to think about how the designed systems can enter into, and affect, users' everyday culture. The design concepts that are developed using our framework resemble users' everyday used devices (i.e. a bracelet for an elderly lady and a toy like wrist device for kids). In the case of the device for elderly, the framework helped designers to think about users' social and emotional relationships. The kid's monitoring and tracking device provides a "sense of freedom", in a way that kids can engage into their play or other activity without being interrupted by the device. Quite opposite to kids' devices, the device for elderly provides continuous care by assisting, for instance, taking pills and by helping them with other daily activities. This may provide emotional satisfaction: "there is somebody constantly caring and looking after me". In a different instance, the device gets warmer when some other elderly having a similar device comes in the user's territory. Again, the minimal transmitted data could provide a large value to the elderly. This way the framework helped in establishing a channel that could signify social, cultural and aesthetical aspects of human interaction.

Broadening the design space.
The designers in our case did not apply our framework as a substitute to "traditional" design approaches. In fact our framework showed to be complementary to state of the art methods like DUTCH (van der Veer, van Welie, 2000). The systematic application of the concept of *Experience as Meaning* resulted in broadening the scope of design, adding a systematic focus on experience to the user-centered viewpoints of functionality, interaction, and representation.

As an evaluation of these design concepts, we organized student presentations in the presence of relevant stakeholders. The design concepts were presented in the form of a list of interface features and mock-up based scenarios describing different contexts of use. The design concepts received positive reviews from the committee. Another way to evaluate these concepts could have been to carry out a user study. We chose not to do that with these concepts since the goal of these studies were to investigate how well designers could use the framework and to what extent creativity is added to their designs.

CONCLUSIONS

Every aspect of an interactive system can to a certain degree affect users' experience and it is very important to take human experience in account while designing systems. The domain of art can provide an excellent metaphor to understand a user's experience and design strategies can be developed from, or inspired by, arts. In this paper, we showed that it is possible to think about and design for experiential effectiveness in systems by using conceptual tools and frameworks like the one presented here. *Experience as Meaning* is an account for thinking about users' experience with interactive systems. A framework like this provides a vision of applying experiential effectiveness in the early stages of design.

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