
Children's Information Seeking and the Design of Digital Interfaces in the Affective Paradigm

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ABSTRACT

Research reveals that affect imparts directionality to cognition, which in turn influences actions. The role of affect has been well recognized in psychology, computing, education, cognitive science, and neuroscience. However, little recognition has been given to the study of affect in the field of information science. In this article the term "affective paradigm" is introduced based on research grounded in many disciplines. Research that investigated children's affect in seeking information and participating in the design of digital interfaces is reviewed. Unanswered questions in these areas of study are addressed.

INTRODUCTION

The fields of information-seeking behavior and computing are increasingly focusing on the role affective states play in interacting with information systems (Nahl, 2004; Druin, 2005; Bilal, 2001; Kuhlthau, 1991, 2004; Wilson, 1999; Picard, 1997). Information seeking is founded on the cognitive paradigm that ascribes the purpose of an information retrieval system as to "help solve problems rather than to merely find texts about those problems" (Raber, 2003, p. 104). Unlike the physical paradigm that focuses on how to match the content of texts in these systems with a user's query, the cognitive approach is concerned with mapping texts onto the user's anomalous state of knowledge (ASK) or knowledge structures (Raber, 2003). ASK (Belkin, Brooks, & Oddy, 1982) presumes a gap (anomaly) in a user's knowledge structure and that the motive for seeking information is to resolve this anomaly by acquiring information that changes the user's

state of knowledge. The physical and cognitive paradigms have been acknowledged as crucial notions that underlie our understanding of the field of information science.

The cognitive paradigm focuses on the whole user's experience in seeking information, that is, thoughts, feelings, and actions (Dervin, 1983; Ingwersen, 1992; Kuhlthau, 2004; Nahl, 2004). Attention that has been given to affect in research that is grounded in psychology, cognitive science, neuroscience, computing, and education (Burlison & Picard, 2004) requires that feelings be studied in the realm of an "affective paradigm."

One may argue that, while a user's affect can be explored by using a qualitative research methodology, information retrieval systems (IRs) are not sufficiently advanced to model a user's affect during the interaction, and, therefore, the affective paradigm is incomplete. While this may be true, researchers in artificial intelligence and affective computing (Burlison & Picard, 2004; Picard, Vyzas, & Healey, 2001; Pantic & Rothkrantz, 2000) seek to develop intelligent applications that detect a user's affect while interacting with computers to help cope with negative affects. Adaptation of these applications to IRs in the near future may provide a more complete picture of the affective paradigm.

In the current information environment, children have become major consumers of information (Rothman, 2003). The Web is a rich information tool; but it is complex and may impose disorientation and cognitive overload on users (Saracevic, 1997). Since children have emotional skills and needs that vary from those of adults (Ericson, 1978; Walter, 1994; Bjorklund, 2000; Bilal & Kirby, 2002; Druin, 2005), they need to possess not only adequate information-seeking skills but also intelligent affective strategies that will help them cope with its complexity.

THEORETICAL FRAMEWORK

Prominent theorists in the field of psychology (John Dewey, George Kelly, and Jerome Bruner) consider learning as a process of construction that engages all aspects of an individual's experience (Kuhlthau, 2004). This constructivist view of learning recognizes that affective experience directs cognition and action throughout the process of construction. Kuhlthau borrowed the theories of these constructivists to explain the user's perspectives on information seeking. Her Information Seeking Process (ISP) model describes the kind of thoughts, feelings, and actions a user experiences at each phase of the construction process. She states that negative affect such as uncertainty could lead users to be less willing to continue interacting with an information system (Kuhlthau, 1993). Nahl (2004) supports this view and contends that uncertainty could add to the "affective load," especially when a user's coping skills are inadequate.

Affective technology, affective computing, and emotional design are areas of research being investigated in the fields of computer science, human-

computer interaction, and cognitive science. In his recent book, *Emotional Design*, Norman notes that “everything [we] do has both a cognitive and an affective component—cognitive to assign meaning, affective to assign value. [We] cannot escape affect: it is always there. More important, the affective state, whether positive or negative affect, changes how we think” (2004, p. 25). He adds that, while cognition interprets and understands the world around us, emotions allow us to make quick decisions about it.

Current research conducted at the MIT Affective Computing Research Group aims at developing new computational theories of affect and learning through studying, testing, modeling, and giving computers the ability to recognize common affective states expressed by users while interacting with computers (for example, frustration, confusion, fear, distress, or joy). The MIT approach is grounded in the findings from cognitive science, psychology, neuroscience, medicine, psychophysiology, sociology, and ethics (Picard, 1997). Burselen and Picard (2004), who are on the MIT Group, for example, have applied affective agents to help users develop skills such as affective self-awareness for dealing with failure and frustration while interacting with computers.

An individual’s emotional experience has been a primary topic of study throughout most of the history of psychology. Erikson’s (1978) development theory, the “Eight Stages of Man,” covers the socioemotional stages an individual experiences during an entire lifespan, from infancy to older adulthood. Krathwohl, Bloom, and Masia (1999) developed a taxonomy with six educational objectives in the affective domain that focus on a student’s level of commitment (receiving, responding, valuing, organizing, and valuing).

Recently, emotional intelligence and affective education have been recognized as integral to learning. Steinberg (1998) acknowledges a child’s cognitive and affective skills in the classroom and that learning takes place in an “emotionally safe” environment. Goleman’s (1997) emotional intelligence notion dismisses IQ as the only predictor of achievement and grounds emotional skills as essential for success. He contends that, through the application of intelligence to emotion, we can improve and gain control of our lives. Indeed, recent research has revealed that learning to cope with information overload helped users reduce uncertainty and frustration (Nahl, 2004).

THE STATUS OF RESEARCH

Compared to the literature devoted to adult users, the body of literature on both children’s use of the Web and interface design for children is very small. From this literature investigators have focused on the cognitive behavior and alluded to one or two affective factors expressed by users such as preferences, satisfaction, frustration, and joy (Bilal & Wang, 2005; Shenton & Dixon, 2003; Large & Beheshti, 2000; Sullivan, Norris, Peet,

& Soloway, 2000; Hirsh, 1999; Kafai & Bates, 1997). According to Picard (1997), common factors that computer users experience include confusion, frustration, dislike, like, joy, satisfaction, motivation, and preference. The section below reviews studies that examined the impact of these and additional factors on children's information seeking on the Web.

CHILDREN'S INFORMATION SEEKING ON THE WEB IN THE AFFECTIVE PARADIGM

Watson (1998) analyzed stories from nine eighth-grade students about using the Web and extracted common themes about the students' feelings and perceptions. A sense of self-confidence and authority in using the Web emerged from both having experience with using the technology and learning by "trial and error." Joy and challenge in finding information and the need for patience and persistence surfaced as motivational factors. Additional factors that influenced the students' affect were ease of access, finding information quickly, grandness of the Web, and ability to browse and search. Watson's study provides interesting dimensions of these young users' thoughts and feelings by relying on their stories. However, examination of the students' affective states during Web interaction may provide a more complete picture of the "actual" interaction between their thoughts and feelings and, subsequently, will help generate a framework for both educators and information professionals to use in designing curricula and Web training programs. Moreover, a student's willingness to engage in a "trial and error" learning experience may offer educators and curriculum designers new ideas for pedagogy since this mode of learning may challenge the systematic approach to accessing information.

In studies that examined middle school children's information seeking in using the *Yahooligans!* Web engine/directory, Bilal (2000, 2001, 2002a) explored these young peoples' affective, cognitive, and physical behaviors in performing three tasks: one fact-based (Bilal, 2000), one research-based (Bilal, 2001), and one fully self-generated (Bilal, 2002a). Children's affective states were captured through individual interviews that covered questions about these factors: joy of using the Web, frustration, confusion, motivation, persistence and patience, task preference, source preference (for example, Internet vs. print sources), and search engine preference. These studies revealed an interaction between children's affective states and cognition and actions. The affective results of these studies are reported below. For results concerning the cognitive and physical behaviors, the reader is referred to Bilal (2000, 2001, 2002a).

Joy of Using Yahooligans!

What did the children enjoy about using *Yahooligans!*? Most children (87 percent) referred to ease of use over print sources, ability to search by keyword, learning about the topic searched, grandness of information on

the Web, availability of graphics, convenience of access, and fun. These comments were echoed in statements that children shared: “Easy to find information . . . Type a word and takes you to a site . . . Click on information to find it . . . I found information on ice skating, [my] personal topic . . . [I think] information is interesting . . . [I enjoyed] information and pictures . . . I’ve never searched Yahoo!igans! Searching new things is neat to me.” The child who did not enjoy using Yahoo!igans! was scared of computers. Overall, joy and motivation of using the Web increased children’s persistence and patience in finding information despite the difficulties and breakdowns they had experienced due to both insufficient Web skills and the inadequate interface design of Yahoo!igans!.

Frustration and Confusion

Frustration arose when children retrieved zero hits and when they did not find relevant information. Forty-three percent felt frustrated during the search process. Of these, 5 percent were uncertain about their ability to use Yahoo!igans!, and 10 percent did not find the answer to the fact-based task or locate relevant information on the research-based task. As children shared: [I am] “confused because it said it would find information but didn’t . . . Because [I] never used it . . . First I was confused during searching because I couldn’t find the answer. [It] got better when I did my personal search . . . You look for information and it doesn’t give it to you.” Feeling frustrated was also expressed for slow download of Web sites, screen freezing, and confusing screen display. At the time of data collection (1998), Yahoo!igans! was slow and the Netscape browser used was version 2.0. The fact that the browser froze frequently increased children’s frustration and uncertainty. In addition, the organization of the retrieved results (categories and sites within categories) was confusing to a few children. Despite these difficulties, no child abandoned his or her Web session. At the time of the study, the Internet was a novelty to many children at the middle school. The fact that children had the opportunity to use the Internet increased their resiliency in pursuing the tasks.

Motivation

Most children (85 percent) were motivated to use the Web for many reasons: increase in self-confidence, challenge, discovery, and convenience. As a few children said: “I could do it because I didn’t think I could do it” (self-confidence); [I learned] “something I did not know before on topics I’m interested in” (discovery); [it is] “still new to me and gives me something different,” “got to use the computer, go to different places for fun, [and you] find study you don’t know about” (challenge and discovery); [I can] “use the Internet from home . . . most people have Internet in their homes . . . there are so many sites and instead of driving to the library you get on the Internet at home . . . [The] Internet is growing fast . . . all things you can learn . . . tells more than encyclopedia” (convenience); and [it provides]

“games and more information . . . doesn’t take long . . . All in one place . . . chat, email, finding information for projects, and downloading information on projects” (fun, grandness of information, and convenience). Lack of motivation was expressed due to being scared of using computers, difficulty in finding information, and unfamiliarity with Yahoo!igans! These findings should provide grounds for future research that measures children’s level of positive and negative affect systematically throughout the information-seeking process.

Persistence and Patience

Children’s motivation in using Yahoo!igans! augmented their persistence and patience in locating the desired information. They expressed that, unlike print sources, the Web supported exploration and discovery and provided comfort and convenience. These comments were reflected in these statements: [I] “know the answer is there and I know I’ll probably get the information eventually . . . It’s got to be there, so I keep trying . . . Knowing that I’ll probably get the information eventually . . . [I] don’t have to read words all the time . . . [I] wouldn’t persist in encyclopedia use.” Indeed, most children (65 percent) preferred using the Web to print sources. The second favorite source was encyclopedias (by 15 percent), followed by books (5 percent), a combination of the Internet and encyclopedias (5 percent), encyclopedias and books (5 percent), and Internet and books (5 percent). A recent study by America Online (Rothman, 2003) revealed that the Internet has remained children’s primary source for educational and entertainment information.

Search Engine Preference

At the time of data collection (1998), Yahoo, Excite, WebCrawler, and Infoseek were the most popular search engines. Twenty percent favored Yahoo, while 15 percent preferred Netscape. One child (5 percent) mentioned America Online and two children (10 percent) said Prodigy. WebCrawler and Excite were each mentioned by 10 percent of the children. Interestingly, one child (5 percent) noted the Web site of the University of Tennessee. The fact that not all children recognized the difference between a search engine and a browser, a service provider, or an institution’s Web site indicated inadequate knowledge of how to use the Web. Children’s search engine preferences may have changed with the advent of search engines such as Google. A recent study (Bilal, 2003) showed that children preferred search engines that are designed for adult users such as Google, Alta Vista, AskJeeves, and Yahoo. The fact that these young users preferred search engines that are not geared toward their age level may be due to either unfamiliarity with them or that those engines designed for them do not meet their needs. When search engines do not offer high usability, kids go elsewhere (Nielsen, 2002).

Task Preference

Prior research revealed that, when children choose their own topics, they develop interest and tend to be more motivated in seeking information (Gross, 1997). Children were given tasks in two categories: fully assigned and fully self-generated. The tasks from the former category were closed (fact-based) and open-ended (research), and the task from the latter category entailed finding information on a topic of interest. Of the children who articulated their task preference, 45 percent favored the fully self-generated task, 20 percent the research task, and another 20 percent the fact-based task. One child (5 percent) liked all three tasks and another one (5 percent) was unsure. Overall, children preferred the fully self-generated task for three reasons: satisfaction with search results, ability to choose the topics and modify them during searching, and challenge in finding information about a topic of interest. As one child shared: [I liked the personal search] “because I wanted to figure out for myself that I can use it [the Web] and use it well.”

Children were positive about their experience with the Web mainly due to challenge, motivation, and increase in self-confidence. These positive affects are encouraging especially in light of the many difficulties children experienced. Yahoo!igans!’s inadequate design (for example, lack of spell-checking techniques, absence of corrective feedback mechanism, small database size, and scanty indexing) was at the crux of the problems children experienced. These findings are surprising especially since this engine/directory is specifically developed for young users. Like many IRs that were developed for children, Yahoo!igans!’s failure to meet children’s needs and support their information seeking have led many researchers to design interfaces from children’s perspectives by involving them in the design process. The following section describes research that explored children’s cognitive and affective needs for design features that digital interfaces should provide for them.

CHILDREN AND AFFECTIVE SYSTEM DESIGN

The notion of “emotional design” has recently emerged as an essential component of system design. Norman notes that “attractive things make people feel good, which in turn make them think more creatively” (2004, p. 19). Emotions, which are a component of affective states, are “personal,” and creating system interfaces for children should be based on their affect for them. It is argued that successful interfaces for children are those that are designed for them and with them. Children are capable of being design partners and can be considered as equal stakeholders in the design of new technologies (Druin, 2005, 1999; Druin, et al., 2003).

Gathering children’s likes and dislikes about certain interface features may serve as a first step toward designing affective interfaces for them.

Large, Beheshti, and Rahman (2002) obtained the reactions of children aged between ten and thirteen using four Web portals that are especially designed for their age group: Yahoo!igans!, AskJeeves for Kids, KidsClick!, and Lycos Zone. Children expressed their feelings about each portal and provided suggestions for improvements. Children's needs were combined into four categories: portal goals, visual design, information architecture, and personalization. Children need a portal that provides both educational and entertainment topics. The latter seemed to increase their motivation in seeking information. In the children's eyes, the visual design of a successful portal is one with a fun name, colorful backgrounds and foregrounds, large fonts, graphics and animation, recognizable characters, suitable vocabulary, well-laid-out screens, and no advertisements. Children preferred a portal with information architecture that offered directness (little effort to search quickly), a combination of keyword and natural language searching, browsing through subject hierarchies, metasearch links (link to external search engines), display of retrieved information with informative summaries of the content, and spell-checking techniques. Based on these findings, the researchers have developed two Web portals for elementary school children that are informed by children's affective and cognitive states (Large, Beheshti, Nessel, & Bowler, 2004).

Involving children as design partners moves system design one step further. In collaborating with middle school children, Bilal (2002b, 2003) gathered eleven drawings or prototype interfaces that children designed for Web search engines. Using paper, pencil, and crayons, children created interfaces with features that met their needs. Analysis of these interfaces showed that color was used to either label text or highlight some features. The drawings equally illustrated children's need for searching and browsing by subject category. Keyword and phrase searching had explicit instructions on how to perform each of the functions (for example, type a question here, go get it). Children expressed the need for subject categories that covered both educational and entertainment topics. The *Help* feature was shown on five drawings, and on two of these it appeared twice, once in the upper-left-hand corner and another time in the lower-right-hand corner. On average, a child's interface had fifteen features.

The interfaces combined simple and sophisticated design. Simple design included the name of the engine, a search box, and subject categories. Sophisticated design entailed additional features such as two search boxes, one for keyword and another for natural language; instructions on how to perform a search; links to external search engines; and extensive broad and specific subject categories. Children's drawings were combined into three main categories: goals, functionality, and visual design.

Goals: All drawings had educational and entertainment information, indicating that children wanted to use the engines to find information for schoolwork as well as play games, chat with friends and family, listen

to music, and initiate email communication. Entertainment information seemed to motivate the children in using the engine.

Functionality: The importance of keyword searching and natural language searching was evident in all interfaces as search boxes for both features were included on most of them. Specific instructions on how to perform a keyword or phrase search (for example, click here, search, type a phrase) were covered on most drawings. In addition, children desired subject categories for browsing by broad and narrower topics. Fifty percent of the drawings showed the need for a *Help* feature.

Visual design: Children cared for text written in black and white and for color around search features. Four drawings had images such as kids holding hands and self-portraits. The names of the engines were based on the children's names (for example, Catlin.com; KidsSearch.com). These children had affects for personalizing the interfaces.

These children were effective in designing interfaces for Web search engines from their own perspectives. The next step is to generate a workable interface that builds on children's affective and cognitive developmental abilities and to test it with children in various settings.

Affective design has been acknowledged by researchers in the field of human-computer interaction. One project in this area is the International Children's Digital Library (ICDL), which was developed with children and for children. The ICDL (<http://www.icdlbooks.org>) offers books in multiple languages worldwide and enables children to access and read an international collection of children's books online. The ICDL has categories of books by subject, genre, publication date, characters, color, shape, and, most importantly, feelings (Reuter & Druin, 2004). The *feelings* category is based on children's need to find books by how they make children feel (for example, happy, scared, sad). The success of the ICDL design is attributed to its interfaces, which are informed by children's feelings and thoughts. Future applications for the ICDL could include intelligent agents that detect children's emotions to assist them in coping with negative affects they may experience while interacting with certain books.

DISCUSSION

This article introduced the term "affective paradigm" based on research grounded in computing, cognitive science, education, psychology, and information science. Many disciplines have recognized the crucial role of affect on cognition and actions. However, little recognition has been given to the study of affect in the field of information science, especially as it pertains to children.

Information seeking is a dynamic process that involves the whole individual. Affect imparts directionality to problem solving, which in turn influences actions. This triad of feelings, thoughts, and actions forms, according to Nahl (1996, 2001), a conceptual framework that will drive us

into the “user-centered revolution.” This revolution, however, requires that we advance our knowledge of affective system design so that we can implement intelligent applications in the affective domain. Fortunately, current research in affective computing promises new advances in this area of study that may impact the design of IRs in the near future.

There are a few models of information seeking that integrate a user’s feelings, thoughts, and actions. Kuhlthau’s ISP model (1993), for example, describes a user’s affective states at each stage of the information-seeking process. Given that this model was based on a series of studies that were conducted with college students, and given that children have emotional experiences and needs that vary from those of adults, it is possible that the ISP model does not pertain to young users and that a new model is needed.

Many questions remain to be addressed in the affective paradigm. Are children more successful in using systems that are designed from their perspectives than systems that are not? How does a user’s affect influence the interaction with affective features available in an interface? What applications are needed to address children’s affective states in IRs?

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