Favorite Websites: Understanding Prior Knowledge of Teens’ Mental Models of Public Library Websites for Teens

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ABSTRACT
In this paper, we explore teens’ mental models of public library websites for teens (teen library websites/TLWs), specifically favorite websites as they relate to prior knowledge and experience. Thirty teen participants from three public libraries within three demographically diverse locations in New Jersey took part in the study. Each participant completed a questionnaire, a drawing task, and a semi-structured individual interview. During the semi-structured interview, participants described their drawings in detail, discussed and demonstrated their favorite websites and evaluated current TLWs. The results showed that teen public library users hold multiple mental models of TLWs. In addition, favorite websites data provided some understanding of the role of prior knowledge and experience in teens’ use and expectations of TLWs. Based on analysis of the data, we offer design recommendations for making TLWs better match teens’ design and use expectations and preferences.

Keywords
Mental model, website evaluation, representation, adolescents, teens, human information behavior

RELATED LITERATURE
Teen Information Needs
Researchers have identified major areas of need that should be addressed when working with the teen population and public libraries. Agosto (2007) surveyed teens about their use of public libraries and found that teens use public libraries as an information gateway, a social interaction/entertainment space, and a beneficial physical
environment (p. 58). Apart from understanding the use of the bricks and mortar library, Agosto (2002) offers a theoretical model based on bounded rationality and satisficing as it pertains to young people’s decision-making, providing four major determinants of young people’s Web-based decisions: personal preference, object engagement, human processing constraints, and contextual constraints. The discussion provides reasons why teen websites may fail or succeed within the teen demographic and emphasizes the need to understand context in order to design and develop for the teen population.

Hughes-Hassell and Miller (2003) researched how teens contributed to the design and development of public library websites by surveying public libraries in U.S. and Canada. They suggested that library websites address teens’ needs on academic, social and recreational levels. Agosto and Hughes-Hassell (2005) looked at the everyday life of urban teens 14 – 17, a group studied even less than other teens, and found that the typology of information needs can be mapped to prior research on teens, which helps to provide an additional area of research within the teen population. The researchers also proposed theoretical and empirical models regarding urban teen information needs, identifying seven “selves” (social, emotional, reflective, physical, creative, cognitive and sexual) that make up urban teen development (Agosto & Hughes-Hassell, 2006a, 2006b). Within preteen research, Meyers, et al. (2009) investigated the everyday information seeking of preteens by developing the “Tween Day” methodology, which involved a five-hour research “play date” with multiple methods of data collection, social interaction and creative play of three groups of preteens. The researchers found that access to other people can be a determining factor in an information search, and preteens are not a homogenous group but rather a group that is influenced by developmental factors, race, socioeconomic status and expanding social worlds (networks) where they constantly need to adjust their information seeking based on the social context.

As a result, it is important for researchers to recognize that teens are not a homogenous group. Understanding the multifaceted teen context is the first step in designing and developing websites that respond to their wide-ranging information needs.

**Mental Models**

Mental model theory provides the theoretical framework for this study. The concept of a “mental model” is often attributed to Kenneth Craik’s *The Nature of Explanation* (1943) in which he described people’s ability to construct internal representations of the external world. Craik believed that people carry internal symbolizations of the external world that they can use to understand possible actions, try out alternatives, draw conclusions, and react to the present and future base on previous knowledge (Craik, 1943). The actual term “mental model” was coined by psychologist Philip Johnson-Laird (Staggers & Norcio, 1993), and like Craik, Johnson-Laird (1983) suggested that a person who understands a phenomenon creates a mental representation that can be used to explain that phenomenon. Norman (1983) applied mental models to human-computer interaction (HCI) and built on the idea of an internal representation of the external world, where mental model referred to the user’s mental model of the information system with which the user is interacting.

Inconsistent definitions of mental model are often viewed as a major problem by the research community (Doyle & Ford, 1998; Farooq & Dominick, 1988; Staggers & Norcio, 1993; Westbrook, 2006). Researchers have used “conceptual model,” “mental model,” “user model,” “cognitive model,” “designer model” and other terms interchangeably, creating a situation where one cannot be sure of the concept when reading multiple authors’ works. Staggers and Norcio (1993) highlighted the conflicts that appear in the work of different researchers, stating that “Young (1981, 1983) … uses the terms conceptual model and mental model synonymously to refer to users’ mental representations of their interactions with complex devices”, while “Moran (1981) refers to users’ mental representations as their conceptual model of the system while Norman (1983a) titles the same concept mental model.” As a result, there is a stumbling block in the progression of research when the terminology used does not have a clear meaning.

Doyle and Ford (1998) analyzed this problem in detail for system dynamics. They argued that the concept of mental models was vital to system dynamics research but that an explicit definition was rare, leading to confusion and lack of understanding of mental models. The authors analyzed current definitions of mental models within and outside of system dynamics research and proposed the following definition, “A mental model of a dynamic system is a relatively enduring and accessible, but limited, internal conceptual representation of an external system whose structure maintains the perceived structure of that system.” According to Westbrook (2006), this definition of mental models works well for information studies as it speaks to the dynamic nature of information systems and users’ ability to create internal representations.

Although definitions in the research literature vary across researchers and domains, one finds that Craik’s original concept of an internal representation of the external world can be identified in many of the definitions of mental models and as such, will be used as the main definition for mental models in this paper. Thus, for this study a mental model is defined as an internal representation of the external world.

Young (1983) suggests eight different types of mental models (strong analogy, surrogate, mapping, coherence, vocabulary, problem space, psychological grammar, commonality), but provides little support and reasoning behind these suggestions, which were not readily adopted by the larger research community as distinct mental model...
types that could be used going forward (Staggers & Norcio, 1993). One possible reason for the lack of widespread adoption of Young’s mental model types can be that people do not create mental models with such clear distinctions, particularly centering around the idea of a structural map, and it is possible that a user’s mental model may include multiple if not all the suggestions presented. For example, in thinking about electric flow, a user might hold a flowing water metaphor/analogy mental model that can account for multiple types of mental models, including reasoning about a problem space and an understanding of physical relationships (Gentner & Gentner, 1983). Research studies exploring the mental models of novice and expert users provide another position on different types of mental models. These studies describe mental model types as novice models or expert models, suggesting that users can form naive and utilitarian models as compared to elaborate and structural mental models (Papastergiou, 2005; Thatcher & Greyling, 1998). The mental model of a novice may eventually be developed into that of an expert, confirming that mental models develop over time and can be augmented with continued interactions (Greeno, 1983). Thus, the novice and the expert may exhibit different mental models of the same external context that can be viewed as different levels of understanding.

Norman (1983) presented six general observations about mental models based on his work with human error and human-machine interaction, suggesting:

1. Mental models are incomplete – people do not form complete mental models but rather models that include uncertainty, and partial descriptions
2. Mental models are unstable – people forget details
3. Mental models lack firm boundaries – people confuse similar operations and devices
4. Mental models are unscientific – people maintain superstitions as part of their models
5. Mental models are parsimonious – people would trade extra physical action for reduced mental complexity
6. People have limited ability to “run” their models

People do not require complete models to achieve their goals and as such can function with varying efficiency and effectiveness (Westbrook, 2006). Jonassen and Henning (1996) emphasize the dynamic, multi-modal and multi-dimensional nature of mental models as more than structural maps of components, suggesting that the traditional view needs to be adjusted.

Drawing Method
For the current study, the drawing method provided a means of directly capturing teens’ mental models of TLWs, particularly their non-verbal representations. Graphic elicitation techniques such as drawings enable participants to express complex or abstract ideas that are difficult to express verbally (Crilly, Blackwell, & Clarkson, 2006). However, it is important to use other data collection techniques in combination with graphic elicitation in order to provide context and explanation (Pink, 2006; Varga-Atkins & O’Brien, 2009). Research on mental models has relied on the use of verbal/written protocols such as interviews or questionnaires to elicit mental models (Borgman, 1985; Staggers & Norcio, 1993), but there is a developing method of combining verbal/written protocols with a drawing task to elicit a fuller picture of users’ mental models. Because a user’s mental model is not directly observable, it was necessary to use multiple methods of data extraction that can get to both the verbal and non-verbal representations (Zhang, 2008a, 2008b). The drawing task used in this study was based on the work of Thatcher and Greyling (1998), Papastergiou (2005) and Zhang (Zhang, 2008a, 2008b).

Thatcher and Greyling (1998) explored South African university students’ mental models of the Internet using a questionnaire placed next to the Internet terminals at the university library. The questionnaire asked the students to “draw or sketch” how they thought the Internet was structured or how it worked, and to annotate those drawings. Fifty-one participants responded correctly to the questionnaire. The authors organized the drawings into six categories with each having a representation derived from the data: 1) Interface and Utilitarian Functionality, 2) Central Database, 3) User to the World, 4) Simple Connectivity, 5) Simple Modularity, and 6) Modularity and Networking. The authors found that experienced users have more complete and detailed mental models, and they suggested that an understanding of users’ mental models can be used to design Internet interfaces that can reinforce accurate and complete mental models.

Using a written questionnaire and an individual drawing task to elicit Greek high school students’ mental models of the internet, Papastergiou (2005) built on the mental models identification work of Thatcher and Greyling (1998). Three hundred and ten students completed the drawing task. The resulting data were categorized and analyzed to produce eight categories of mental models of the Internet: 1) non-digital entity, 2) services and content, 3) user’s computer, 4) huge remote computer, 5) connection between two computers, 6) few computers linked through a connection point, 7) computer network, and 8) network of computer networks. The author found that the drawings revealed misconceptions that emerged from the survey and that high school students formed utilitarian mental models rather than structural mental models of the Internet.

Recent research (Zhang, 2008a, 2008b) expanded these earlier methods to include a semi-structured interview and two search tasks that explored 44 undergraduate students’ mental models of the Web as an information retrieval system. Based on the drawing task, the author identified four categories of mental models of the Web: 1) technical view, 2) functional view, 3) process view, or search engine centered view, and 4) connection view. In addition, Zhang combined the data from multiple data collection methods to
derive a collective mental model of the Web, suggesting that there is a tangible structure that can provide a holistic view of students’ conceptual understanding (Zhang, 2008b).

Together, these studies revealed the importance of using drawing as a technique to elicit mental models and showed how drawings can represent people’s understanding of particular concepts. The first two studies (Papastergiou, 2005; Thatcher & Greyling, 1998) used a written questionnaire to gather additional data while the third (Zhang, 2008a, 2008b) included a semi-structured interview and search task, which helped the researcher probe deeper and provided additional dimensions to the data.

RESEARCH QUESTIONS
This study explores the following research questions:

1. What are teens’ visual representations of mental models of public library websites for teens (TLWs)?
2. What is the role of teens’ favorite websites in determining prior knowledge and experience as it relates to teens’ design and use preferences for TLWs?

METHODS
Research Locations
The present study was conducted with teen participants (13 to 15 years old) from three public libraries in three different cities within the state of New Jersey. The cities (here called “North,” “Central,” and “South”) represented diversity in terms of location, population size and demographic characteristics. The population in North was over 200,000; in Central it was below 50,000; and in South it was below 25,000 (U.S. Census Bureau, 2012). In Central, the median family income (~$156,000) and home value (~$600,000) were significantly more than the other two locations, the state of New Jersey and the country. The North had the lowest median family income (~$58,000), but a median home value (~$360,000) greater than the state and the country. The South’s median family income (~$74,000) and owner-occupied home value (~$239,000) were above the country but below the state. All three cities had a White majority but two of the three cities’ (Central and South) White population was over 50%. The North’s second largest group, Black or African American, represented 25.8% of the population, and the Central’s second largest group, Asian, represented 37.7% of the population. The South’s White population was over 80%, which was significantly greater than any of the other races identified.

The three public libraries selected also represent three public library service population ranges derived from the Institute of Museum and Library Services’ (IMLS) U.S. public libraries survey (Institute of Museum and Library Services, 2009). The North public library was a municipal library with one main library and nine branch libraries, including regional and neighborhood libraries with a library service area of 100,000 – 249,999. One branch library was used for the study because of its teen center and access to teens within the library system. The Central public library was a county library system with one main library and eight branch libraries with a library service area of 25,000 – 49,999. One branch library servicing the community was used for the study because it included a large teen population. The South public library was a municipal library with one main library and no branch libraries with a library service area of 10,000 – 24,999. The main library was used for the study as it provided library services to the teen population of the community.

Participants
Thirty teens (17 females, 13 males) ages 13 to 15 years old participated in the study. Participants were recruited based on their experience using the public library and the Web. There was no requirement that their local public library needed to have a TLW because mental model research suggests that teens will formulate their own expectations based on their previous experiences using websites and the public library even if they had never used a TLW.

<table>
<thead>
<tr>
<th>Location</th>
<th>Gender</th>
<th>Ages 13 yrs.</th>
<th>Ages 14 yrs.</th>
<th>Ages 15 yrs.</th>
</tr>
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<td>1</td>
<td>3</td>
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<td>1</td>
<td>3</td>
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<td>Totals</td>
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</table>

Table 1: Participants by Age, Location and Grade

Data Collection and Procedures
Participants were first asked to complete a background questionnaire, followed by the drawing task, and then the semi-structured interview. Each participant was scheduled for a two hour session in the public library’s conference room. Participants were given as much time as they needed for each task, but no more than the two hours total to complete all three tasks. No participant ran out of time and all completed each part of the study at their own pace. As an incentive, participants were provided with a modest compensation and a thank you letter for completing the study.

Written Questionnaire
At the beginning of the research session, participants completed a written questionnaire regarding demographics, internet access, use of the public library, and use of public library websites, including TLWs.

Drawing Task
Each participant was given a scenario-based drawing task where the participant role was as a member of a library youth advisory board asked to “Please draw or sketch your design for a public library website for teens.” After
completing the drawing, participants wrote descriptions of their drawings.

Semi-Structured Interview
The semi-structured interview asked participants to describe their drawings in detail, their main ideas/goals, what they expected other teens to know prior to using their websites, and any additional information that they were unable to represent in the drawing. Next, participants were asked to identify and describe their favorite website(s) for personal use before demonstrating it on the provided laptop computer. Analysis of teens’ favorite websites provided an additional understanding of teens’ prior knowledge and experience and how it may affect teens’ mental models of public library websites. Finally, participants were shown three current TLWs and asked to explore and evaluate them individually and comparatively using think-aloud protocols.

Data Analysis
Each interview was audio recorded and transcribed. Click-through website data were captured using a laptop computer with screen capture software as the participants navigated the websites. Each drawing was photographed and digitized. Drawings and transcriptions were imported into NVivo 9 for coding and analysis. Open coding was used to code favorite websites according to the emerging themes in the data. Descriptive statistics were used to analyze the questionnaire data. The audio transcriptions and drawings were analyzed using standard thematic analysis (Braun & Clarke, 2006) techniques. Also called simply “qualitative content analysis” (Wildemuth, 2009), the process includes repeated readings of a body of qualitative data to develop and refine thematic categories and a coding scheme to address a set of research questions. It is useful for analyzing both word-based and visual (drawings-based) data (Leech & Onwuegbuzie, 2008).

RESULTS
Public Library and Internet Experience
All participants were frequent visitors of the public library, visiting in person daily (30%), a couple times per week (50%) or a couple times per month (20%). While at the public library participants borrowed, returned, and read books, did homework, played games, hung out with friends, and went online. Participants went online daily, including multiple times per day, or a couple times per week. Most participants used a laptop computer (53%) to go online and the majority of participants went online from home (70%). Of the participants that went online from home, 43% used a laptop, 20% used a desktop and 7% used a mobile phone. Twenty-seven percent of participants went online from the public library and 17% of those used a desktop computer.

Mental Models of Public Library Websites for Teens
Based on participants’ drawings and descriptions, five mental model styles were identified. Three of the five mental model styles were similar, but not identical, to three of the four styles identified by Zhang (2008a) (“Functional view,” “Process view,” and “Connection view”). Research in this area has focused mainly on mental models of the Internet (Dinet & Kitajima, 2011; Papastergiou, 2005; Zhang, 2008a, 2008b), but this study is focused on mental models of TLWs. It drew from previously identified mental model styles but adjusted them based on the data. Two additional mental model styles, “Portal view” and “Information Discovery view,” were identified. The set of five styles below builds on mental model styles of the Internet, but narrows the focus to a specific context.

1. Single Functional View (Figure 1) – Teens saw the TLW as a place to accomplish a particular task-oriented goal. They drew websites focused on a specific activity/subject that they enjoyed such as creating music, picture frames and graffiti. They expected users to visit the websites because they were interested in the specific subject.

![Figure 1: Single Functional View of TLW](image)

2. Process View (Figure 2) – Teens saw the TLW as search-engine centered. They drew websites that predominately used search to find information. They expected users to arrive with an information need.

![Figure 2: Process View of TLW](image)
3. **Social Connection View (Figure 3)** – Teens saw the TLW as a means of communicating with others across the Web. They drew websites focused on chatting with friends and expected users to chat about books and other subjects with their friends.

![Figure 3: Social Connection View of TLW](image)

4. **Portal View (Figure 4)** – Teens saw the TLW as a portal leading to available resources that the library had to offer. They drew websites that were button/link-centered with a section devoted to featured content. They expected users to click on the buttons/links to access the available content.

![Figure 4: Portal View of TLW](image)

5. **Information Discovery View (Figure 5)** – Teens saw the TLW as providing all the information they needed about the library and the world, immediately and dynamically. They drew websites with multiple, constantly updated, dynamic sections devoted to current events, news, activities, and recommendations. They expected users to receive the most current information upon arrival on the website and users could click into a specific item for additional information.

![Figure 5: Information Discovery View of TLW](image)

The distribution of the mental model styles by sex (Figure 6) showed that the portal view was the most popular mental model style for both males and females. For males, the process view followed by the information discovery view were the next popular mental model styles. For females, the information discovery view followed by social connect and single functional view were the next popular.

![Figure 6: Distribution of Mental Model Styles by Sex](image)

**Favorite Websites**
The participants were asked to identify their favorite website for use in their daily lives. There were no restrictions regarding the type or number of websites that
they could identify, and responses were almost equally divided between participants selecting one or two favorite websites, with two participants selecting three favorite websites. Nineteen unique websites were identified, but Facebook, the social networking website, represented one of the favorite websites of almost 50% of the participants.

<table>
<thead>
<tr>
<th>Favorite Websites</th>
<th># of Teens</th>
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<tbody>
<tr>
<td><strong>Social Networks</strong></td>
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<td>Facebook (<a href="http://www.facebook.com/">http://www.facebook.com/</a>)</td>
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Table 2: Favorite Websites

**Favorite Websites: Reasons for Visiting**
The teens spent a good portion of their daily lives on their favorite websites. They went to their favorite websites to talk with friends and family, play games, watch videos, read the news, learn a topic, and to be entertained.

**Theme: Social Connection**
Facebook was the leading favorite website. Teens used it to remain up-to-date and to connect with friends and family regardless of location. As one of girls said, “I kinda like it how people can be connected even without actually like the human connection, just like the internet.” (PID008)

The social connection can be seen in most, if not all, of the favorite websites. For the author website, the teen chatted with her friends and the author of her favorite books:

I get to talk to the author as well. So, she's on it daily. We get to talk to her and ask her about her inspiration and how she learn [sic] from the books. (PID003)

For the gaming websites, teens interacted and chatted with others while playing games. As one of the boys explained, his favorite website enabled him to play “the games, and to talk to my friends. Like Cafe World, Farmville.”(PID031)

For the email website, specifically Gmail, teens chatted with their friends and commented on each other’s documents:
And for Gmail, well, I just email my friends or just chat with them or like I’d email them. I have a lot of friends in Chicago, so I talk to them, like conversations on email. (PID011)

For YouTube, the social connection came in the form of commenting on videos and following video creators that the teens liked.

**Theme: Entertainment and Learning**
Teens entertained themselves and explored their own interests online to combat boredom:
So, you get that mix of entertainment and also, sort of, helps you gear yourself towards the future. (PID009)

Teens used their favorite websites not only to be entertained, but also to learn more about subjects of interest. One teen used the Curiosity website to find answers to questions she had about life and the world. Another went to YouTube to watch a video that taught him how to play a song on the piano:
I'm just learning the piano. I usually take my dad's iPad and plop it on the piano and just like look at this guy playing. (PID007)

In some cases, favorite sites combined entertainment with learning. For example, one teen played educational games on the Primary Games website to learn math and other subjects.

**Theme: Frequency**
All participants visited their favorite websites either daily or weekly. Seventy-seven percent of participants (23) visited their favorite websites at least once per day. Twenty percent of participants (6) visited their favorite websites multiple times per week. One participant indicated that there were technical difficulties preventing him from visiting his favorite website from home, but even he was able to visit his favorite website regularly through a class in school.

**Favorite Websites: Likes and Dislikes**
Teens were asked what they liked or disliked about their favorite websites. In addition to the ability to communicate with friends, teens liked simplicity of design and use, clear
organization, and multiple use opportunities. They disliked advertising (ads) and inappropriate content.

**Theme: Simplicity and Organization**

Simplicity and organization were described in terms of ease of use and lack of information overload where teens were able to find what they needed easily without being overwhelmed by information:

> It's really easy to use, you know. Like everything is there for you. You don't really have to like figure out anything. (PID016: Gmail and Yahoo)

The teens emphasized that website content should be well-organized and clutter-free:

> Everything is all organized. It's not just cluttered. It's not clustered or anything. It's nice, spread out. (PID007: YouTube)

**Theme: Opportunities**

Opportunities were described in terms of available possibilities for interaction and activity while on the website, particularly different actions associated with the site. This applied to all aspects of the website, including user accounts, content and design. For example, the gaming websites offered multiple types of games that teens could choose to play each time they went to the site. Even if a teen chose to play a single game, within that game teens wanted multiple possibilities for variety each time:

> Well, they have all these items and you can go on the grand exchange, it's like this big trading center thing. And the skills, how you can train your skills. There's definitely things to do with that. And I love the mini-games. (PID018: RuneScape and YouTube)

In addition, opportunities referred to the currency of the content on the website:

> Like how you go on a certain website and they only post things like once every week, whereas this site, they have multiple people actively involved making articles and trying to tune up the website, almost every second of the day. So, every time you come back here, it's like a new thing is up and you're not bored every time you come. (PID017: Zelda Informer and Facebook)

**Theme: Ads**

Teens disliked ads on their favorite websites and would remove them if they could:

> When you watch a video, sometimes, it'll stop it and then these ads will come up right before you watch the video. And it takes forever. (PID021: YouTube)

However, there was a grudging acceptance that ads were an unavoidable part of the user experience:

> Obviously, I'd try to remove the advertisement, but I guess that doesn't really count. (PID015: Yahoo and Google)

**Theme: Inappropriate Content**

In addition to ads, the teens disliked inappropriate content on their favorite websites, specifically content that used inappropriate language or was mean-spirited. In more than one case, participants stated that people posted mean comments or inappropriate pictures that they would need to delete, and in some cases could not delete:

> You can only delete your answers, but if someone says something mean to you, then you can't get rid of it. Cause it's always out there. (PID012: Formspring)

Some of the participants expressed the desire for community moderators to remove inappropriate content:

> Even though it's their choice to read the comments, YouTube doesn't really protect against swearing and words that could offend people. (PID007)

**Favorite Websites: Change**

When asked what they would change about their favorite websites, responses ranged from very specific changes to no changes at all. For example, some of the teens would change content that seemed random or irrelevant to them, including ads:

> Maybe, how they have random stuff here. Like top ten, I don't really need to know about that stuff. (PID013: Curiosity)

In terms of design, the theme/background and/or the color of the website was one unifying area of change for teens, but there was considerable variance in terms of preferences. Some teens preferred a specific color:

> How would I change it? Put more color into it. And make Facebook not blue but green. ... Why green? Green because, blue is not that interesting. I don't think it's that interesting. (PID019: Facebook)

Other teens wanted more control over the choice of color:

> And then, like, on the white space the colors can change or something like that. Nothing necessarily big, but just entertaining. Like if you want a blue background instead or something like that. (PID020: YouTube)

Overall, the teens spent a lot of time on their favorite websites and enjoyed most aspects of them. Understanding what they liked, disliked or would change about their favorite websites provides the background necessary to understand teens’ previous experiences and knowledge and how that may influence their mental models of TLWs.

**DISCUSSION**

Looking at favorite websites through the lens of the teens’ drawings, there were similarities that confirm that teens drew inspiration from their favorite websites for their TLW design drawings, whether they explicitly stated the
influence or not. Their mental models and favorite websites tended to share similar goals, designs, and navigational structures. For example, the simplicity of the Google website design can be seen in the design of the process view (Figure 2) mental model. Search is the major focus of the design with very minimal additional options available. Teens that provided process view models tended to prefer sites with similarly simple designs.

The Portal view (Figure 4) and the Information Discover view (Figure 5) mental models represent examples of the opportunities, entertainment and learning themes discovered in the favorite website analysis. For example, the teens’ favorite websites MiniClip (Figure 7), a gaming website, and CNN (Figure 8), a news media website, were similar to the Portal view and the Information Discover view.

The use of favorite websites to elicit mental models addressed issues of past experience with a system beyond a single use experience. Teens typically used their favorite websites every day and sometimes multiple times per day. They understand how websites work for them within their personal context, and as such it influences their expectations and mental models of TLWs.

The results show that teens want to spend their time on websites that are easy to use, content appropriate, ads free, customizable and interactive. Teens also want to socialize online with friends and family, be entertained and learn new things. These findings suggest that TLWs should be designed to reflect particular mental model styles to address the multiple ways teens expect to use and interact with the website. For example, a teen with a single functional mental model is likely to be focused on learning, doing, or interacting with a specific goal and content domain when using a TLW. The teen who is going to the author website to find the latest book from a favorite author is also expecting to communicate with friends and the author about that book while on the website. Thus, it’s important to incorporate these themes within the design of the TLWs to meet teens' wide-ranging needs and expectations.

**STUDY LIMITATIONS**

It is important to note that the results from this study are not fully generalizable to the larger population of U.S. teens. However, they are transferrable to similar research conditions and contexts; the degree of transferability will vary as the research context varies. Further, since the participants volunteered for the study, they tended to be frequent public library users with positive views of public libraries. Non-users of the public library were not recruited, and as such the study does not include the non-users’ perspective on TLWs.

**CONCLUSION**

Existing research on mental models has focused on the Internet as a whole as the area of study and has relied on extracting previous knowledge and experience through information retrieval search tasks. The current study has focused on a specific area of the Web (public library websites for teens) and has extracted previous knowledge and experience through analysis of teens’ drawings and of their favorite websites. Understanding teens’ favorite websites helped to identify the five mental models styles of TLWs extracted through the drawing task and suggests that TLW designers should base their designs on teens’ broader website design and use preferences in order to increase teens’ interest in using TLWs.

In addition to making TLW design based more closely on teens’ website design and use expectations and preferences, it seems that libraries need to do a better job of advertising the existence of their TLWs. When asked if they used the public library’s website, 70% of participants stated they did, but when asked if there was a teen section, an
overwhelming 77% stated that they didn’t know. Of the three public libraries where teens were recruited, two did have website sections dedicated to teen services, but only a minority of the teens in these libraries knew of their existence. As a result, it appears that even teens who use general public library websites are often unaware that there might be specific website sections dedicated to teen services.

This paper is an early effort to understand the role of favorite websites in determining teens’ mental models of TLWs. Future research will explore Web objects of mental models and favorite websites to identify overlap, and identify specific steps designers can take when incorporating mental models of TLWs in their designs.

REFERENCES


