Children in the Physical Collection: 
Implications for the Digital Library

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ABSTRACT
Finding a good book can be difficult, particularly for young readers. This paper adds to our understanding of how children select books for recreational reading by exploring the ‘native’ strategies (both successful and ineffective) that children employ in physical bookstores and libraries. The insights gained from how children find and select books in the physical environment are applied to suggest design guidelines for a children’s digital library.

Keywords
Observational study; children; recreational reading.

INTRODUCTION
Surprisingly few previous investigations of children’s information behavior have focused on recreational reading, despite growing concerns that leisure reading is declining (Reutzel and Gali, 1998). The primary purpose of this paper is to add to our understanding of how children approach the selection of finding books to read for pleasure—their tactics for identifying a ‘good’ book, the features of the book or environment that may influence the success or failure of their strategies, the role that other children and adults may play in selecting books, and so forth.

The approach taken is to focus on authentic children’s behaviors ‘in the wild’; that is, children looking through ‘real’ collections (of substantial sizes) in search of, in the charming terminology of Tunnell And Jacobs (1989), ‘real books’ (commercially produced books freely chosen to be read for fun rather than to support classroom learning). To this end, an observational study was performed of children in public libraries and bookstores.

The design and development of new digital libraries is necessarily based, in the first instance, on information behavior observed in existing systems (both physical and digital). The children’s behaviors in the observational study are examined to identify additional directions for research and development in children’s digital libraries.

This paper is organized as follows: first, an overview is provided of research methodologies employed in earlier empirical, observational studies of how children choose books, together with a brief discussion of how three children’s digital library systems have incorporated insights into children’s behavior into the design (RELATED WORK). Next, the DATA COLLECTION AND ANALYSIS methods are described (primarily participant observation and shadowing). The OBSERVED BEHAVIORS of children in the physical library are explored in detail, and the IMPLICATIONS FOR A CHILDREN’S DIGITAL LIBRARY are drawn from these behaviors. We end by suggesting future directions for this research (CONCLUSIONS AND FUTURE WORK).

RELATED WORK
The most closely studied aspect of how children locate recreational reading material is the choice between candidate books—the point at which the child examines the books on offer and picks one to read. The focus of these studies is to develop an understanding of what aspects of a particular book influence a child to decide that it is a ‘good’ book. To that end, studies tend to involve fine-grained analysis of the behavior of small numbers of participants (e.g., 9 participants in Kragler, 2000; 18 participants in Reutzel and Gali, 1998), and to examine the decision process when choosing between a small number of options (e.g., selection between 5 books in Hiebert et al., 1990; between 9 books in Mohr, 2006). This present paper differentiates itself by exploring behavior when choosing among hundreds or thousands of candidate books—and so necessarily analyzes the behavior at a coarser level. The sole observational study of book selection in a realistically sized collection (Reutzel and Gali, 1998) focuses on developing a micro-analysis of how children physically interact with books on shelves. This present paper instead looks at broader patterns of behavior in moving through a book collection.
For practical reasons, it is more straightforward to study behavior in a school setting (e.g., Mervar, 1989; Kragler, 2000; Reutzel and Gali, 1988). However, there is evidence that children use different strategies when choosing books that are solely read for pleasure, and when choosing books that will potentially be used for school purposes (Mervar, 1989). This present study is situated outside the classroom, and largely was conducted during school holidays.

The largest-scale empirical study to date (Pjpterson, 1986) examined 142 ‘negotiations’ between children and librarians in public libraries—interchanges in which the child approached the librarian for assistance in locating a recreational reading book. This present study instead looks at children’s unmediated behavior in physical collections. Pjpterson’s study was conducted to assist in the design of a child’s bibliographic database for choosing fiction; to that end, the research was useful in uncovering the facets (subject matter, setting, emotional impact, reading level, etc.) to include as metadata to support children in directly searching/browsing the resulting database.

Other children’s digital library development efforts that are directly based on studies of children’s behavior include the Search Wall (Detken et al., 2009), the International Children’s Digital Library (Drui, 2005), and Theng’s unnamed digital library (Theng et al., 2000; Theng et al., 2001). The Search Wall is provides a tangible, interactive surface (wall) to support browsing in a physical library. The design is based in observations of children in public libraries; unfortunately the observational study is not reported on in full, and forms only a small part of the written record of the project. The design principles elicited emphasize the importance of browsing for children, and suggest that physical, auditory, and visual support are necessary for both searching and browsing.

The ICDL and Theng’s digital library are developed in the Participatory Design framework. Instead of treating potential users as passive subjects of study, Participatory Design methodologies directly involve users as partners in the design process—designs are suggested by, tested, and approved by the children through a series of design exercises. Both digital library development efforts also drew heavily on design features suggested by existing research into children’s behavior in book selection.

**DATA COLLECTION AND ANALYSIS**

This work is situated in ethnographically – based system design (Monk and Gilbert, 1995). This approach is most effectively applied in the initial stages of system design, as a form of requirements elicitation; the research is intended to develop an ethnographic ‘rich picture’ of the social interactions and stakeholder goals and concerns (Monk and Howard, 1998), as well as a nuanced understanding of the activities in the domain under study.

The primary method employed in this study is anonymous participant observation, in which the researcher posed as a reader in bookstores and public libraries, and unobtrusively observed the activities of children and their caregivers as the children gathered reading material. During the observations, the researcher engaged in normal activities for the library or bookstore—consulted bookstore attendants for children’s titles suitable to give as gifts, browsed through children’s bookshelves as though gathering selections to bring to a child, and leafed through books and magazines in ‘adult’ sections near the children’s books.

The bulk of the observations were carried out while schools were in recess, thus increasing the likelihood that the books were indeed for recreational reading, rather than to support schoolwork. The children observed ranged in age from very young (infants and toddlers) to teenagers. These observations took place in the children’s sections of two large bookstores and three public libraries, for a total of 11 sessions and 14 hours. Observations were carried out in the USA and New Zealand.

Anonymous observations yield a rich picture of behaviors, but not of the motivations behind the actions. To flesh out the observations, seven children aged 6 to 10 were ‘shadowed’ as they selected recreational reading (two children at bookstores, five at public libraries). As these children looked for books, they were asked to ‘think aloud’ about their activities. The children were also de-briefed after the shadowing exercise about why they chose the books that they selected for later reading. For both participant observations and shadowing exercises, manual notes were taken.

Children typically find it difficult to self-reflect about their activities (Reuter, 2007), so ‘think-aloud’ in shadowing yielded limited results. The shadowing behaviors were discussed with the parents of these children, to gain further insights into the motivations behind the observed behaviors; inconsistencies between the viewpoints of the parents and the children were noted and explored. Pseudonyms are used below for participants in the shadowing exercises.

Observational study is used here as a means for eliciting interface and interaction design guidance for digital libraries tailored for children. To achieve that purpose, ethnographic observations must be open-ended to allow insights beyond the expected, yet sufficiently purposeful to narrow the focus to aspects of the activity addressable by software development. To that end, the priorities in the observations were:

- to discover the common stages or steps in a child’s visit to a library or bookstore
- to elicit the social aspects of a library / bookstore visit, particularly in regards to how other people influence a child’s books selections
- to identify problem points in the library or bookstore experience—difficulties that children experience in locating and selecting recreational reading books
• to identify aspects of the physical library or bookstore that children enjoy, and that successfully support the child in locating and selecting recreational reading books.

Notes from the observations, shadowing exercises, and parental de-briefings were analyzed using a grounded theory approach (Glaser and Strauss, 1967). This is one standard methodology for making sense of qualitative, particularly ethnographic, data; the researcher attempts to view the data without prior assumptions, and to generate theory from the data through an iterative series of ‘close readings’ of the recorded observational data. As common themes and patterns emerge, a deeper understanding of the observed activities and behaviors is drawn bottom-up from the data. The iterative coding proceeded until theoretic saturation occurred (that is, until no further categories were identified).

**OBSERVED BEHAVIORS**

An adult’s understanding of a visit to a bookstore or library in search of recreational reading would commonly run as follows:

• the goal of the visit is to acquire interesting books, which I will read at home;
• I know how much time I can devote to this trip to the library/bookstore; and
• there is an upper limit to number of books I select, with that limit enforced in a bookstore by what I can afford, and in a library by a loan maximum on my library card or by my understanding of how many books I can finish before they must be returned.

A typical script for an adult’s trip to a bookstore / library, then, might be (Ooi, 2008):

• go to the area is most likely to contain books of interest to me (for example, the recreational reading / fiction section)
• if I know of a particular book of interest, then I search for it (possibly using the online catalog)
• otherwise, I browse the area to identify books that match my reading interests
• as I browse, I build up a candidate set of books to purchase / have issued to me
• when I approach my time limit, I cull the candidate set to meet my book limit
• I then leave that part of the collection, purchase / check out my books, and leave the bookstore / library

Children learn appropriate behaviors for an activity from adult instruction and through experience. The older children observed in the libraries and bookstores (pre-teens and early teens) came closest to matching this adult script. The remainder of this section explores the children’s patterns of behavior that emerged from the data, highlighting the points of similarity to, and difference from, adult activities when seeking leisure reading material.

**Finding the Right Area**

The broadest grouping of books is usually by the reader's recommended age: for example, both libraries and bookstores commonly create sections for pre-school, young reader, junior fiction, and young adult books. While the bulk of a child's book selections are usually from a single age grouping, children also frequently 'read up' and 'read down', moving back and forth between the age-categorized sections. For example, consider one shadowing exercise:

Anne (10) moves quickly through Junior Fiction, picking out 4 books in a few minutes. Her younger sister, Rose (7), is flipping through the bins of picture books. Anne begs her mother for permission to independently look through the Young Adult Fiction section (in a different area of the library); she's visibly proud when she returns with two novels that her mother agrees she is old enough to read. Rose is still browsing the picture books. Anne walks over to tell her that it's time to leave, and as she escorts Rose over to their mother she casually grabs a picture book (aimed at 4 year olds) that she adds to her own selections.

Earlier studies note similar patterns of behavior (e.g., Fresch, 1995), with children ‘yo-yo-ing’ between books aimed at lower and higher reading levels.

Children were observed to quickly find a section of the library to browse, apparently without reading the signage and certainly without resorting to the online catalog. Physical bookstores and libraries signal the intended reading age for each area by the area’s furnishings, decorations, and color scheme; for example, the pre-school area is of often decorated in primary colors and has stuffed animals nearby, whereas the junior fiction books section generally features more stylish and sophisticated colors and larger, nearly adult sized chairs. The areas themselves are often arranged sequentially by reading age order, so that children can easily move up to the adjacent next higher reading age area or down to the previous area. Young Adult sections are frequently set apart from the others or at the very least are placed as far as possible from the pre-school and young reader sections, to minimize the chances that younger children will inadvertently stumble on the more controversially themed books.

On return visits to bookstores and libraries, children appear to recall the physical location of the shelves and displays that had captured their interests previously. Earlier studies also noted that children are keenly aware of the physical layout of ‘their’ sections in a library (e.g., Reutzel and Gali, 1998; Detken et al, 2009). Unfortunately these spatial cues are frequently disrupted in bookstores, as seasonal or themed displays move in and out of the children’s area;
bookstores, after all, are geared to promote sales of newly published books rather than old stock, and one powerful technique to encourage exploration by continual novelty in the shelving:

Aisha, age 6, tries to show the researcher her favorite books in a local bookstore: “I want to show you something… oh, they change things every week! Everything’s such a bumble now, I can’t find anything.

Libraries alter shelf arrangements and displays less frequently than bookstores, but as libraries generally have only have one or a few copies of a given item then the available collection display is more dynamic—it can be difficult or impossible to re-locate a book checked out in an earlier visit, or indeed even a book spotted earlier in the present visit if another child has nabbed it in the meantime.

Choosing a Good Book
An early study of children’s reading behaviors draws a distinction between interests and preferences in reading material that highlights a fundamental difference between how adults and children approach recreational book selection (King 1967, as cited in Reutzel and Gali, 1998):

...preference is relatively passive, while interest is inevitably dynamic. A preference is readiness to receive one object as against another; it does not induce us to seek out the object.

Younger children (pre-school and elementary ages) clearly choose reading material on the basis of serendipitous encounters with a book that matches a preference, rather than actively engaging in a strategy to satisfy an interest by looking for books of a particular genre, theme, author, or other characteristic. Older children tend to be more aware of their own tastes, to be more able to navigate the collection’s organizational system, and of course to be able to read more fluently—and so begin adopting more active strategies to find books that match their interests.

The primary—apparently, in many cases, only—basis for the ‘good / not good’ decision is the appearance of the cover. The importance of book covers in children’s reading selection is well known (e.g., Campbell et al., 1988; Reutzel and Gali, 1997; Reuter, 2007; Mohr, 2006); the observations and shadowing exercises confirmed earlier insights into the significance of book covers and the richness of the inferences that can be drawn from them. In this present study, the more interesting finding is the speed at which the assessment could be made, even by children of very young ages.

Young children (toddlers to new readers) dart around the displays, grab a book that catches their eye, and make a split-second decision as to whether or not it is likely to be a ‘good’ book. Books are much more likely to be considered for selection if the cover is visible (that is, if the books is displayed face out on the shelf or at the end of a row, and if the book is at the child’s eye level). Few of these youngest readers browsed shelf-by-shelf or even row-by-row; instead, they caromed from one spot to another.

Older children tended to be more methodical in their browsing, but still relied on a quick impression of the book from the visible spine or cover to make many decisions in libraries (bookstores are considered below). Unlike the younger children, older children independently considered the books shelved with only the spine visible, where the younger (under 5 years old) generally had to be prodded by parents or older siblings to look at anything but the books on the front-facing shelves. Older children often walked quickly and confidently past the shelves, scanning from top to bottom in just two or three seconds—stopping to pull out one or two potentially interesting books every few feet based on the color and appearance of the spine alone.

Quite sophisticated judgments, then, are made on probable theme, storyline, time needed to read the book, emotional tenor, and so forth with a single glance at the cover. Supporting evidence for the extent children’s ability to make inferences from the cover alone emerged in the de-briefings from the shadowing exercises. It was not unusual for a child to offer an elaborate explanation as to why a particular book had been chosen (e.g., “cause it’s silly and funny and has nice pictures in it and good writing and not too many words”) when that book had been casually lifted from the front-facing display shelf as the child walked past.

Cover images are consulted even in the older groups, to gain an impression of the story and as an aid to memory of previous readings. Children often recognized previously read books by cover rather than remembering them by title; in spine-out displays of series books, for example, few children read the titles on the spines, preferring instead to pull out each book in the series and view its cover in order to locate the next unread book.

Where the pre-literate or newly literate children could only judge a book by its visual appeal, older children could (and did) sometimes consider the title, back cover text, table of contents, first few pages of text, and sample pages from the middle of the book. The lower the limit on the number of books to be purchased/issued, the longer the time spent by older children in considering a specific book and the more aspects of the book viewed to support that decision. The larger the number of books the child was able to take home, the less significant each specific book choice became, at least in the library context—if one book of a dozen turned out to be a dud, then the child could simply return it unread at the next library visit. In bookstores, the child can only purchase one or two books, and then that purchase will remain at home; in this situation, the child tries to find as much evidence as possible to make a decision.

Social Aspects of Finding Books
For a child, finding a good book is rarely a solitary activity. Children visit bookstores and libraries accompanied by
parents, siblings, and friends. The youngest drag books back to their parents to show off their finds, and to hear at least a few pages read out to them. Older siblings recommend to younger the books that they themselves enjoyed at that earlier stage, or point out interesting books that they’ve run across as they browsed. Friends give each other advice as they walk through the displays together (one girl to another, both approximately aged 10: “No, don’t get that one, it’s for boys… that one is about bears, it’s too scary”). Pre-literate children proudly ‘read’ to other toddlers or to their own parents. Parents offer recommendations based on their understandings of the child’s interests (“how about this one, it’s a space book”; “try this book, it’s written by the author who does the books you like, the funny pirate stories”).

Earlier studies have noted that recommendations from the child’s parents, teachers, siblings, and social circle can play a significant role in encouraging children to seek out specific books to read (e.g., Mohr, 2006; Pejtersen, 1986). These studies have largely been retrospective, based on children’s explanations of how they came to read particular books. As such, they necessarily miss much of the rich behavior that occurs in the displays, as children are given, seek out, and themselves give advice and express opinions while browsing. The social interaction can be a significant opportunity to learn about the process of selecting a book: how to decode cover images (for example, to know that the story line will be ‘too scary’), strategies for finding a book that s/he might enjoy (e.g., looking for other books written by a favorite author), or ways bond with a sibling or friend over a recommendation (“here, Jessie, you’ll like this one, it’s funny”).

Recommendations from parents are particularly significant, given that parents frequently make the final decision on which books are to be purchased / issued (Winnowing Down the Candidate Set). Sometimes the child seeks out a parent’s advice (this is most common with the youngest children). More frequently, the parent offers unsolicited advice to help choose a book, to guide the child to a section of the library that the parent feels is most appropriate for the child (generally by age, sometimes by topic), or to assist the child in winnowing down an overly large set of possible books to purchase / check out. The child is sometimes visibly reluctant to accept a parent’s selection on their behalf, but generally doesn’t object unless the book is utterly unsuitable:

Father: How about this one, it’s about Justin Bieber.
Daughter (approx. 11): I said I wanted a good book.
that a book had been located tended to disrupt the process of building a candidate set of books: children frequently simply sat down and began reading. If not prompted by a parent to resume browsing, the children would often read the book from cover to cover, the youngest sometimes reading through the same book several times. When the parent announced that it was time to leave, the child would then have only one book to purchase or have issued—and the book had already been thoroughly explored. At that point, the children often made a quick, seemingly random selection from the closest display (a behavior also noted by Reutzel and Gali, 1998).

Children of all ages were noticeably distracted from the task of building the candidate set by non-book objects and novelty document formats. A DVD of The Cat in The Hat can be more appealing than the classic book. Children’s sections of both bookstores and libraries now often include toys: bookstores stock tie-ins such as Dora the Explorer™ or Where The Wild Things Are™ dolls, and libraries often include activity areas stocked with blocks, play mats, and stuffed animals (Figure 1a). These of course have great appeal to the youngest children, who then have to be prompted by their parents to switch from play back to looking for books. Bookstores also stock a significant proportion of ‘novelty’ books: pop-ups, activity books, books with attached music keyboards or music players, ‘texture’ books with fabric inserts, flipbooks, and so forth (Figure 1b). While technically books, they are designed more to be played with than to be read in the conventional sense. Indeed, in the bookstore observation sessions the books that were handled most frequently and for the longest periods of time (up to 22 minutes by a single child) were stiff cardboard books shaped like trucks, complete with wheels (Figure 1c)—but not a single child was seen to open them to inspect the text!

Additionally, children tended to treat attractive objects in the area as if they were toys. One public library offered jigsaw puzzles; while the puzzles themselves were not on display, their document surrogates (laminated sheets that included an image of the completed puzzle) were carefully sorted and stacked by little girls (Figure 1d). Colorful throw pillows were piled up and knocked over, and sturdy wooden reading nooks were climbed like jungle gyms—bright and eye-catching objects were particularly prone to distract children to play, rather than to look for (or at) books.

Some play activities can be viewed in a more positive light, as supporting engagement with a particular book. Two of the children who participated in shadowing exercises spontaneously brought out notebooks to draw their impressions of the books that they had chosen—books that had so excited them that they had read them while in the bookstore or library, but still wanted to take home (example in Figure 2).

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**Figure 2. Rose envisioning herself as the ballerina protagonist in one of her newly checked-out library books**

### Winnowing Down the Candidate Set

In both bookstores and libraries, parents frequently exercise veto power over the final selection of books to purchase or have issued. Typically the parent inspects the candidate set for ‘inappropriate’ books, and explains to the child why particular books are rejected. The most common reason given for rejecting a book was that the parent felt that it was not aimed at the child’s age level: because, for example, the book contained mature themes, was too long or was written in a style too difficult for the child to read, or alternatively that it was too short and simple to challenge the child. Other reasons for rejecting a book can be idiosyncratic; Anne’s mother, for example, asked that Anne put back a Guinness Book of World Records annual because while “some records are ok, others are just gross”.

Children usually accepted the parent’s judgments without protest, but occasionally debated the decision. This occurred more frequently in bookstores than in libraries; libraries allow large numbers of books to be checked out in one session, and it is apparently easier to be philosophical about losing one selection out of many than it is to have the bookstore’s single selection vetoed. Further, bookstores charge for purchases, and even very young children are acutely aware of the differences in prices between books—and that the more expensive books require substantially more sophisticated justifications than a selection from the bargain table.

After the candidate set has been trimmed down to contain only books that meet the approval of the parent, then the child may have to discard further books to meet a limit on number of books s/he is allowed to purchase or have issued. At this point the decisions can become agonizing, and additional advice is often sought from parents, siblings, and friends. Sometimes the advice is heeded, and sometimes it is ignored; the child relishes having the power of final choice:

Setting: the newspapers and magazines section of a bookstore. Mom is browsing at magazine rack. Her son, about five years old, comes over with five books that he’s picked from the children’s section. Mom reminds him that he can only have one. He spreads the books out on a nearby table. He thinks
and thinks, finally culls the choices down to two, but still can’t make up his mind.

Boy: Mom, which one should I buy? Which one do you like? Which one should I get?
Mom: You buy the one you want, that you like.
Boy: No, you tell me.
Mom: Well, I think you should buy this one [points at one of the two books].
Boy: I hate that book.

Success! Leaving with the Book(s)
Children very quickly learn the protocol for taking their selections home: we queue to pay in bookstores, and queue to have books issued in libraries. Very few instances of shyness, anxiety, or reluctance were noticed in interactions with sales clerks or librarians; indeed, it was a proud moment when a child was given the money to hand over to the sales clerk or (even more exciting!) could pull out his or her very own library card.

IMPLICATIONS FOR A CHILDREN’S DIGITAL LIBRARY
Table 1 presents an overview of system design implications, explored in more detail in this section.

The behaviors described in Section 3 suggest a child’s view of the constraints involved in a visit to a library or bookstore:

- The primary goal of the visit is to have fun! A secondary goal is to read, or at least begin reading, a book. Selecting books to take home is a distant third as a goal.
- The length of time available to enjoy the library / bookstore is determined by someone else, and I might or might not know how much time I have.
- The number of books that I can take home is determined by someone else (the parent paying for the book or the rules of the library): I might or might not know my limit, and the limit may change from visit to visit in ways that I don’t quite understand.
- The child’s ‘script’ for visiting the library / bookstore, then, is much less algorithmic, more open-ended, and less self-determined than the adult’s script:
  - Go to the most visually interesting area and look through the items that grab my attention (these might, or might not, be books)
  - If I’m not in the area containing books appropriate to my age, then someone (parent, librarian, sibling) will quickly tell me to move to the ‘correct’ space
  - Look first at the books sitting face out on the shelves or display areas, then at the spines of books at about my eye level, then possibly at the spines of lower/higher books
- When I find a book that looks interesting, sit down in the nearest spot and start reading it
- Occasionally check to see what my parents / siblings / friends are doing—they may have found something interesting that I should look at too, and I want to show them the great book that I’ve found
- I accumulate books but often don’t cull; if I decide that I want to take a book home, I’m very reluctant to leave it behind
- Someone else (a parent, older sibling, or librarian) tells me which of my choices I’m allowed to keep
- Eventually someone tells me it’s time to go home!

In physical bookstores/libraries children find leisure reading primarily by browsing rather than by searching (Finding the Right Area)—an effective strategy given that children are usually not actively seeking a particular book or indeed seeking to satisfy particular interests (Choosing a Good Book). Visual cues and spatial layout signal the location of age appropriate books, and spatial memory is important re-finding both areas of interest and specific books (Finding the Right Area). The effectiveness of visual cues for orientation within a collection is supported by previous research with physical and mixed physical / digital libraries (e.g., Detken et al., 2009; Jorgensen, 2006). These behaviors suggest that particular attention be paid to conveying a visual sense of the ‘geography’ of a digital library, and that the representation be as stable as possible. Stability will support both finding (as the child learns the most relevant areas for his/her tastes) and re-finding (ameliorating current difficulties in re-locating books or subsets of the collection that were previously of interest). Exploration can be encouraged by visually drawing the child’s attention to new or related books within the same area—in the words of Plaisant et al. (1997), bringing to the surface the ‘treasures’ hidden in the depths of the collection.

Many children clearly have some difficulty in learning and following the adult’s library ‘script’: children lose track of (or simply don’t know) the time and book number limits for a given visit, and may spend their entire visit reading rather than identifying books to read at home (Building the Candidate Set). While it may be the case that a digital library has no constraints on time spent in interacting with the collection or restrictions on downloads, it is equally plausible to envision a digital collection with constraints similar to those of a physical library—for example, with limitations on access to copyrighted material. A digital library could assist children in working to constraints by prominently displaying time and book price/number counters, and by limiting the proportion of any particular book that can be viewed before ‘checkout’.

Development of a user profile for each child would allow the system experience to be tailored to the individual. Some aspects of the profile could be prescriptive—for example, setting limits on the number of books a child can access at
any one time—while other aspects could support increasing autonomy—for example, the child could select topics or authors that s/he particularly enjoys, so that new books that meet these preferences are drawn to her/his attention.

Representations of books in a digital library at a minimum include book covers, given the cover’s significance in selecting reading material (Choosing a Good Book). It will be challenging to augment current cover-based children’s browsing interfaces (e.g., Druin, 2005; Hutchinson et al., 2007) to support both extremely rapid scanning (Choosing a Good Book) and richer visualizations than are currently implemented (e.g., in Druin, 2005; Hutchinson et al., 2007). One immediately useful feature based on cover images would be to maintain a visual record of the books that a child has read—thus building on the child’s visual memory to support re-finding of previously enjoyed books and to assist in finding new or unread books in a series or set of related titles (Choosing a Good Book).

Colorful, interactive, multi-sensory interface functionality is likely to appeal to children, but may distract from the fundamental purpose of a digital library: to support reading rather than play. Similarly, multi-media and interactive documents are likely to be enjoyed as toys rather than read as books (Building the Candidate Set). However, younger pre-literate / newly literate children in particular enjoy engaging a book by creating their own ‘annotations’ in the form of drawings based on the book’s plot or themes (Building the Candidate Set). This behavior suggests that a child’s account for the library could include an area in which the child can record his/her impressions of books that have been ‘checked out’—with drawing support as well as text input facilities.

Social interaction can occur at any point in the book choice process (Social Aspects of Finding Books). At a minimum, a digital library should allow children to both receive and make recommendations, and support development of more nuanced understanding of strategies for identifying a ‘good book’ by presenting a recommendation’s rationale. It will be interesting to explore the relative effectiveness of anonymous recommendations or advice; it is not clear that the recommendations of anonymous readers would carry the same weight (or indeed, be as pertinent to a particular child’s tastes).

Few if any facilities for parental involvement are supported in current children’s digital libraries (e.g., Reutzel and Gali, 1998; Druin, 2005)—surprising given the prominent role that parents play in physical libraries and bookstores. Theng et al. (2001) implement ‘gatekeeper’ (security) features in their children’s digital library, but primarily for the purposes of authenticating and maintaining version control for student submissions to the digital library. In this study, parents clearly desire facilities to support / enforce parental approval for their child’s selections (Winnowing Down the Candidate Set). The most common parental concerns are with reading level and ‘mature’ themes in individual books—these commonly appear in the metadata for children’s books, and so for these it would be relatively straightforward to implement a ‘parental settings’ feature that would allow the parent / caregiver to set aspects of the child’s user profile, so that their child views only those portions of the collection that the parent feels are appropriate for the child.

These would be relatively coarse and broad filters, however; it would not be possible to create a priori filters to cover all possible cases (for example, to capture the rationale behind the veto of the Guinness Book annual by Anne’s mother). This fine-grained control is only possible if the parent is given the option of inspecting each book the child chooses. It is important, however, that children be allowed to make their initial set of choices as independently as possible; children particularly enjoy demonstrating that they are capable of autonomous decisions and actions (Winnowing Down the Candidate Set and Success!), and earlier studies have shown that children show greater engagement with reading when they select their own books (Campbell et al, 1988).

The children should also be given an explanation of why particular books are veto-ed or why some portions of the collection are off limits—children naturally resent arbitrary and inexplicable decisions and are much more likely to accept a parent’s verdict if they understand the decision’s rationale. These explanations will also often imply a progression to the point at which a particular book will become an acceptable choice (for example, when the child reaches a certain age or when his/her reading level improves).

Parents also look to assurances of the quality and acceptability of the collection as a whole. Parents value the gatekeeping services provided by bookstores and libraries. One parent characterized the concept of a children’s online library as “…scary. Who knows what books are there, if they’re appropriate, if there’s been a virus and now it has porn? There’s no librarian. There’s no trust.” The challenge will be to build that trust in a virtual environment—for example, by supporting the parents to quickly overview the collection contents and collection development principles, to easily identify the sponsoring organization for a collection, and to contact ‘digital librarians’ for further information about the digital library.

CONCLUSIONS AND ON-GOING WORK
This initial work suggests features and functionality for a child’s digital library for recreational reading, together with a rationale for these features based in observed behavior in physical libraries, with children engaged in authentic reading activities. The results from the observations also confirm findings from earlier work exploring the strategies and tactics that children employ to navigate a physical library and to select books to read.
The next logical step is to implement these design concepts within an existing digital library framework—for example, as a customization of the standard Greenstone interface (Witten et al., 2008). This is the approach taken by Theng et al. (2000, 2001) with their digital library to support collaborative writing for children; this approach has the advantage of conservation of effort in implementation of basic retrieval and search functionality.

Effective user testing of the developed children’s digital library will require the establishment of a test collection of sufficient size and sufficient interest to children, so that children are making decisions of a proportional size and difficulty to those made in a physical library. The International Children’s Digital Library (Druin 2005; Hutchinson, 2007) was under development in the early 2000s, when relatively few children’s books were available for inclusion in the digital library—so the initial user testing (eg, Druin 2005) was conducted over a collection of 196 international folk tales, intended to cater to ages 3 to 13 (the latest versions of the ICDL include several thousand documents, though in several languages). From a child’s point of view, the issues involved in selecting one or more documents from a collection of this size will qualitatively and quantitatively differ from the prospect of walking into a an ordinary physical children’s collection numbering in the thousands, and attempting to find a good book to read.

The library developed by Theng et al. (2000, 2001) finessed problem of obtaining a document set suitably sized for user evaluation by focusing on a collection created by the children themselves—and so the children were primarily working collaboratively to write new stories to add to the digital library, rather than to locate and read stories already in the collection. It is not clear from the research literature that evaluating search support played a significant role in testing of this system.

At present there are far richer opportunities for building a realistically sized collection for testing—a larger number of ‘free’ digital children’s documents are available for download, and test collections can be created simply by purchasing digital versions of commercial books. Though in this latter case the collection itself could not be released for public use, the digital library framework (interface and retrieval system) could be made available.

This present study intentionally did not limit its focus to any particular age group (indeed, a striking feature of the patrons of the children’s section was the broad age range, from infants in arms being held up to the shelves, to teens or young adults with reading difficulties searching for easy-to-read material). A natural next step will be to carry out narrower studies for specific age ranges and reading levels, to explore whether refinements of these design guidelines would be likely to benefit those groups. Similarly, studies of children on the autism spectrum or with specific learning disabilities may suggest ways to better support these children in their reading.

REFERENCES


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<tr>
<th>Observational study</th>
<th>Design guidelines</th>
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<tr>
<td>Children love to play—but play can distract from reading</td>
<td>Adopt a ‘child friendly’ approach to interface appearance and interaction design, but avoid gratuitous multimedia or game elements</td>
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<tr>
<td>Younger children are pre-literate or newly literate; reading fluency can take years to develop</td>
<td>Emphasize browsing over searching</td>
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<td>Children take a visual, spatial approach to understanding physical collections</td>
<td>Support textual information with visual cues, both for the collection as a whole and for individual books</td>
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<td>Children may not understand the constraints to selecting books (time, cost, number of books)</td>
<td>Browsing more naturally fits this style of interaction than searching</td>
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<td>Parents act as gatekeepers to collection access and by approving the child’s book selections</td>
<td>Build on these spatial analogies for browsing the digital collection</td>
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<td>Children enjoy social interactions as they choose books, and learn strategies for book choice from these interactions with friends and family</td>
<td>Spatial organizations are most effective if they are stable from one visit to the system, to the next</td>
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<td>Children enjoy taking responsibility for their own reading material</td>
<td>Prompt children with the initial values of the constraints, and indicate the approach to time / cost / number limits</td>
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<td>Provide explanations / rationale for constraints</td>
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<td>Reassure parents on the quality and appropriateness of the collection</td>
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<td>Support the parent in limiting access to ‘inappropriate’ portions of the collection</td>
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<td></td>
<td>Allow the parent to veto specific book selections</td>
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<td></td>
<td>Children should be able to receive recommendations from within their family and social group, together with their rationale</td>
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<td></td>
<td>Children should be able to give recommendations, and should be prompted to give a rationale</td>
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<td></td>
<td>The child should take the lead in choosing books, to as great an extent as possible</td>
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<td>Ensure that the child can access relevant portions his his/her account profile, and can make decisions about some of the settings</td>
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Table 1. From observations to suggestions for interface and interaction design