

## Children and Information: A Review of Changing Trends in Research Approaches from 1989 to 2009

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**Abstract:** Researchers studying the information seeking behaviors of children have developed an increasingly user-centered approach in the last twenty years. At one time, the research focused heavily on identifying whether or not a child found the correct answers to imposed queries. Now the current demand is for researchers to stop asking the questions and start listening to user-generated queries. Researchers today are inspired to get into the minds of young people and discover how an information retrieval system will better meet their expressed needs. This review of the last twenty years of research highlights the innovative approaches researchers have developed for learning about the interests of young people, their abilities and weaknesses, and their criteria for selecting information that is relevant to their searches. These discoveries promote further insights into the design of interfaces that will meet the needs of children with greater efficiency and accessibility.

**Keywords:** Children, Information seeking behaviors, Research trends

**摘要:**最近二十年里,研究者研究儿童的资讯搜索行为,已经迅速发展为以户为中心的模式。过去,研究重点是关注儿童是否能够查找到问题的正确答案。现在,研究者不再提出问题,开始倾听使用者所遇到的问题。今天的研究者受年轻人的思维的影响,从而开发出能够更好地满足年轻人特有需求的信息检索系统。最近二十年的研究回顾,突出了研究者的创新方式。这些研究者们用特有的方法掌握年轻人的兴趣、才华、缺点,以及他们选择与其研究相关的信息标准。这些研究发现促进了更高效用的儿童页面设计的出现。

**关键词:** 儿童 资讯搜索行为 研究趋势

### Introduction

It has long been apparent to researchers that children using information retrieval systems bring a set of skills and needs to the process that differ from those of their young adult and adult counterparts. Over the years, theories have arisen which attempt to explain these differences in generational approaches to information. When Marchionini (1997) observed in 1989 that elementary school children were able to use the electronic environment more successfully for their simple subject searches than did high school students for their complex queries, he postulated that high school students were basing their mental models of the new system on "print metaphors". Today, the Generation Xers he observed twenty years ago have made way for a new generation. For the youth of the 21st century, digital environments have become a way of life, and the "print metaphors" of yesterday

no longer hold the same weight. Instead of basing their mental models upon print sources, children today are influencing the creation of new print sources modeled after the digital world. This new climate is one of the primary changes that have demanded fresh approaches to the study of children's information seeking behavior.

Despite their familiarity with the digital world, children continue to demonstrate some difficulty retrieving the information they need. Young people who are in a state of constant mental development are often frustrated by unsuccessful information searches, and they habitually seek a path of least effort. Over the past twenty years, there has been a surge of research devoted to learning what their needs and expectations are when using a search interface.

Historically, researchers first observed children as users of information retrieval systems, then as informants. Over time, children were invited to participate in the construction of systems as testers, and finally, as design partners (Druin, 2002). In this ever-shifting research environment, researchers have stopped relying on adult standards of success so as to listen to children's own standards and evaluations. Their findings corroborate existing information retrieval theories while emphasizing a need to pay more attention to the element of "affect" in information retrieval systems whenever they are designed for children. Affect, or a user's emotional experience of an interface, plays a significant role for child users. An adult can view a system as a tool they can either accept or reject, but children tend to experience things in a much more emotional way. A child's successful use of the system depends greatly upon how comfortable he is with using it.

### **A History of Information Seeking Models**

Marchionini (1997) describes information seeking as being "driven by human needs for information so that human beings may interact with the environment". Many different models have been developed over the years to clarify just how human beings go about that information seeking process. One of the leading early models was Belkin's (1980) theory of Anomalous State of Knowledge (ASK). Belkin postulated that a person is driven to seek information by the awareness of a problem, although the problem may not be clearly understood. The individual must clarify his problem before he can take the necessary steps to fill the gaps in his knowledge. This theory was one of the first to emphasize a person's cognitive development, and it held water with contemporary theories of cognitive psychology.

Although Belkin identified an emotional drive for understanding and knowledge, Kuhlthau's model (1991, 1997) of the Information Search Process was one of the first to explore the many different emotions involved in information seeking. Kuhlthau takes a constructivist approach, laying out a process of building knowledge through six stages that take the individual from task initiation and selection of a topic, to prefocus exploration, to focus formulation, to collecting information, and finally, finishing the search. At every step of the way, Kuhlthau identifies the affects of uncertainty, optimism, confusion, doubt, frustration, clarity, confidence and satisfaction that accompany the user throughout this process. Perhaps her sensitivity to the user's emotional state was due in part to her theory being based on studies with adolescents (Hirsh, 1999; Cooper, 2005)

Kuhlthau updated this theory in 1997 to add her findings that young people require *collaboration and conversation* for clarifying their information needs. These are two of the “Five C’s” she identifies for children’s successful information retrieval; the other C’s are *continuing*, because information seeking is a process that requires patience; *charting*, which helps a user to visualize her information need; and *composing*, which is necessary for the user to integrate her newly acquired knowledge with a sense of satisfaction.

Belkin and Kuhlthau’s models make information seeking appear to be a linear path from confusion to certainty, but the most recent trend has been a search process that is more circular. The Iterative Search Process model suggested by Hembrooke, Granka and Gay (2005) makes the admission that, after a user has collected the information retrieved by a search, the user must then evaluate whether it has been successful or not. If not, as is often the case, the user must decide either to reformulate the query and begin the search all over again, or to end the search in dissatisfaction. This is perhaps a more realistic model of information seeking, because the user is required to clarify his need, not once, but as many times as it takes to get to a point of satisfaction.

In addition to using these models of information retrieval, researchers also pay close attention to psychological theories of cognitive development. Perhaps the most frequently cited theory is that of Piaget’s (1969) stages of development. Piaget theorized that elementary school children, who are the subjects of most information retrieval research, are in a Cognitive Operational stage in which they are not yet strong with abstract concepts but can solve problems related to actual objects and events. For this reason, researchers have suggested that school assignments for children of this age group be structured in a concrete, non-abstract way (Hirsh, 1999). Adolescents, in Piaget’s model, find themselves in the final stage of development called the Formal Operational stage, in which they are expected to be able to formulate theories and solve problems on a complex, abstract level.

In light of the most recent studies of teen brain development, Piaget’s theory may require major updating: neuroscientists have found evidence that points to a continued development from age fifteen up to age twenty-five, so an adolescent’s mental state can hardly be termed finished or finalized. On this ground, researchers have begun to contend with Piaget’s theory and point to its failings, but few other child development theories have spanned so many disciplines. Piaget’s theory of child development continues to pervade the literature of education, psychology and information science research.

### Research on Keyword Searching

Solomon (1993) conducted research with elementary school students of many different age groups, observing their keyword searches on OPAC systems. He corroborated Marchionini’s (1989) findings that older children had more trouble with their complex queries than did younger children with their simple queries. He considered that this was due in part to the structure of Library of Congress Subject Headings, which favors a broad, deductive approach to searching. This kind of information retrieval requires taking many steps to answer complex questions, and some-

times the answers are not forthcoming.

Solomon (1993) suggests that information seeking is not a linear, one-way process, but involves many dead ends or "breakdowns" from which one must recover. He found that younger children, used to being uncertain, were more willing to keep going, trying different queries after a search failed. They also felt free to ask adults for help. But older children were not so willing to ask for assistance, and walked away angrily when the OPAC search returned results that were not useful to them.

Solomon's research exposed serious problems of user dissatisfaction with the OPACs of that day. For example, children using the OPAC looking for "planes" did not turn up the 31 results that were given a subject heading of "airplanes". Children who did not have the vocabulary to try different terms were at a great loss when using a library OPAC in 1993.

Responding to Solomon's research on children's use of keyword searches, Borgman, Hirsh, and Walter (1995) published their study of the Science Library Catalog. Over a period of four years they constructed many versions of a library catalog and studied the way children used it. First they studied children's use of existing OPACs and their research corroborated Solomon's findings; they noted that children generally had difficulty performing successful keyword searches on OPACs. Nonetheless, the researchers found many children preferred the freedom of keyword searching to other search methods. The Science Library Catalog (SLC) was developed to eliminate the problems encountered by children in OPAC searches, including the OPAC's dependence on typing, spelling and vocabulary skills. Children were studied using both the SLC and two different OPACs. The SLC offered children the opportunity to use their mouse to browse and select from lists of topics, arranged in Dewey Decimal hierarchies. Its visual interface of a bookshelf and a cartoon bookworm offering assistance invited children to explore on their own without needing any prior training or skills. Borgman, Hirsh, and Walter's research helped to highlight differences between keyword based search engines and browsing search engines. Their findings were influential for many interface designers, despite the fact that keyword based systems have only become increasingly ubiquitous since then.

### **The User-Centered Model**

The first of many major shifts in research approaches to children's information seeking occurred in 1995, with Gross's (1995) recognition that a user will have a different relationship to the search process depending on whether her search is imposed or self-generated. Self-generated searches "spring from the context of an individual's life" while imposed searches originate with some other person's demand (Gross, 1995). Previously, it was a habit of researchers to give children imposed queries and then to evaluate their successes or failures based on the researchers' expectations. But Gross found that students lack of motivation when doing searches for school assignments or researchers may have been due to the imposed nature of the searches. When a query is imposed, the seeker will find ways to minimize her effort as much as possible. But when a query is self-generated, the seeker has a higher interest in learning.

In response to Gross's finding, Hirsh (1999) worked with educators to develop her seminal research of children's relevance criteria. With innovative professional collaboration, Hirsh enlisted the help of teachers and librarians to give the fifth grade subjects of her study an assignment that invited a wide range of creativity in format and in selection of a topic. The ten children she studied were asked to write a biographical research report on a sports figure, with a map of the sports figure's hometown, photos of the sports figure, and a story of the sports figure's life and career. The assignment involved the retrieval of information in many different formats. The assignment also drew upon a known area of children's interest and it was no surprise when children responded to it with a positive, motivated attitude. The school librarian worked with them to help them discover useful searching techniques, and their teacher invited Hirsh to conduct a number of observation and interview sessions with them.

The students in Hirsh's (1999) study were growing up with a new relationship to electronic resources as a result of the increasing ubiquity of the Internet. They were allowed to use Internet sources as well as print sources for their projects, so they spent as much time using Internet search engines as they did OPACs. The athletes they chose were very famous and there was ample information available. The study gave Hirsh an opportunity to find out how children selected the most relevant information from the vast amount at their disposal. Instead of imposing her own standards, Hirsh set out to discover the reasons why children found certain information to be relevant, and what their criteria were.

Using the children's own statements, Hirsh was able to identify the criteria they used to decide whether something was relevant to their project or not. The most frequent criteria that came up in their interviews were Topicality, Interest, and Novelty. Sometimes the children's concrete-operational attempts to find topicality were misguided, as they rejected good books with clever titles when they did not find their athlete's name clearly and prominently displayed. But they also seemed to embrace learning in some surprising ways. When they went to the shelves to find the book they were looking for, they often stopped to consider other books that might be pertinent. Students were willing to collaborate with each other, sharing any information they found that they knew would be helpful to another student's search. They were also motivated to gather information about their athlete that their fellow classmates would find fun and interesting. Throughout the study the students were constantly expanding their knowledge of their sports figure and sharing knowledge with each other, supporting Kuhlthau's model of a dynamic Information Search Process that promotes learning through collaboration and conversation.

Hirsh discovered that students had several effective techniques for evaluating the usefulness of the sources available. They skimmed paragraph headings and first sentences, read descriptions, and checked indexes. If a source did not have a description or index it was often discarded before being read. This was necessary in light of the constraints on their time and the vast amounts of information they had to sift through. The students hardly ever cared about the authority of sources, a problem that has been frequently discussed by information professionals. The students were simply concerned with whether the sources focused entirely or partially on their chosen athletes.

Though most information was carefully evaluated, some information was selected for expediency—especially in the case of pictures, which were sometimes chosen without much attempt at evaluation. However, students did not generally settle for the first piece of information found, as this topic was “one that generated high levels of interest” (Hirsh, 1999).

Hirsh noticed that, for all their hard work, many students suffered from a lack of understanding of the Internet browsers they were using. The fifth graders constantly failed to make use of Internet browsing tools and history features designed to aid them when a search must be performed over again. Students also complained that the Internet pages they found were written at a difficult reading level. This is a problem that will continually follow children as they become more used to search engines designed for adults.

### The Fingerprint of a User's Need

In 2005, Shenton and Dixon (2005) continued the work of Hirsh by attempting to get a user-centered, “multi-dimensional picture” of children's information needs. They identified an array of needs that children have when seeking information, including many that, apart from Hirsh's (1999) study, had not been addressed in much of the literature.

Children were interviewed in focus groups, and were asked to discuss any instances they could remember when they needed information about something. The authors chose an interview approach that left the concept of information open ended, so that they could hear what children said they needed, without imposing adult judgments or standards. Children identified needs for information at their reading level, information that was current, information that did not overwhelm them in quantity, and information at varying degrees of specificity. Explaining children's information needs from the standpoint of the user's situation, Shenton and Dixon explored the wide spectrum of factors that influence a child user's need, and examined every shade of need for each factor. They concluded that each child approaches an information search from a unique background with a unique set of need factors in mind. It is the role of librarians to help children to better articulate their own mental fingerprint of information need.

Echoing Hirsh's (1999) findings, Shenton and Dixon (2005) found that children often feel perplexed by the reading level of websites. Often the children interviewed were unaware of their need for websites at their reading level until the sites retrieved were found to be inadequate. This finding corroborates Belkin's (1987) theory that humans usually do not know exactly what knowledge they are lacking until they start poking around. The children that Shenton and Dixon studied were interested in filling a “gap” in their knowledge, and more gaps often arose when they did not find what they were looking for.

Shenton and Dixon's (2005) research prompted a more multifaceted, user-centered approach to the reference interview, in which the librarian must draw out a young patron's “real concerns” beyond the obvious things that children find easy to articulate.

### Implications for Interface Design

In the “user-centered revolution” of the twenty-first century, more attention has frequently been paid to the “triad of feelings, thoughts, and actions” that make up a user’s approach to information seeking. Bilal (2005) proposed the development of an “affective paradigm” which will bring these aspects into greater focus. She argued that the affect of interfaces would become increasingly important when designing information retrieval systems for children.

Bilal confirmed the findings of Hirsh (1999) and Shenton & Dixon (2005) that children are increasingly ignoring the search engines built for them, and they are instead becoming avid users of adult search engines. Bilal suggested that this transition was a direct result of children’s dissatisfaction with child search engines. She studied children’s use of the kids’ search engine Yahoogigans! and, at first, found surprisingly high levels of motivation. The children were excited and proud to be using the Internet and were thus persistent and patient information seekers. But as the study went on, Bilal found that this search engine was not meeting children’s needs for spell-checking, feedback, and exhaustive indexing, which are features of the larger adult search engines. Because of this deficiency many children graduate themselves to the adult search engines before they are ready to handle the reading level of adult web pages.

Bilal wrote of the importance of children feeling positive affects, such as challenge, motivation, and self-confidence, whenever performing searches on the Internet. In Bilal’s later research, she pulled children out of their traditional roles of “user” or “informant,” and placed them in the role of interface designer. She invited them to tell her what they wanted to see in a search engine interface, and she drew it for them. The most frequent things the children suggested were: “Help” functions; subject categories that were both broad and specific; instructions on how to perform a search (written in explicit, kid-friendly language); and two separate search boxes for keyword and natural language searching.

Other researchers were also interested in designing developmentally appropriate interfaces for children based on positive affect. Cooper (2005) theorized that children, who are in a concrete-operational stage of development, have an especially strong need to feel success and confidence, or else their early efforts at exploration will be discouraged. Therefore, search engines need to be designed with “built-in safety nets,” like a spell checker, so that children can search freely without becoming overwhelmed by the skills they lack. This is completely in keeping with the findings of Solomon and Borgman, Hirsh and Walter in regards to the dissatisfaction children feel when they do not have the correct spelling of a search term. Cooper suggested that young children may feel more powerfully the confusion theorized by Kuhlthau and the anomalies discussed by Belkin. They are already at a loss for the vocabulary to articulate their information needs, so they may feel higher levels of frustration. Cooper recommended that a developmentally-appropriate search engine should be open-ended, involve many senses, offer feedback, keep records, encourage exploration and risk-taking, and promote critical thinking.

### Radical Change Theory

Perhaps no author represents the user-centered trends of the twenty-first century more than Dresang's (1997, 2005) "Radical Change Theory", which was designed to explain certain changes in handheld books for youth. She found that books today are increasingly published in formats reflecting the "interactivity, connectivity and access of the digital world". Children's familiarity with the highly interactive formats of Internet pages has led to books being designed with complex, non-linear layouts. The pages of today's children's books are littered with pictures, "fun facts," and suggested resources for more information. The children Dresang interviewed said that they enjoyed looking at a page full of information in various visual formats; they added that they like to make "choices" of what they want to read (Dresang, 2005). Dresang (2005) suggested that, contrary to stripping children of their patience for reading books, the new format actually promotes the development of abstract, critical thinking.

Dresang remarked upon several unfortunate trends she found in the existing literature about children's relationships to digital environments. She pointed out that, for example, research previously showed a rift between gender groups that suggested boys were more comfortable with digital information seeking than girls were. Today, girls are every bit as enmeshed in the digital world as boys. Researchers must take care not to make assumptions that are outdated in the digital world.

Dresang posed many hard questions about the "gold nuggets" researchers may have overlooked in their studies. Much of the early research that investigated children's information seeking behavior focused on its failings. Dresang challenged researchers to stop focusing so heavily on children's failed searches, and to pay more attention to the new behaviors fostered by the digital environment. She also called for more studies that allow children to define for researchers their own criteria of a successful search. Her points are salient and provocative, yet she neglected to mention Hirsh's extensive user-based study of children's relevance criteria in 1999.

### Conclusion

Researchers studying children's information seeking behavior generally operate under the understanding that children have a fundamentally different approach to information than adults do. Children have stronger feelings, which can lean toward extreme enjoyment or massive disappointment. They are still developing their skills with spelling, typing and vocabulary, and therefore are in need of search engines designed with their abilities in mind. But despite all of the cards stacked against them, children have clearly become more frequent users of adult search engines, wherever some of their needs may be better met.

We must not lose sight of the goal to design better and easier interfaces for child users. With an open-ended, user-centered approach, we can continue to make progress toward that goal. Today's child user will be tomorrow's adult user, and at the rate that children are reshaping our world, it will be interesting to see how our search interfaces change and develop to meet the demands of an increasingly interactive population of digital users.

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