Task-based Models of Children's Information-seeking Behavior in Digital Libraries

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This paper presents four empirical task-based models of Arabic-speaking children's information-seeking behavior in using the International Children's Digital Library (ICDL). Children performed four tasks that varied by type and structure. The models consist of seven modes of behavior and a range of moves associated that characterized children's behavior. Included are affective states before and after using the ICDL. Children's behavior was iterative and non-linear. The type and structure of the tasks influenced children's information-seeking behavior. Implications are made for practitioners, school teachers, and researchers.

Keywords: Children, digital libraries, task-based models, ICDL.

Introduction

The field of information-seeking behavior, in general, and that concerns children, in particular, lacks understanding of how children interact with digital information environments at both the national and international levels. While a body of research is available about children's use of various information retrieval systems, no models of their information-seeking behavior in digital environments exist.

Existing models of user information-seeking behavior in digital environments (e.g., Marchionini,1995; Ellis & Haugan, 1997; and Choo, Detlor, & Turnball, 2000) and general models described by Case in his books on information seeking (2002; 2007) are typically geared toward adult users. There are a handful of models applicable to children and young adults. The Big6 Skills (Eisenberg & Berkowitz, 1990) focuses on problem solving, is theoretical in nature, and was developed in a traditional information environment. Kuhlthau' Information Search Process model (2003) is empirical in nature and was initially developed in 1991 based on undergraduate students' information search process and later validated with high school students. However, the model is yet to be validated with younger children. Enochsson (2005) developed a model of six skills that Swedish students regarded as fundamental for successful Web searching skills: language, knowledge about the technology, knowledge about different ways of information seeking, how search engines work, setting goals, and being critical. The model focuses on skills rather than information-seeking behavior. In a recent study, Agosto & Hughes-Hassell (2006) modelled the everyday life information needs of teenagers, but did not explore their information-seeking behavior in using digital systems to meet these needs.

Many researchers argue that information seeking is a task-based behavior because it takes place in context that is determined and motivated by a specific task and its complexity (Kim, 2007; Vakkari, 2003; White, Jose, & Ruthven, 2003; Jarvelin & Ingwersen, 2004; Gross, 2004; Vakkari, 1999; Marchionini, 1995; Bystrom & Jarvelin, 1995). Existing literature on children's information-seeking behavior (Bilal & Bachir 2007a; Bilal & Bachir, 2007b; Chelton & Cool, 2007; Bilal, 2005; Bilal & Wang, 2005; Druin, 2005; Bilal, 2004; Chelton & Cool, 2004; Large, 2004a; Large, 2004b; Bilal, 2003; Shenton & Dixon, 2003; Bilal, 2002a-b; Bilal & Kirby, 2002; Large, Beheshti, & Rahman, 2002; Druin, 2002; Bilal, 2001; 2000; Large & Beheshti, 2000; Large, Beheshti, & Moukdad, 1999; Bilal, 1999; Bilal, 1998; Schacter, Chung, and Dorr, 1998), and of user information seeking, in general (Case, 2007; Case, 2002) lacks a task-oriented model of children's information-seeking behavior in digital environments. This paper is a first attempt towards filling this gap by modelling Arabic-speaking children's information-seeking behavior in using the International Children's Digital Library (ICDL).

ICDL as an international Web interface

The goal of the ICDL (*http://www.icdlbooks.org*) is to build a collection of digital books that will ultimately make every culture and language represented in its collection available to children ages 3-13. To date, the ICDL has a collection of 2451 books in 45 languages including Arabic. The Arabic collection includes 26 books that have been contributed by Bibliotheca Alexandrina located in Alexandria, Egypt. The ICDL has three different interfaces to use for finding books: Simple, advanced, and location. A full description of these interfaces is provided on the ICDL website.

Research Questions

This paper addressed these two research questions: 1. What task-based empirical models can be generated based on Arabic-speaking children's information-seeking behavior in the ICDL, and 2. What impact does the type of task have on children's information-seeking behavior in the ICDL?

Related Literature

This section will focus on two main bodies of related literature on children's use of digital libraries: 1. The ICDL, and 2. Artemis.

1. *The ICDL*

In a recent study, Bilal & Bachir (2007a-b) examined the cognitive, affective and physical behaviors of ten Arabic-speaking children's information seeking and success in using the ICDL to find and read Arabic books. Children performed four tasks that varied in structure (assigned, semi-self generated and fully self-generated) and by type (fact-and research-based). Data collection took place at Bibliotheca Alexandrina located in Alexandria, Egypt. Children's interaction on each task was captured online using HyperCam. Their affective states were elicited during exit interviews. Children's information-seeking behavior was characterized by browsing using a single function; that is, looking under Arabic language from the pull-down menu. Children were more successful on the fully self-generated research-based task than on the assigned or semi-assigned tasks. Older children were more successful in finding information than younger ones. The type of task influenced children's success, time taken, and the number of moves made. Not being skilled in the English

language created a barrier to children's full exploration (i.e., keyword searching) of the ICDL. Children expressed anxiety and uncertainty as to their ability to use the ICDL successfully before using the ICDL, but were certain and satisfied after completing the tasks. Children made recommendations for improving the ICDL to support their information behaviour and needs.

An earlier study by Hutchinson, et al. (2005) examined elementary school children's searching and browsing in two new interfaces developed for the ICDL category browser. One is simultaneous and another is sequential. Children created more Boolean searches in the simultaneous interface than in the sequential interface. Older children were more successful than younger ones, performed the tasks faster, took less time, and needed less assistance in navigating the ICDL. The authors recommended improving the design of subject taxonomies in the ICDL.

In a related study, Reuter & Druin (2004) investigated the searching and book selection behaviors of ninety-six first- through fifth-grade students from the suburbs of Maryland in using the ICDL. Age and gender influenced searching and book selection. Younger children preferred simple and more interactive interfaces; whereas, older children favored more sophisticated interfaces. Children in grades one through five were able to navigate the category structure to browse, but were unable to use Boolean logic. The authors suggested search and browse features to implement in the ICDL for younger children.

2. Artemis

Artemis interface was developed at the University of Michigan to assist students in searching online collections. Artemis allows users to store search results in a workspace, browse collections, search by keyword, and access diverse internal and Web collections. Unlike the ICDL, Artemis is not available in the public domain. Bos et al. (2000) assessed the usability of the first version of Artemis with high school and middle school students. Findings revealed that the students spent time evaluating search results and searched metadata such as document titles, collection titles, and abstracts. Students developed fairly sophisticated search strategies, using both browsing and searching, and constructed multiple keyword searches. Overall, high school students did not use Artemis as often as did middle school students due to long start-up time and access availability only from high school.

In a recent study, Abbas, Norris, & Soloway (2002) examined a group of six graders' use of Artemis from 32 public middle schools. Individual classes and achievement levels influenced children's use. Students who attained a higher grade used Artemis more efficiently and tended to use more searching and organizing scaffolds as compared to lower grade users who used more of collaborative scaffolds. A mismatch was found between the students' search terms and the controlled vocabulary employed in Artemis. The authors suggested that the students' representation scaffolds of search terms be used to learn more about how they represent and express their information needs to the system an how the system should be redesigned to support these needs.

METHOD

A quantitative method was employed to collect data about children's information-seeking behavior in using the ICDL. Children's screen activities on each task was captured using HyperCam, a software package that captures screen activities. A qualitative method that utilized exit interviews elicited children's affective states.

Participants

Ten Arabic-speaking children ages 6-10 participated in data collection. The children were recruited by staff at Bibliotheca Alexandrina's Children's Library. Four children were male and six were female. One child was six-years old, three were seven-years old, two were eight, two were nine, one child was nine and a half years-old, and one was ten-years old. Children possessed adequate level of computer and Internet experience. Only one child was familiar with the ICDL. All children had limited English language skills.

Procedures

Data collection took place in late December 2004 at Bibliotheca Alexandrina Children's Library. Children were divided into two groups of five and their use of the ICDL was scheduled on two separate days. After signing consent forms, each group was escorted to a computer lab equipped with five PCs. Children were verbally introduced to the tasks and given a written task sheet with instructions. Each child's screen activities on the four tasks was recorded, saved, replayed, and burned onto CDs. Children were interviewed upon completion of the tasks and their affective states were elicited.

Tasks

Children performed four tasks that varied in type (fact- and research-based) and in nature (assigned, semi-assigned and fully self-generated). The fact-based assigned tasks were: 1. How many books does the ICDL have in the Arabic language, and 2. Find a book in the Arabic language named *Dima* and open the first page of the book. The research-based semi-assigned task was: Find a book about *animals* in the Arabic language and write the name of the book on your sheet, and the research-based fully self-generated task was: Find any book in the Arabic language and read as many pages as you can.

Data Analysis

Each child's activities on each task was coded and analyzed. Each action a child made on each task was input into an excel sheet that included the sequence of the action, a description of the action, and comments/observations about the action. This process resulted in forty combined excel sheets on the four tasks (4 tasks x 10 children). We categorized each action under the 7 modes of information seeking-behavior developed by Bilal, Sarangthem, & Bachir (2008-in press).

Since no models of children's information-seeking behavior in digital environments exist, we reviewed selected models of adult user information seeking-behavior that are often used as a framework for generating new models (Ellis & Haugan, 1997; Choo, Detlor, & Turnball, 2000; Marchionini, 1995) and adapted certain processes from these models to build the models described in this paper.

Results

This paper addressed two research questions: 1. What task-based empirical models can be generated from Arabic-children's information-seeking behavior in using the ICDL?, and 2. What impact does the task have on children's information-seeking behavior? The results are reported within the context of each question.

1. Task-based models of Arabic-speaking children's information-seeking behavior.

The task-based models shown in Figures 1-4 show the 7 modes that characterized children's information-seeking behavior in the ICDL and the range of moves associated with them. The modes are indicated **M**, the moves as **MV**, and the transitions between the modes as **T**. The **Start** mode in each model is preceded by an information need, which is a priori for seeking information on a task (Bilal, 2002; Marchionini, 1995; Bystrom & Jarvelin, 1995; Belkin, 1980). A description of the modes and moves are as follows:

Start (M1): This is the first step for beginning a task after a child recognizes the information need. It generally begins with **scanning (M1V1)** the features of the ICDL homepage such as icons, Simple search, Advanced search, and Keyword search. The resulting action is **selecting (M1V2)** the Simple search feature by clicking on it. Children return to the homepage to restart a task or to choose a different interface feature to explore.

Recognize (M2): In this step, a child **scans (M2V1)** the language pull-down menu from the Simple Search interface and **selects (M2V2)** Arabic language. This move results in a display of thumbnails of Arabic books.

Browse (M3): In this step, a child scans the list of book thumbnails and moves to the next page to view additional thumbnails. Here two types of browsing are observed: **Directed** and **Semi-directed**. **Directed** browsing includes **viewing (M3V1)** and **verifying (M3V2)** the information. It is guided by a target such as the assigned fact-based tasks. **Semi-directed** browsing consists of **examining (M3V3)** the information found. It is achieved when the target is less definite such as the behavior observed on the fully self-generated open-ended task.

Differentiate (M4): In this step, a child views Arabic books and selects the book that meets the need of the task. Two types of discrimination behavior were observed: **Directed** and **Undirected. Directed** differentiation consists of **viewing (M4V1)** and is similar to the directed browsing in that it is focused and has a target such as finding information for the known-item tasks (tasks 2 and 3). **Undirected** differentiation has very little focus such and is characterized by **sweeping (M4V2)**. This type of behavior occurred on the fully self-generated open-ended task that entailed viewing many books before deciding on a book of interest to read.

Read (M5): In this step, a child reads the title of a book to answer task 2 (known-item title, *Dima*), or reads the first three pages of a book to answer task 3 (known-item subject, *Animals*), or reads one or two books on a topic of interest for task 4 (fully self-generated, open-ended). Reading results in using a source and/or learning about its content. For example, a child opens a page of a book, reads it, learns about the content, and moves forward to read the next page. Two types of behaviors are observed in reading: **Directed** and **Undirected**. Directed reading consists of **viewing (M5V1)** and engaging in reading an entire book or specific pages of it. This behavior is seen on the assigned fact-based tasks. **Undirected** reading is characterized by **flipping (M5V2)** book pages and sometimes without actually reading the text. Flipping takes less time than viewing and engaging in reading. This behavior occurs frequently on the fully self-generated research-based task.

Explore (M6): In this step, a child clicks on selected navigation controls (e.g., icons, buttons, arrows, etc.) embedded in the ICDL and/or the Internet Explorer browser to discover their purposes. Exploration occurs throughout information seeking, but is more frequent during reading. For example, a child clicks on the plus sign (+) icon located at the top navigation bar of the screen and finds that a page is amplified. The child then clicks on the minus sign (-) and the page returns to its original size. We classified this move as **navigating (M6V1).** We named children's use the ICDL buttons for back arrows and the Internet Explorer Back button as **backtracking (M6V2)**.

Finish (M7): In this step, a child ends a task and moves to another one or stops upon completion of task four. Finishing sometimes results in note taking, which occurred when children are instructed to write down the answers for the fact-based tasks (1 and 3) on the task sheet.

2. *Task impact on children's information-seeking behavior in the ICDL.*

The models show major differences in children's information-seeking behavior across the four tasks (Figures 1-4). As seen in Figure 1, children used five out of seven modes of behavior on Task 1, performed only three moves associated with the *Explore* mode, and made a few transitions between the modes. At the *Start* mode on Task 1, children made the highest number of moves that included Scanning and Selecting (MV=25) followed by Directed Viewing moves under the *Browse* mode (MV=13). Directed Viewing was target-oriented and influenced by the type of this task, which was fact-based (find the number of Arabic books in the ICDL).

On Task 2, children's behavior was characterized by the 7 modes of information seeking (Figure 2). Children's browsing increased from MV=13 on Task 1 to MV=40 on this task; however, the type of browsing moves remained the same (View/Verify). Children made MV=11 moves under the *Differentiate* mode that were both Directed (View) and Undirected (Sweep). Reading was minimal on Task 2 (MV=7). Children's Navigation and Backtracking moves associated with the *Explore* mode were higher on this task (MV=13) than on Task 1 (MV=3). The overall children's behavior on Task 2 was non-linear and more iterative than it was on Task 1.

Children made transitions among the various modes of information seeking on Task 3, from *Browse* to *Differentiate* and vice versa, and from *Differentiate* to *Read* and vice versa, among other ones (Figure 3). Task 3 was open-ended, semi-assigned, and asked children to find a book of interest about *Animals* and to transcribe the name of the book on the task sheet. Children's browsing moves were both Directed and Semi-Directed (MV=36) and *Differentiation* moves were Directed and Undirected. The latter moves were higher on Task 3 as opposed to those on Task 2 (MV=29 vs. MV=11, respectively). Finding a book of interest about Animals resulted in more reading than anticipated (MV=47). Reading moves were both Directed (Viewing) and Undirected (Flipping). Children's exploration seen under the *Explore* mode was higher on Task 3 (MV=21) than that on Task 2 (MV=13). Overall, children's behavior on Task 3 was much more iterative and non-linear than it was on Tasks 1 and 2. The more open-ended the task was, the more iterative moves and transitions between the modes are observed in the models.

On Task 4, children's information-seeking behavior was similar to that on Task 3, with the exception of reading shown under the *Read* mode (Figure 4). The highest number of moves children made on Task 4 were associated with the *Explore, Browse, Differentiate,* and

Read modes. Reading moves were both Directed (View) and Undirected (Flip). The highest number of reading moves are on Task 4 (MV=187). This is not surprising because the task was open-ended and fully self-generated, allowing children to select their own book of interest on any topic and to read as many pages as they could. Children's overall behavior was non-linear and iterative across most of the modes of information seeking.

Conclusion and Implications

The seven modes that characterized Arabic-speaking children's information-seeking behavior in the ICDL and the various moves associated with them are based on the general model of Arabic-speaking children's information-seeking behavior in using the ICDL (Bilal, Sarangthem, & Bachir, 2008, in press). The general model is based on the results of the studies by Bilal & Bachir (2007a-b). The models will be validated in future research with children of different cultural background.

The task-based models are empirical in nature and should serve as a framework for building holistic task-based models of children's information-seeking behavior in digital environments. Our models benefited from existing models of adult user information-seeking behavior in digital environments, especially those by Marchionini (1995), Ellis & Haugan (1997), and Choo, Detlor, & Turnball (2000). Due to space limitation, we did not compare our models with these models.

The models represent children's information-seeking behavior in using the ICDL and have implications for practitioners and school teachers as they may assist these professionals to become cognizant of the non-linear nature of children's information seeking in digital environments. Steps children are asked to follow in the research process should be flexible to allow for exploration and discovery. A variation in task assignment should be provided to children to uncover how their information seeking behavior varies across tasks and, determine the type of professional assistance they need to support the behavior.

The models show negative affect experienced by children before using the ICDL and positive affect upon completion of a task. Future research should explore the progression in children's affective states at different stages of the information-seeking process to identify whether these states influence their cognitive behavior. Practitioners and teachers should become aware of how positive and negative affect may influence children's information seeking, especially when asked to use information systems that are unfamiliar to them, and to provide effective strategies to help them cope with negative affect (Bilal, 2007; Nahl & Bilal, 2007).

Researchers interested in exploring children's and young adults' information seeking and use of resources in various digital interfaces are encouraged to use the task-based models described in this paper and validate them. Research is being planned by the first author to test the general and the task-based models with Arabic-speaking children in Lebanon in using the Arabic version of the ICDL.

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Statement of Originality

This statement certifies that the paper above is based upon original research undertaken by the authors and that the paper was conceived and written by the authors alone and has not been published elsewhere. All information and ideas from others are referenced.
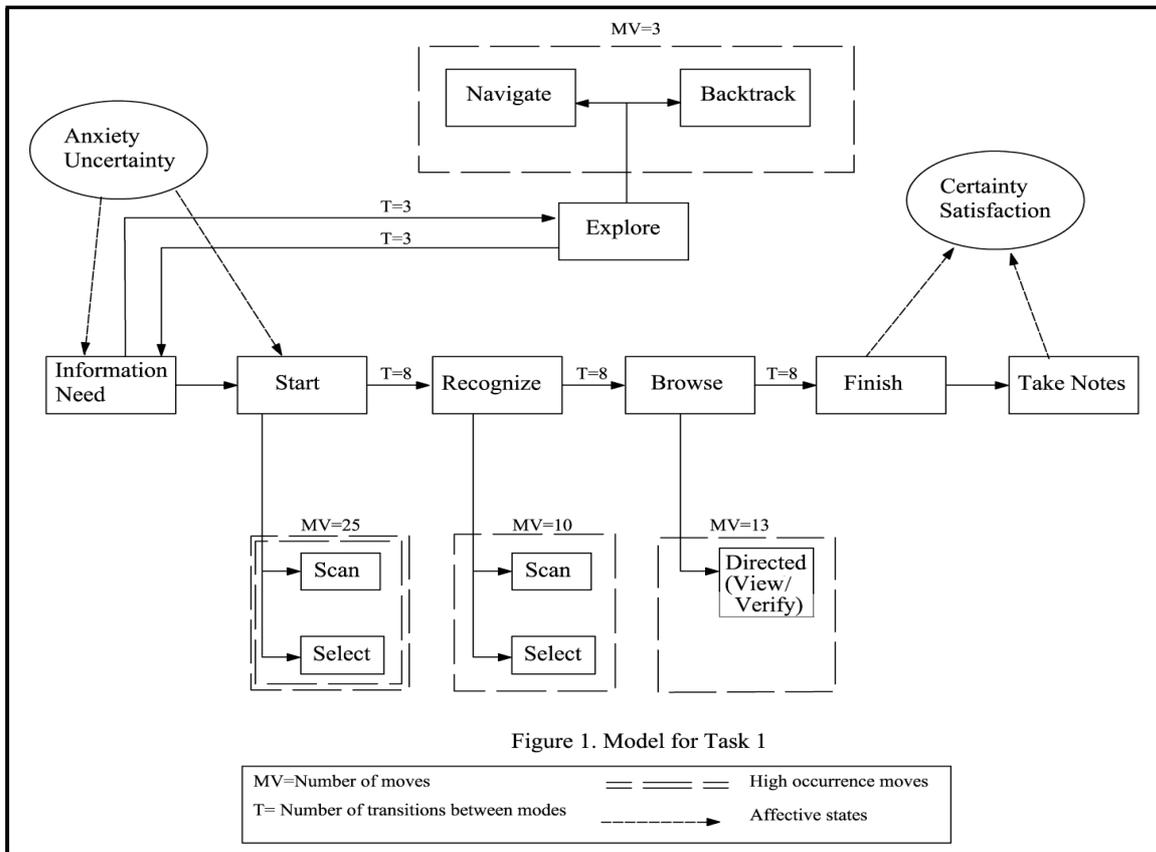
Appendix

Figure 1. Model for task 1.

Figure 1. Model for Task 1

MV=Number of moves   High occurrence moves
T= Number of transitions between modes   Affective states

Figure 2. Model for task 2.

Figure 2. Model for Task 2

MV=Number of moves   High occurrence moves
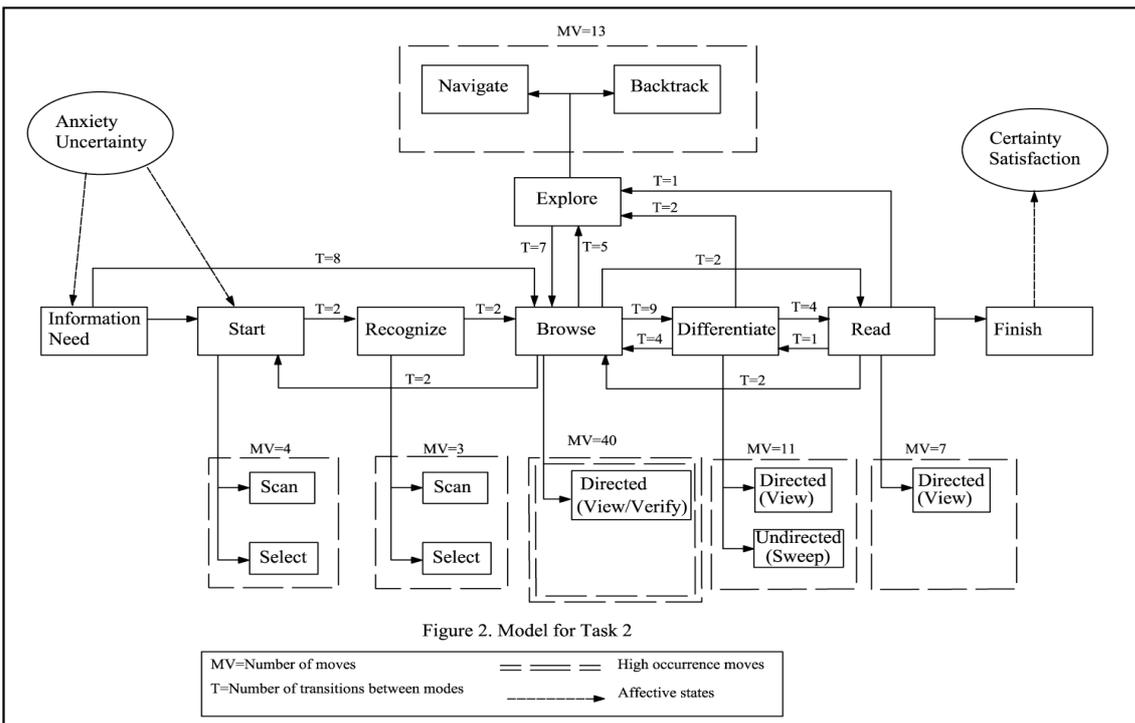T=Number of transitions between modes   Affective states
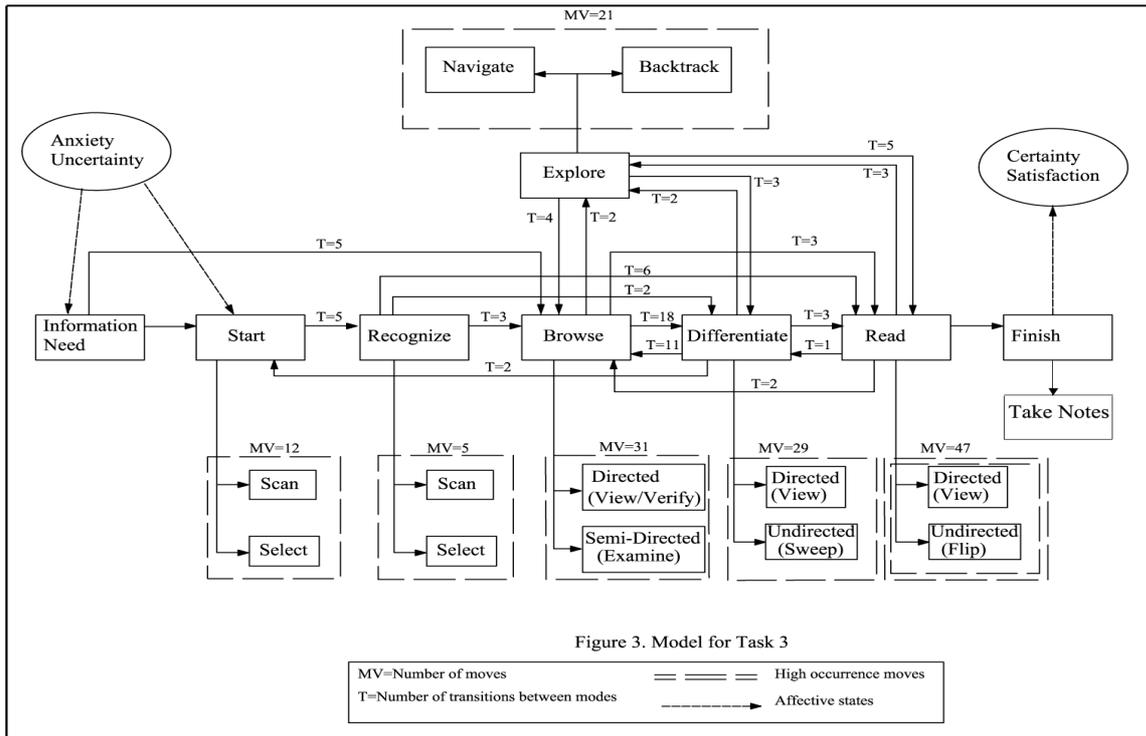
Figure 3. Model for task 3.

Figure 3. Model for Task 3

Figure 4. Model for task 4.

Figure 4. Model for Task 4