Designing a Pleasurable Interface: Emotion in Human-Computer Interaction

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In recent years interaction design has looked beyond sheer usability to questions of user emotion, most typically positive emotions such as satisfaction, pleasure, fun and delight. When designing task based applications for mobile devices that tend to be viewed as a chore, how might current research into the role of emotion in Human-Computer Interaction and the heuristics set forth influence the design?

The case in point is the design of an application to track tax deductable expenses on a mobile, hand-held device, such as a PDA. While it's unlikely that the task involved might ever be considered fun, what can be drawn from current research to make the application more appealing to a user? What might make it stick? The research questions posed to assist in the design of such an application are the following:

- What are some of the key usability issues and heuristics for interaction design?
- How has emotion been approached in the field of Human-Computer Interaction?
- What guidelines or heuristics have been set forth in designing for positive emotions such as pleasure and fun?
- What critiques have been leveled against new design trends?
- What new models or methodologies might become relevant in the future?

Principles of Interaction Design

In the book *Designing the User Interface: Strategies for Effective Human-Computer Interaction* (2004) Shneiderman and Plaisant provide a comprehensive look at some of the key tenets of interface design. Designing what they call a quality service involves considerations of timing, avoiding harmful mistakes (otherwise thought of as error recovery), system response time to user inputs, and reduction user frustration.

Response time is defined as the time measured in seconds it takes from when a user initiates and action to the system outputting a result. In considering response time one must also consider "user think time," or the time in seconds the user thinks before initiating a next action (Shneiderman & Plaisant, 2004, p.455). The majority of users' desire rapid or instant response time, though Shneiderman and Plaisant (2004) note that rapid interaction increases the possibility of error rates. Also, any extreme variations in response time can be highly unsettling to the user (Shneiderman & Plaisant, 2004, p.469). Most often what is an acceptable response time is determined in relation to previous experience (Shneiderman & Plaisant, 2004, p.463). Technology users have become even more accustomed to rapid response time, yet timing is still a crucial element to factor into design.

When considering response time in design, other principles such as closure, short-term memory limitations and chunking must be considered. Miller's law, which states that people can keep about seven chunks of information in their short-term memory for 15 – 30 seconds, shows what limited capacity we have in absorbing new information (Shneiderman & Plaisant, 2004, p.458-9). Processing information and problem solving uses both short-term and long-term memory. We start by clustering small chunks of information if we are unfamiliar with a new task, and then, as we grow more familiar and expert in the task, we begin to cluster concepts into larger chunks. We comprehend complexity by forming high-level concepts (Shneiderman & Plaisant, 2004, p.458-9). In the design of an application to be used on a mobile device, the limitations of short term memory must be a factor in both error recovery and the amount of information offered at any time through the interface.

Shneiderman and Plaisant sum up the criteria for user speed, low error rates and high satisfaction with the following criteria (Shneiderman & Plaisant, 2004, p.458-9):

- Users have an adequate knowledge of the objects necessary for problem solving
- The solution can be carried out without any delays
- No system distractions to the user

- User experiences no or low anxiety about the system
- Feedback is provided about progress towards the solution
- Errors are avoided or handled easily

Shneiderman and Plaisant also find the visual display to be a key component to successful designs. A dense, cluttered display might result in user dissatisfaction, and inconsistency in format might inhibit user performance (Shneiderman & Plaisant, 2004, p.490). To support user task performance, the design must (Shneiderman & Plaisant, 2004, p.490):

- Consider knowledge of user tasks first
- Provide the necessary data for the user to carry out the task
- Use an appropriate sequence of data
- Use meaningful groupings of items
- Label information in terms suitable to user knowledge
- Be consistent in the sequence of groupings
- Use an orderly format

As technology advances and the capacity and speed of our computers increase, it's interesting to consider Shneiderman and Plaisant's findings in terms of designing task sequences over time and in context of use. What is an appropriate and meaningful sequence of data or groupings carried out over a series of screens, and how might that order influence a user's opinion of the task? What might a user consider a delay in a task sequence, and how might the system take over any work considered too time consuming to the user? Though the guidelines presented by the authors are foundational, they still pose unanswered questions important to designing a system as a whole.

Another highly influential set of principles for interface design are “Nielsen’s Ten Usability Heuristics”. They are the following (Nielsen, 1994):

- Visibility of system status
- Match between system and the real world
- User control and freedom
- Consistency and standards
- Error prevention
- Recognition rather than recall
- Flexibility and efficiency of use
- Aesthetic and minimalist design
- Help users recognize, diagnose, and recover from errors
- Help and documentation

Nielsen’s Heuristics focus on creating a usable system. In following his principles a simple, efficient design can emerge that will leave a user satisfied due to ease of use. However key principles such as natural language, error prevention and user control neglect the context of the human task the software supports. Is a usable system enough to encourage use of an application? And is usability enough in a highly competitive culture?

Emotion in Human-Computer Interaction

The field of Human-Computer Interaction has traditionally focused on research based on observation of what is objective and measurable. Historically, well-being has referred to ergonomics in the workplace (Carroll, 2004, p.39). One of the primary foundations to the field, cognitive psychology, does not have a history of examining the role of emotion and pleasure in cognition, and in turn, HCI has been reluctant to explore what is considered subjective (Monk, Hassenzahl, Blythe, & Reed, 2002, p.924). Emotion is difficult to pin down and study because

it is in context, volatile and ephemeral (Hassenzahl, 2004, p.47). However, as communication technology moves out of the workplace and into the home, issues such as emotion, pleasure and fun have become important research topics within HCI (Monk, Hassenzahl, Blythe, & Reed, 2002, p.924).

Additionally, current research and cultural theory has shown the integration of emotion in cognition. Boehner, DePaula, Dourish, & Sengers (2005) point to neurologist Antonio Damasio, who has demonstrated "the interdependence between emotions and activities previously considered to require rational thought, such as problem-solving and decision-making" (p.60). They also note the influential writer Don Norman, who "incorporate[s] emotion as a central component, noting that the experience of "everyday things" is conditioned not simply by practical or "logical" concerns but also by aesthetic and emotional ones" (Boehner, DePaula, Dourish, & Sengers, 2005, p.61). These authors and others have inspired new approaches to interface design that move beyond usability.

Some of the earliest research into how to create a pleasurable or fun interface was in game studies and software geared towards children (Shneiderman, 2004, p.48). This research served as a starting point in the exploration of what might make an interface fun for adults, or in a more commercial context, how to create a "delightful" experience for a client.

In his 1982 paper "Heuristics for Designing Enjoyable User Interfaces: Lessons from Computer Games," Thomas Malone emphasizes three key concepts to analyze the appeal of a game interface: challenge, fantasy and curiosity. Malone's Heuristics for Designing Enjoyable User Interfaces (Malone, 1982, p.65) are the following:

1. Challenge
    i. Goal. Is there a clear goal in the activity? Does the interface provide performance feedback about how close the user is to achieving the goal?

ii. Uncertain outcome. Is the outcome of reaching the goal uncertain?
    1. Does the activity have a variable difficulty levels. For example, does the interface have successive layers of complexity?
    2. 2. Does the activity have multiple level goals? For example, does the interface include scorekeeping?

2. Fantasy
    a. Does the interface embody emotionally appealing fantasies?
    b. Does the interface embody metaphors with physical or other systems that the user already understands?

3. Curiosity
    a. Does the activity provide an optimal level of informational complexity?
        i. Does the interface use audio and visual effects: (a) as decoration, (b) to enhance fantasy, and (c) as a representation system?
        ii. Does the interface use randomness in a way that adds variety without making tools unreliable?
        iii. Does the interface use humor appropriately?
    b. Does the interface capitalize on the users' desire to have "well-formed" knowledge structures? Does it introduce new information when users see that their existing knowledge is: (1) incomplete, (2) inconsistent, or (2) unparsimonious?

In a game interface, users derive pleasure by working through increasingly difficult challenges. To create a feeling of challenge, users must feel a level of uncertainty about the outcome of mastering their goal. Appropriate feedback keeps the user from feeling lost, and allows them to know where they stand in accomplishing goals. Malone (1982) found that multiple layers of complexity in the game interface to be an important tool to create user challenge. Presenting the user with increasing levels of difficulty is one form of doing this. Designers can also include layers of complexity within a level to appeal to diverse expertise levels (this is especially important in multiplayer games). "Users could derive self-esteem and pleasure from

successively mastering more and more advanced layers of the system, and this kind of pleasure might be more frequent if the layers are made an explicit part of the system" (Malone, 1982, p.66). Another way Malone suggests to approach multiple layers of complexity is to allow the flexibility and openness for users to manipulate or hack the system for their own use within layers.

Fantasy in a gaming interface appeals to user emotions and employs metaphors to communicate how the user must work within the fantasy to accomplish goals. In using fantasy, Malone (1982) points out that designers need to consider how different personalities may emotionally react to different fantasies and audience knowledge of fantasy scenarios used. As for his third concept, curiosity, Malone finds information complexity to be key. Ease of use and the comprehensibility of the system are still primary factors, but used carefully, randomness, novelty, surprise and audio/visual effects can also engage the user.

“GameFlow” is a more current set of heuristics for enjoyment in game interfaces. Sweetser and Wyeth (2005) find that current literature on game heuristics focuses on "usability in games, rather than player enjoyment in games” (p.1). They seek in their heuristics an integrated model of and method to assess player enjoyment that is based on Csikszentmihalyi’s study of “optimal experience” called flow (Sweetser & Wyeth, 2005, p.1-2). They state that "the key element in flow is that it is an end in itself – the activity must be intrinsically rewarding and autotelic" (Sweetser & Wyeth, 2005, p.3).

GameFlow Heuristics (Sweetser & Wyeth, 2005, p.5-6):

1. Concentration: Games should require concentration and the player should be able to concentrate on the game.
2. Challenge: Games should be sufficiently challenging and match the player’s skill level.
3. Player Skills: Games must support player skill development and mastery.
4. Control: Players should feel a sense of control over their actions in the game.

5. Clear Goals: Games should provide the player with clear goals at appropriate times.
6. Feedback: Players must receive appropriate feedback at appropriate times.
7. Immersion: Players should experience deep but effortless involvement in the game.
8. Social Interaction: Games should support and create opportunities for social interaction.

Shneiderman, Plaisant and Nielsen found principles such as simplicity and logical, meaningful sequences of information key to usability, however heuristics for game design take a different approach. Multiple layers, complexity and an appropriate amount of challenge and uncertainty engage users, laying grounds for a fun experience. However, according to John Carroll (2004), fun is not necessarily captured by either simplification or complexity in design. So what is fun, and how might it assist in designing more pleasurable interfaces?

In Carroll's paper "Beyond Fun," he defines something as fun when (Carroll, 2004, p.38):

- It "attract[s], capture[s], and hold[s] our attention by provoking new or unusual perceptions, arousing emotions in contexts that typically arouse none, or arousing emotions not typically aroused in a given context."
- It's surprising
- It's challenging yet offers "transparent" guidance and feedback and "task closure"

Carroll's definition of a fun interface is still grounded in usability heuristics. In fact, Carroll (2004) argues that fun should be included in the broader definition of the term usability. He states that the "tools people use, such as computers and software, can affect their perceptions of both self-efficacy and collective efficacy, and thereby enhance or impair future learning and performance" (Carroll, 2004, p.39). What is fun is its ability to arouse an emotion in an unexpected context or surprise us. The degree in which emotions should be aroused, or generally how surprising an element of an interface should be is not explored, and is problematic in its implications for design. Carroll also notes that cultural identity and diversity and its effects on emotion in design is unexplored

territory. A surprise that generates positive emotion in one culture could very well bring up the opposite reaction in another.

In a more recent paper, “Designing For Fun: How Can We Design User Interfaces To Be More Fun?,” Ben Shneiderman offers three goals in which to design for what he calls “fun-in-doing” (Shneiderman, 2004, p.49):

- Provide the right functions so that users can accomplish their goals
- Offer usability plus reliability to prevent frustration from undermining the fun
- Engage users with fun-features

He considers fun features to be “alluring metaphors, compelling content, attractive graphics, appealing animations, and satisfying sounds" (Shneiderman, 2004, p.49), but warns designers of the possibility of going too far. Again, a solid grounding in usability heuristics to start with is highlighted. Fun, for Shneiderman, is an additional feature – a layer on top of the interface, be it content, animation or graphics. But which then, is fun, completing the task or engaging in the fun feature?

In the paper “FUN,” John Carroll and John Thomas attempt to distinguish between ease of use and fun. They define ease as a process that is "learned quickly, with few steps and few errors. They can be communicated to others with few words and performed fluently" (Carroll & Thomas, 1988, p.21). The authors say that sometimes a system might be labeled as easy to use when it may actually be fun. On the other hand, fun might not always be considered easy to use, provided the system’s complexity feels worthwhile to the user. Like Shneiderman, Carroll and Thomas (1988) distinguish between fun and ease of use. They feel this is because associating the two may place too much of an emphasis on simplicity, when complexity can also be considered fun.

Carroll and Thomas (1988) demonstrate the power of intrinsic motivation over extrinsic incentive using an example from research in educational games.

> [F]un is also likely to have powerful influences on what people will even try to do and on how long they will persist . In a classic experiment, Lepper, Green and Nisbett (1973) studied a situation in which children played with colored pencils. Half the children were simply allowed to play with the pencils, the other half were rewarded for doing so. The effect of this manipulation was that the unrewarded children played with the pencils longer than those who had been rewarded. Lepper, Green and Nisbett suggested that the intrinsic reward of the colored pencils alone was a stronger incentive than the extrinsic reward offered for playing with them, and that in fact, offering the extrinsic reward weakened the attractiveness of the pencils. (p.22)

The weakness of an extrinsic reward is interesting because it appears to stand in contrast to adding fun features on top of everyday tasks. If the interaction itself is not enjoyable, an added layer of fun features might weaken the attractiveness of the tool itself, as it did with the colored pencils. In their study of educational gaming Carroll and Thomas (1988) found intrinsic motivators to be "properties of spatiality, interactiveness, and feedback" (p.22). Encouragement to take risks, allow failure and users sense of control were also found to be properties that increase a feeling of enjoyment. These properties are essential to interacting with the interface, integrating enjoyment into the task itself, and offer design possibilities. However adding fun features such as animation or sound to an application that tracks tax deductable expenses on a PDA seems more of an annoyance than an incentive to use and enjoy the interface. What is missing from heuristics with an emphasis on fun is a consideration of the tasks themselves and the context it exists within.

In “Emotions Can Be Quite Ephemeral; We Cannot Design them,” Marc Hassenzahl argues that emotion and cognition cannot be separated from each other. "Emotions need cognition, and research on the role of emotions in decision-making demonstrates that cognition needs emotions, too" (Hassenzahl, 2004, p.46). So when

designers design for an emotion, the challenge becomes exploring the interplay and integration of cognition and emotion (Hassenzahl, 2004, p.47). Hassenzahl suggests that there is a common set of needs people share that can serve as a starting point for design (Hassenzahl, 2004, p.47):

- manipulation (goal-achievement)
- stimulation (personal growth, an increase of knowledge and skills)
- identification (self-expression, interaction with relevant others)
- evocation (self-maintenance, memories)

Hassenzahl also stresses the need for designers to understand the context in which users are situated. Satisfying different needs for users within context can create positive emotions for a user Hassenzahl, 2004, p.47). New design methodologies have arisen to attempt to meet the challenge of designing technologies that address the interplay of emotion and cognition in the users' context.

Integration of Emotion and Cognition: New Design Methodologies

Critiques such as Hassenzahl's have been made of how the study of emotion in HCI still relies too heavily on the conventional, cognitive model, depending upon it as a "base for adding "emotional" understandings," (Boehner, DePaula, Dourish, & Sengers, 2005, p.59) and in response new methodologies are emerging. Boehner, DePaula, Dourish, & Sengers (2005) claim that because emotion is considered part of the traditional information processing framework, "emerging understandings of emotion are subject to the same critiques that have been leveled at purely cognitive approaches in the past – that is, their failure to account for and adequately incorporate an understanding of everyday action as situated in social and cultural contexts that give them meaning" (p.59). Three of these new design methodologies, pragmatist aesthetics, reflective and affect as interaction, focus on emotion and experience in its socio – cultural context from varying angles.

Pragmatist Aesthetics

In the paper “Aesthetic Interaction: A Pragmatist's Aesthetics of Interactive Systems,” Petersen, Iversen, Krogh, & Ludvigsen propose what they call pragmatist aesthetics to the field of interaction design. The authors define a pragmatist aesthetic as a "theoretical foundation for staging a concept of aesthetic interaction," and view aesthetics in three ways: "socio-cultural approach to aesthetics, designing for mind and body and the instrumentality of aesthetics" (Petersen, Iversen, Krogh, & Ludvigsen, 2004, p.270). The foundation for their approach is the American philosopher John Dewey. Dewey sees an aesthetic experience as both rooted in our cultural context and our prolonged, secondary experience beyond our primary reaction (Petersen, Iversen, Krogh, & Ludvigsen, 2004, p.271). The authors challenge the idea they see in interaction design that aesthetics is primarily a visual experience. To them, aesthetics is more than the "pleasing visual appearance of products," instead; they emphasize aesthetics of use over appearance (Petersen, Iversen, Krogh, & Ludvigsen, 2004, p.269).

The new emphasis on emotion in Human-Computer Interaction assumes a simplistic view of human nature, argue the authors. According to Petersen, Iversen, Krogh, & Ludvigsen (2004) people don't always desire emotions like fun or pleasure, and that it's also wrong to assume that emotion can be examined isolated from "socio-cultural context of use" (p.270). Designing with a pragmatist aesthetic emphasizes context of use over the designer's intention. Instead a designer creates space for the user to have personal experiences within an interactive system rooted in their own socio-cultural context. The pragmatist perspective emphasizes exciting the user's imagination and approaches experience in a more holistic fashion by appealing to the mind and body (Petersen, Iversen, Krogh, & Ludvigsen, 2004, p.271).

Reflective Design

In their paper “Reflective Design,” Sengers, Boehner, David, & Kaye propose that reflection should become a critical goal for design in Human-Computer Interaction. They state "technology design practices should support both designers and users in ongoing critical reflection about technology and its relationship to human life" (Sengers, Boehner, David, & Kaye, 2005, p.50). By introducing a new methodology based upon critical reflection, they claim technology design will have a more "socially responsible" (p.49) outcome. The authors state that reflection has physical and sensual aspects to it as well as cognitive. They more specifically define the term reflection as critical reflection, which pulls “unconscious aspects of experience to conscious awareness” (Sengers, Boehner, David, & Kaye, 2005, p.50). By surfacing unconscious “attitudes, practices, values, and identities,” (p.50) Reflective Design provides the user opportunities to make decisions based upon that new awareness and experience themselves and the world in new ways.

Reflective design draws upon and critiques design methodologies such as participatory design, value sensitive design, critical design, ludic design, critical technical practice and reflection-inaction. The authors put forth principles and strategies for their method, which emphasizes design for critical reflection both within the designers life and practice and the users, acknowledging reflection as an important part of experience.

Principles of Reflective Design (Sengers, Boehner, David, & Kaye, 2005, p.55-6):

1. Designers should use reflection to uncover and alter the limitations of design practice.
2. Designers should use reflection to re-understand their own role in the technology design process.
3. Designers should support users in reflecting on their lives.
4. Technology should support skepticism about and reinterpretation of its own working.
5. Reflection is not a separate activity from action but is folded into it as an integral part of experience.
6. Dialogic engagement between designers and users through technology can enhance reflection.

Reflective Design Strategies (Sengers, Boehner, David, & Kaye, 2005, p.56-7):

1. Provide for interpretive flexibility.
2. Give users license to participate.
3. Provide dynamic feedback to users.
4. Inspire rich feedback from users.
5. Build technology as a probe.
6. Invert metaphors and cross boundaries.

Affect as Interaction

In the paper "Affect: From Information to Interaction," Boehner, DePaula, Dourish, & Sengers critique what they see as measuring affect in a more traditional cognitive approach in the field of Human-Computer Interaction. The authors advocate that the field of HCI develop strategies for "measuring things such as awareness, expression, and engagement" (Boehner, DePaula, Dourish, & Sengers, 2005, p.67) and shift away from a more quantitative approach to measuring affect. They state that an individual's experience of emotion is not a private affair; it is "mediated by cultural and social situations… [and] also used to enact and sustain those settings" (Boehner, DePaula, Dourish, & Sengers, 2005, p.64). Information technologies should be understood on "multiple levels simultaneously – as technological artifacts, social facts, and cultural narratives" (Boehner, DePaula, Dourish, & Sengers, 2005, p.67).

Design Principles for Affect as Interaction (Boehner, DePaula, Dourish, & Sengers, 2005, p.65-6)

The interactional approach:

- Recognizes affect as a social and cultural product.
- Relies on and supports interpretive flexibility.
- Avoids trying to formalize the unformalizable.

- Supports an expanded range of communication acts.
- Focuses on people using systems to experience and understand emotions.

The authors also advocate viewing information technologies as participatory, flexible and hack-able systems. “Participation emphasizes the ways in which information systems act as platforms upon which social structure is enacted, rather than as entities employing representations of the world and therefore always at one step removed from it" (Boehner, DePaula, Dourish, & Sengers, 2005, p.67).

Pragmatist Aesthetics, Reflective Design and Affect as Interaction all stress the role of emotion within context of use. Pragmatist Aesthetics downplays the designers’ intention to user context, appealing to a user situated in socio-cultural context and creating a platform where experience can occur. Reflective Design, in contrast, looks at the designers’ intentions, hoping to surface hidden attitudes around design practice, culture and technology. It sees design as an ongoing process, one that is never isolated from its socio-cultural context. Affect as Interaction also seeks to create flexible systems that acknowledge a users emotion as integrated in culture. Its focus is on designing around how a user uses, rather than designing a system for a user to use. These methodologies take a more holistic approach to the design process. Not only are designers encouraged to immerse themselves within the context of use, they are also inspired to create systems where unexpected experiences can happen.

Implications

How might new ideas around emotion in Human-Computer Interaction influence design decisions around creating a PDA application that appeals to users? An overarching theme, pulled from Affect as Interaction, is to build a “[system] that act[s] as [a platform] upon which social structure is enacted,” (Boehner, DePaula, Dourish,

& Sengers, 2005, p.67) that is, create a system that allows users to use and experience it as needed in context, rather than simply a usable task sequence. With that idea in mind, first and foremost the design must incorporate basic usability heuristics, and apply them to both the interface and interactions over time. In early stages, designers should seek to uncover attitudes around PDA technology and the task of tracking tax exempt expenses. These attitudes must be understood as needs and goals rooted in a cultural context. Users should be invited to participate in the design process and the PDA application should incorporate user feedback for ongoing development. Important goals include a simple interface that can adapt to and handle information complexity, and an open design with ability for advanced users to manipulate and hack the system. In using these design goals, it is hoped that an application built for a task deemed unpleasant will become appealing and useful to its users over time.

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