Emotion as a Cognitive Artifact and the Design Implications for Products That are Perceived As Pleasurable

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Abstract
Product design that provides aesthetic appeal, pleasure and satisfaction can greatly influence the success of a product. Traditional cognitive approaches to product usability have tended to underestimate or fragment emotion from an understanding of the user experience. Affect, which is inexplicable linked to attitudes, expectations and motivations, plays a significant role in the cognition of product interaction, and therefore can be usefully treated as a design aid. Emotion influences and mediates specific aspects of interaction before, during and after the use of a product. These affective states regularly impact how a user manipulates and explores a user interface in order to support a desired cognitive state.

To better understand the specific qualities of user experience impacting desirability and pleasureability, it is necessary to understand how artifacts trigger and mediate affect and how these processes aid user cognition during interaction. The implications for design are that emotion acts as a critical component of artifact sense-making and determines how artifacts are interpreted (Rafaeli and Vilnai-Yavetz, 2003). Designers that understand how cognitive artifacts interchange with affective artifacts will be better able to support actual product use and perceived pleasure.

Keywords: Emotion and cognition, affect, pleasure, interaction design, Kansei Engineering, artifacts, cognitive artifacts, affective artifacts

Introduction

The field of usability has traditionally focused on ease of use and functionality based on measurable, observable cognitive activity. Only recently, (Norman, 2003) has the usability and design community begun to pay closer attention to the aesthetic, or affective aspects of interaction design in the usability evaluation process. New avenues in emotion design research have been opened up by the work of Jordan & Macdonald (1998), Jordan (2000) and Desmet (2002) who in their work have advocated for a broader focus on pleasure and emotion in the usability and design of a product's user experience.

Emotion and 'pleasure engineering' is beginning to occupy a critical role in product design as usability becomes more of a competitive differentiator in new device design such as mobile handsets and communication devices (Lindholm; Keinonen and Kiljander, 2003). Furthermore, pleasurable products are being seen as a key contributor to the competitive advantage of a firm (Oh and Khong, 2003). Attractive interfaces with high aesthetic qualities arouses attention (Kallio, 2003) are easier to learn, produce more harmonious results and work better (Norman, 2003).

To understand how emotion can be captured and used as a design tool, it is necessary to understand the role of cognitive artifacts and how emotions play the role of "affective artifacts" in the interaction design process.

Artifacts and emotional state changes

Artifacts are the devices, both physical and mental, that reveal the problem solving and problem structuring strategies of users during task completion (Spillers, 2003; Goel and Pirolli (1992) cited in Pearce 1994). Artifacts are instrumental in problem-solving, decision-making and sense-making. Norman (1991) extended artifacts to include cognitive phenomenon, which he termed "cognitive artifacts". Cognitive artifacts are created or elicited in order to aid successful task achievement. They may be used as triggers to preserve workflow integrity, as "task-switching" or "role-switching" aids to manage disturbances, or as mediators of social activity or rhythms (Spillers and Loewus-Deitch, 2003).

Artifacts carry emotional clues for designers. Identifying the role that artifacts play during product interaction can lead to an understanding of the emotional requirements necessary for a design. For example, Wensveen, Overbeeke and Djajadiningrat (2002) designed an alarm clock that predicted mood and acted accordingly based on input from the user. Their work illustrates the importance of a tight coupling between the emotional level of interaction, the appearance and the actual use (interaction design).

Hutchins (1995) defined cognitive artifacts as physical objects made by humans for the purpose of aiding, enhancing, or improving cognition. Likewise, affect serves a crucial function in interpretation, exploration and appraisal of a user interface. The more confusion a user feels with a product, the more likely they are to engage in problem solving behaviors in an attempt to reach a state of understanding. As users explore their concerns by appraising a product, they become either more successful or less successful with a user interface. When examining a new icon on a screen, a user may adopt a state of curiosity or annoyance in order to bridge expected notions of what the icon symbolizes and what it is really supposed to represent. According to Spillers (2004), the curiosity or annoyance provides an *emotional state change* that can either propel the user toward a feeling of satisfaction (success) or disappointment (failure).

Changes in emotional state may serve any of the following functions:

- Explore, manipulate or investigate the interface
- Produce a shift in concentration or attention
- Free up cognitive resources to focus on the task
- Alter the social arrangement or group dynamics where the product is being used

Just as a cognitive artifact is used as a vehicle to perform a task (Hutchins, 1999), so to is emotion used as a variable in task completion. For the designer, emotions in this view are viewed as co-active aspects of the design, and not merely by-products of the design or interaction. In short, the significance of the emotion in the user interaction becomes of primary importance due to its *sense-making properties*.

Affective artifacts as cognitive aids

The primary role of an artifact is to aid and extend cognitive abilities. Cognitive artifacts mediate emotional state changes, and help manage workload, error minimization and task accomplishment (Hutchins, 1999; Norman, 1991; Spillers, 2003). "Affective artifacts" represent or elicit emotions and assist product interaction and user cognition during the product appraisal process (See figure 1).

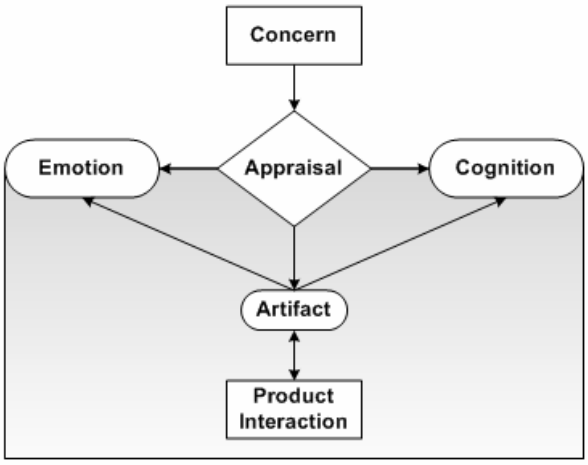

Figure 1, Artifacts that are created or accessed during product interaction take on *affective properties* as they interchange with emotions in order to aid cognition and task performance. (Note: Cognition is separated in Figure 1 merely for illustrative purposes and is not intended to imply that emotion is a "separate" activity of cognitive processing).

Desmet (2002) emphasized the role that concerns play in how people relate to and appraise products. Concerns may also serve more specific task functions, such as acting as triggers to problem solving or to restarting interrupted tasks (Dix and Wilkinson, 2003). Concerns that arise during product interaction, may serve the user in practical ways. For example, users who responded to a new PDA operating system interface (the Sharp Zaurus 5600 Qtopia Desktop), raised concerns of complexity with the PDA, with regard to it's use of top tabs as a global navigation metaphor (Spillers 2004). See Figure 2.

Most users in the Zaurus study sought the familiarity of the Palm desktop and used the concern of complexity to try and "mentally map" device navigation during interaction. Users brought preconceived attitudes to the Linux based PDA (i.e. that it should be as familiar as the Palm Operating System). Attitudes such as these, according to Keinonen (1998), are formed because they serve a number of psychological and social functions. Users do not want to have to relearn the system. They also do not want to feel inferior to a high tech device (PDA) that they feel they are already experts at on the "standard" dominant platform (Palm OS).

Figure 2, The Sharp Zaurus 5600: Top tabs confused users and added a sense of overwhelm to interactions with the device. Users were unfamiliar with the design metaphor of the Qtopia Operating System (Qtopia is an Open Source, free OS).
(Image credit: Amazon.com and Sharp Corporation).

Jaasko and Mattelmaki (2003) found that product availability and novelty is regarded as a remarkable aspect when choosing a product. In the case of the Zaurus 5600, the novelty assessed during usability testing (Spillers 2004) was not related to the interface, but to the external attributes of the device. The bulkiness, heaviness and 'clunkiness' were criticized as being unattractive and ranked in the top three reasons users claimed they would not purchase the system.

Emotional state changes

Task environments are the backdrop where artifacts are created, shared and manipulated. According to Kirsh (2000), users alter their physical environments to gain leverage over problem solving and to aid task completion. Emotions appear to provide a similar purpose in appraisal and performance. Hence, changes in emotional response before, during, and after product interaction are important to note, when identifying concern in the design of products.

Fluctuations in affect may serve a similar function as environmental change, in the sense that they can help buffer the user from error or failure. Spillers (2004) found that when interacting with the Sharp Zaurus PDA, users generated emotional states as a way to *explore, manipulate or investigate* the user interface. For example, in order to try and understand whether the interface contained a specific feature, one user articulated confusion and annoyance. By generating confusion, the user was able to continue persevering until she understood the mechanics of interface functionality.

Kansei Engineering: Precursor to emotional design

Emotion sensitivity in design has its industrial origins in the early "Kansei Engineering" approach of Mitsuo Nagamachi which was established over thirty years ago. Kansei is a design approach aimed at capturing the consumer's expected feeling ('kansei') when they perceive images and objects toward a new product and embedding the emotion into the product. In Japan, Kansei Engineering has been applied widely and successfully from automobile manufacturing to community development (Nagamachi, 2002). Kansei, mixes sensitivity, sense, sensibility, feeling, aesthetics, emotion, affection and intuition (Lee; Harada and Stappers, 2000).

Historically, Kansei Engineering filled a gap in the product design world that traditionally connected designer and consumer. Mass production of products resulted in a "disconnect" between consumer and designer (Lee and Stappers, 2001). Kansei Engineering re-unites the pleasure based qualities of a design with the individual it is designed for. Kansei is also part of a wider pattern of consumer preference for experiential based interactions that offer a "high touch" feeling over products that primarily deliver high-tech interactions (Naisbitt, Naisbitt and Philips, 2001).

If Kansei Engineering's purpose is to organize design requirements around the emotions that embody user expectations and interaction, then emotion can meaningfully be treated as a design tool. The "kansei" can be considered the "emotional signature" of a product. For interaction designers, instead of looking at purely functional behavioral criteria, the focus ought to be on identifying artifacts that trigger and mediate emotional response.

Sense-Making properties of artifacts

Emotion is a critical element of artifact sense-making according to Rafaeli and Vilnai-Yavetz (2003). Emotion, they argue, is central to how artifacts are interpreted. Shifts in emotion assist sense-making. Reliance on physical artifacts may also trigger and elicit cognitive artifacts (emotion) to extend sense-making abilities. For example, when planning an event without a calendar, a user may verbally re-cite the days of the week based on a mental reference of the current date. While this recall is occurring, the user may simultaneously recall events from the previous week, year or decade (triggered by a special date or time of year). The recall may elicit an emotion such as urgency, disappointment or excitement. The benefit of this affective state might be to add cognitive resources (artifacts) to the current situation in order to learn more from past events. Or it may assist in applying perspective to an anticipated situation or problem.

According to Rafaeli and Vilnai-Yavetz, sense-making of the artifact involves emotion in three ways:

1. Instrumentality: Tasks the artifact helps accomplish.
2. Aesthetics: Sensory reaction to the artifact.
3. Symbolism: Association the artifact elicits.

Artifacts appear to both trigger and elicit emotional states. Wertenbroch and Carmon (1997) found that "Consumers enable themselves to maintain the quality of their experiences over time by affecting the internal or external resources and constraints under which they make their choices". They refer to this as engaging in 'dynamic preference maintenance'. Emotion in product interaction seems to play a similar role. For example, users may delay gratification (or evaluation) with a product feature in order to feel fully satisfied that the overall product meets expectations and desires.

Perception of pleasure

Emotions govern the *quality of interaction* with a product in the user's environment and relate directly to appraisal of the user experience. Jaasko and Mattelmaki (2003) presented a framework for user experience where pleasure must satisfy two levels. The first level involves appearance (aesthetics) and user interface (usability).The second level extends to user personality (socio-cultural context), product meaning (time/historic context), environment (physical context), interaction (use context) and product novelty (market context).

Figure 3 below, provides a narrative of how a product can violate a user's perception of pleasure with a product.

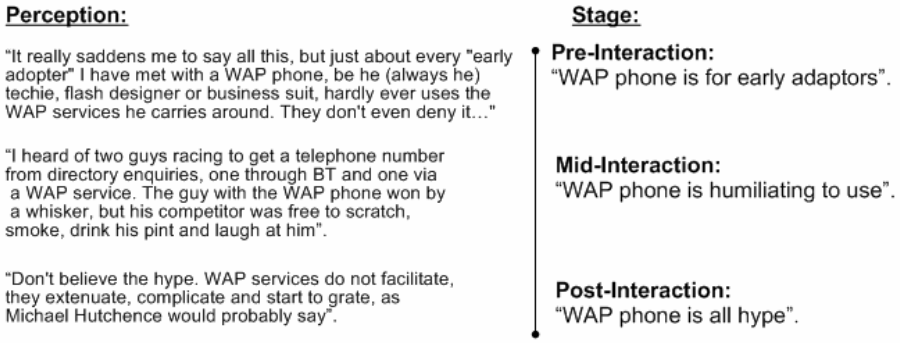

Figure 3, Analysis of a British design magazine writer's appraisal (Exon, 2000) of a WAP (Wireless Application Protocol) enabled mobile phone, provides insight into how concern, appraisal and emotion influence perception of pleasure throughout the interaction lifecycle.

According to Keinonen (1998), emotions that accompany product usability inevitably lead to generalizations made about the product with regard to its perceived usefulness. Keinonen also found that expectations users have toward the expected usability of a product also differ greatly to actual measured usability.

Perception of pleasure encapsulates the usability experienced, the attitudes formed, and the emotions felt during product appraisal. In the WAP phone example, Exon's concerns before, during and after product use, illustrate this negative attitude formation. In short, lack of satisfaction at any stage of the lifecycle can jeopardize the user experience.

A closer analysis of the pleasure that Exon failed to perceive with the WAP phone, provides valuable design clues. Note the affective artifacts that are generated as a result of the appraisal (See Table 1 below).

Concern 1: "WAP is for early adaptors" (Friends may think he is excessive with technology).	**Affective Artifact:** Social identity (Phone should to be acceptable to peers).
Concern 2: "WAP phone is humiliating to use" (Device creates shame).	**Affective Artifact:** Competitive pride (Performing regular social tasks should be elegant).
Concern 3: "WAP phone is all hype" (Disappointment in marketing promises).	**Affective Artifact:** Enthusiasm for new device (Promoted features should meet expectations).

Table 1, Concerns are accompanied by the implied needs (affective artifacts) that the device fails to deliver.

The user's evaluation about whether to keep a product or return it to the store; recommend the product to a friend; or generate an emotion of ownership, loyalty and commitment to the product are outcomes of perception of pleasure. The more closely a product can invite and deliver on user expectations, while intensifying emotional response sets that form favorable attitudes, the more pleasurable the product will be perceived by the user (Jordan 2002).

Conclusion

Emotions govern the *quality of interaction* with a product in the user's environment and relate directly to appraisal of the user experience. Users generate emotion as a way to minimize errors, interpret functionality, or obtain relief from the complexity of a task. As a user appraises a product, they may develop new concerns that cause them to alter their task exploration, seek or solicit help, or begin another task in order to gain a feeling of confidence before completing the more difficult task.

Emotion acts as a cognitive artifact in task achievement and is central to how other artifacts are interpreted and how pleasure is perceived. Emotion also plays a valuable role in sense-making (Rafaeli and Vilnai-Yavetz, 2003) and impacts how users interpret, explore and appraise a user interface. Artifacts that embody affective properties can be viewed as affective artifacts and therefore captured as valuable design criteria.

Emotion plays a significant role in the actual and perceived experience with products (Norman, 2003; Jordan and MacDonald, 1998; Jordan, 2002; Desmet, 2002). Cognitive artifacts mediate and arbitrate the performance and capabilities involved in how users perform their tasks (Spillers and Loewus-Deitch, 2003). Affective artifacts are artifacts that are transformed by the process of *emotional state changes* during product interaction.

Measurable emotional responses with products are apparent where attitudes, values, goals and expectations are coupled with usability and pleasureability (Jaasko and Mattelmaki, 2003). In this view, emotion is seen as an integral component of the design and an important driver of cognitive processing and task performance. User expectations are coupled with the emotional state that accompanies or codifies interaction expectations and the *emotional signature* or "kansei" is reflected in how users perceive pleasure with the product.

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