ABSTRACT

Title of Document: INTERNET SEARCHING IN CHILDREN AND ADOLESCENTS: A LONGITUDINAL FRAMEWORK OF YOUTH SEARCH ROLES

Elizabeth Foss, Doctor of Philosophy, 2014

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The current landscape of literature investigating youth Internet searching focuses mainly on how youth search in classrooms or libraries at a single point in time and highlights problems youth encounter, rather than taking an expansive view of the entire search process. This research uses a *framework of searching roles,* or patterns of search behavior, to provide a complete picture of how youth behave as searchers in the home environment. The searching behavior of the youth participating in this research is examined by viewing the *whole searcher,* where search problems are important, but equally important are factors such as affect, context, and the process of search.

This longitudinal study examined participants at ages 7, 9, and 11 in 2008 to 2009 and again at ages 10 to 15 in 2012 to 2013. The searching behaviors displayed during the study's in-home interviews were analyzed according to qualitative methods that evolved throughout the research. Results of the research provide a comprehensive picture of how youth search roles and search behaviors change over time, and through case study analysis of selected participants. The research also provides in-depth description of how individuals change as searchers over time. Additionally provided is a graphic to summarize the main characteristics of search roles in youth searchers. This research concludes with recommendations to adult stakeholders such as teachers, librarians, search engine designers, researchers, and parents to aid in promoting search literacy for youth.

INTERNET SEARCHING IN CHILDREN AND ADOLESCENTS:

A LONGITUDINAL FRAMEWORK OF YOUTH SEARCH ROLES

By

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There is much to be said for a friend who will not only tolerate, but actively encourage, a doctoral student in discussing their particular area of research. Almost daily

throughout the past year, Lindsay Fitzgerald asked how my work was progressing and was willing to listen to my lengthy answers. I hope I have been as reliable a friend, and if not, that I can amend for the year-long interruption to our irrelevant banter.

My mother, Karen, was the Director of the Catawba County library system in North Carolina until her retirement this year. Some of my favorite childhood memories are of weekly visits to the new library in downtown Tallahassee. Mom would let me check out as many books as I wanted, even if I needed help to carry them all home. My father, Thomas, built his career around helping organizations use and analyze information produced by computers. Dad's interest in technology surrounded my siblings and me as we grew up, and our house always had the latest computers and the fastest Internet. It is no coincidence that I have focused my education in the field of HCI, stopping along the way for a degree in Library Science, as these fields so closely reflect those chosen by my parents. I appreciate their love, support, and encouragement, and I hope I will remain as easily influenced by their choices in years to come.

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A Failed Search

A 7-year-old boy is searching for dolphins. "…I don't know how to spell it…." He types the letters [do]. "There's no dolphin…" He props his chin in his left hand. "I don't know…" Then he sits up and types an [l] in the text box and stares at the screen for 45 seconds. "Still no dolphin!" The boy adds an [f] to the text box, clicks on search, and looks through the autocomplete suggestions for 10 more seconds….then places his left hand under his chin again and mumbles through it while looking down at the keyboard, "I don't know what to do now."

Finn, July 2009; documented through video and researcher notes (Druin, Foss, Hutchinson, Golub, & Hatley, 2010).

This search took place during an interview with a 7-year old male searcher while he searched for "information on dolphins" in an upstairs office on his family's home computer. This simple, one-step search posed numerous problems for the young searcher. In attempting to type, Finn had trouble visually locating the keys he needed. Finn's scanning of the keyboard for the correct letter, with index finger at the ready, caused much of the time delay in entering his query. Finn was aware of the autocomplete feature

of the search engine, and slowly read through the suggested searches the autocomplete generated. However, he was not able to use the autocomplete to ease his spelling and typing problems after making the mistake of adding the letter [f] to his query, as the suggestions were no longer relevant. Finn additionally had reading comprehension difficulty while examining the autocomplete suggestions. Before accessing a results page, or even completing a search, Finn gave up.

Introduction

The transition of information as housed in traditional sources to being widely available via the Internet creates a need for research into how youth utilize and operate as searchers in a changing information landscape. The Internet represents an information repository that is available to all users, including youth (Cole, 2013). In addition, the Internet provides a broad array of sources for information (Cole, 2013). Youth search in all environments where they encounter the Internet, both in formal contexts such as school, and informal contexts, such as in the home or via their social networks (Lampe, Vitak, Gray, & Ellison, 2012). The availability of mobile technology also serves to increase the contexts in which search is necessary, as youth are beginning to use mobile phones with search capability in greater numbers (Lenhart, Ling, Campbell, & Purcell, 2010).

Unfortunately, search engines and search engine features as they exist now are not optimized for use by young children, and adolescents have different use patterns than do adults, leading to unique searching needs (Foss et al., 2012; Foss et al., 2013). Research has found that children, adolescents, and adults encounter barriers when completing

assigned search tasks (Bilal, 2000; Gross, 2006; Wildemuth & Freund, 2009). Typing and spelling are also barriers to successful searching in children (Druin, Foss et al., 2009; Gossen, Low, & Nürnberger, 2011). Children are less successful with keyword search than with browsing (Bilal, 2002; Schacter, Chung, Dorr, 1998), which is a limitation when considering the prominence of search engines over browsing interfaces, although children have different browsing patterns than do adults (Gossen et al., 2011). Query formulation is another well-established difficulty for young children (Bilal, 2002; Gossen, Nitsche, & Nürnberger, 2012; Large, Beheshti, & Breuleux, 1998). Children also often encounter difficulties with result selection from what is presented on the search results page (Duarte Torres, Hiemstra, & Serdyukov, 2010a; Jochmann-Mannak, Huibers, Lentz, & Sanders, 2010). Additionally, many results present websites that use text with a higher reading level than is possessed by the young searcher (De Belder & Moens, 2010).

Adolescents, while more skilled with reading comprehension, typing, and spelling, face difficulties in regulating emotional responses to search, experiencing frustrations with result selection (Foss et al., 2013) or with controlling the desire to consume unnecessary information (Bowler, 2010). Adolescents searching in the school environment often use the computer for tasks imposed on them by others, which creates searching difficulties (Beheshti, 2012; Gross, 2006), or under other limitations such as those of time (Agosto, 2002). Additionally, the desire in adolescents to use the computer socially through co-located search or by communicating through social networks online can make searching on traditional interfaces an isolating experience (Foss et al., 2013). These problems highlight the need for a change in how we view the experience of search and design of tools for youth searching.

It has been the practice in the past to focus on solving individual problems encountered while searching. A simple example of this is young searchers (and often all searchers) experience difficulty spelling. To alleviate this problem, search tools have been added to search engines that allow the user multiple ways to progress successfully with a search without knowing how to correctly spell a query. These search tools include dropdown menus below text entry boxes containing clickable search terms, automatic retrieval of correctly spelled queries, and indicators at the top of the results pages showing the correctly spelled term (such as the "Did you mean" feature of Google (http://google.com), manifested as "Including results for" on Bing (http://www.bing.com)). Other researchers have proposed and created separate search interfaces designed to be used only by children (e.g. Kammerer & Bohnacker, 2012). Still other solutions have been to create more personalized search results based on browser search histories.

There are downsides to solving young searchers' problems by adding features to the search engine, creating a search engine specifically for children, or relying on device-specific search result personalization. In regards to helpful interface features, searchers experience a wide array of difficulties that differ for each individual. Conversely, the skills that individual young searchers do possess also range widely. Addressing the needs of young users by the addition of features to the search interface is not optimal, as it is likely that for a given individual, unnecessary features will be included and needed features will be missing. While prior researchers have designed child-friendly search interfaces based on the recommendations of the existing literature, when these systems were evaluated, youth demonstrated their wide-ranging needs and skills, some of which

fell outside of the support of the system (Gossen et al., 2012; Jochmann-Mannak et al., 2010). Additionally, in addressing separate interfaces for youth as a solution, children should not be treated as a separate user group, as prior research has shown that children prefer to use the same interfaces that are used by adults (Jochmann-Mannak et al., 2010). The literature surrounding the concept of Universal Design reflects this sentiment, holding that interfaces should be approachable for all users, including children, novice adults, those with disabilities, and older adults (Burgstahler, 2011).

In thinking of personalized search as a solution, differentiating between individual youth is difficult on a computer with multiple users, such as in classrooms where youth are likely to encounter Internet searching, as computers do not always have separated log-ins for individual users. One study showed that in the home, 81% of children and 37% of adolescents share computers with family members (Foss et al., 2013). For mobile devices, 23% of youth who own their cell phone share it with others (Lenhart et al., 2010). Methods used by search interfaces to personalize search, such as Internet browsing history, will be influenced by other users.

The View of the Whole Searcher

In order to arrive at a more viable solution to the problem of facilitating youth searching, it is necessary to conceptualize youth search not as a series of problems, but as a complete experience including not only searching skills and deficits, but also emotional reactions during search (Bilal, 2005; Kuhlthau, 1991, 1993; Nahl, 2004), interests, social influences, beliefs of the searcher, and the context of the search. Understanding affective factors to search, the individuality of the searcher, and the search context are important

when considering how to design systems that better support youth searchers as well as when considering how to approach search education. In a call to apply a broader perspective to research and design within Human-computer Interaction, Nardi (1996) describes the approaches of activity theory. Activity theory seeks to unite the intentions, background, interactions with others, and change over time in a user with the actions taken by that user. Nardi describes, “We have recognized that technology use is not a mechanical input-output relation between a person and a machine; a much richer depiction of the user's situation is needed for design and evaluation.” (Nardi, 1996, p. 4) Within the research of this dissertation, affect, individual interests, influencers, beliefs, and environment are considered as aspects of the search experience that will lead to viable solutions to improve search literacy.

To achieve a wider consideration of context and individual differences, or a view of the whole searcher, this research draws upon the methods of Contextual Inquiry (Beyer & Holtzblatt, 1998). Contextual Inquiry was developed to identify the work habits of adults in the workplace with the end goal of better system design for supporting work, and is here applied to the search work of youth. The strength of Contextual Inquiry methods lies in an examination of work from many different viewpoints combined with a synthesis of the varying perspectives. Using Contextual Inquiry methods to examine search behaviors of youth can ensure a complete examination of all relevant search behaviors.

Need for Longitudinal Research

Currently in the searching literature with youth ages 7 to 17, there is a distinct lack of long-term longitudinal work with the goal of establishing how search behaviors change young searchers. With children, some researchers have investigated general Internet use habits over time (Davies, 2011), but this research does not focus exclusively on search. Bilal (2000, 2001, 2002) engaged the same participants in a series of studies, but this research was not concerned with how the participants changed over time, but rather in investigating the effects of task type on search behavior. Kuhlthau examined the same participants over a four-year period beginning when the participants were high school students (1988). There is work with college students examining affect over the course of a semester (Nahl, 2004), although this research is not with younger searchers and mainly focuses only on affective measures surrounding search. Research with medical students spanned nine months, revisiting the students as they gained domain expertise, but this work again does not reveal whether younger youth narrow the focus of their repeated searches as do older students (Wildemuth, 2004). A study on query-log analysis before and after implementation of new search engine features spanning months (Anick & Kantamneni, 2008) again does not isolate young users. Another query-log analysis study establishes patterns of search in domain experts and non-experts (White, Dumais, & Teevan, 2009), but again does not focus on children or adolescents.

Despite the lack of longitudinal research regarding how children change as searchers over time, this is an extremely important area to explore. The results of longitudinal research on youth Internet search have the potential to make a much larger impact than research conducted at a single point in time. This longitudinal study will

show upcoming and declining trends in the technology and search landscape for youth, which is a key factor when attempting to intervene with youth to improve search literacy and information access. For example, demonstrating that particular search habits are present for only one age group can direct energy away from interventions in those areas. Conversely, search habits that persist across all ages and despite a shifting technology landscape can be leveraged for education and engaging youth.

A longitudinal examination of how youth change as searchers over time is the main focus of this work. Longitudinal research allows for understanding patterns of change through time, whether specific effects increase or decrease, and if change does occur, the magnitude of the change (Menard, 2002). The approach to longitudinal work taken in this research is examining the same participants periodically through time, known as a panel study (Saldaña, 2003). Establishing what search behaviors, values, and habits are consistent in youth when considering age and the larger technology landscape provides researchers, designers, educators, and parents insights when attempting to promote search literacy in youth.

Role Framework of the Study

This dissertation builds on the work of two previous studies examining first how children and then adolescents search on the Internet (Druin, Foss et al., 2009; Druin, Foss et al., 2010; Foss et al., 2012; Foss et al., 2013). In applying Contextual Inquiry to the searching behaviors of youth during the previous studies, my colleagues and I were able to observe broad search preferences and skills displayed by groups of youth. The encompassing whole searcher view we used to understand our data led to the

development of eight search roles children and adolescents display when conducting searches and discussing their search preferences. Search roles are differentiated approaches to search tasks in combination with factors such as affect, social use patterns, skill level, or interest. Search roles can help in understanding areas of deficit or strength, potential areas for improvement, computer use motivations, and preferences for information presentation in individuals. They can also act as guides to achieving the overarching goal of improving search literacy, information access, and better search interface design for youth. The process for identifying roles drawn from Contextual Inquiry, the roles themselves for children and for adolescents, and the characteristics of each role are discussed in full in Chapter 3 of this document.

Research Questions

My colleagues and I have conducted two prior studies in the area of youth searching. These studies established the search roles in children, followed by the search roles in adolescents. In addition, these studies provided insights into the search behaviors surrounding each role. Using the previous findings in a comparative qualitative analysis with the current longitudinal data, the following questions are important to this research:

[RQ1] What are the transitions in search role occupancy over time in youth?

This research question establishes the prevalence of the search roles for youth at different ages, relationships between the search roles, and common and uncommon shifts in role occupancy over time.

[RQ2] What are the changes in search behaviors over time by role and by age? This question uncovers changes in numerous observable or historically recalled search and search-related behaviors, both arising during the longitudinal study and existing in the child study research.

[RQ3] How do changes occur over time for individual youth searchers? Through case study analysis of child and longitudinal study data, this question identifies how changes in search roles and the associated search behaviors occur in individual youth.

Research Contributions

This dissertation research makes the following contributions to the area of youth Internet searching:

[C1] Establishes a framework of search roles that youth display over time.

[C2] Describes changes in search behaviors over time by role and age.

[C3] Provides a graphic associating prominent and stable search behaviors with each role.

[C4] Provides guidance to adult stakeholders based on observed patterns in role occupancy and search behaviors.

Contents of the Document

This proposal is structured as follows:

Chapter 1: Introduction- Current section introducing the research problem, theoretical approach, research questions, and contributions for the research.

Chapter 2: Literature review- Section presenting relevant literature on established youth search behaviors, as well as the prior use of the concept of roles.

Chapter 3: Preceding research- Section presenting two related preceding studies on youth searching, the framework for the identification of search roles, and descriptions of each search role in children and in adolescents.

Chapter 4: Research methods- Section establishing the role of the researcher, the participants in the child and longitudinal studies, data collection procedures, and the analysis phases.

Chapter 5: Results- Section describing the changes in the search role occupancy during the child study and the longitudinal study, and the changes in terms of specific search behaviors between the child and the longitudinal studies.

Chapter 6: Case Studies- Section exemplifying findings pertaining to roles using in-depth analysis of selected cases.

Chapter 7: Discussion- Section presenting updated role descriptions and discussion of the major findings and how they relate to existing research

Chapter 8: Implications- Section addressing the stakeholders to youth search, and including the contributions, limitations, and future directions for the research.

Appendices- Containing relevant supplementary material.

References- Containing the works cited within the body of the document.

Chapter 2: Literature Review

In this chapter:

- Youth searching literature
  - Triggers
  - Search stoppers
  - Result selection criteria
  - The visual context
  - Influencers to search
  - Affect
  - Rules
  - Task type
- Role literature
  - Role theory
- Summary of literature review

Chapter 2 describes the relevant literature surrounding the processes and the context of youth search on the Internet. Findings from prior research with youth ranging in age from 7 to 17 are presented. Literature discussing the prior use of roles concludes the chapter, as the concept of search roles features prominently in this dissertation research.

Youth Searching Literature

Prior literature regarding what is known about youth search aids in situating the findings of the current research. Examining the whole searcher requires accounting for a wide array of factors and the areas of the literature presented below reflect these varied areas. *Triggers* are search initiators or motivators, and factor in at the initiation of the search process. *Search stoppers* are reported or observed reasons to terminate a search. *Result selection criteria,* or reasons for picking a result from the search results page, is another stage of the search process on which prior literature has focused. *The visual*

context examines how children and adolescents use pictures and video during searching. Other focal points for all youth are the people who *influence* search, and for adolescents, how social their searching has become. The *affect* or emotions of youth searchers also allow a view into the whole experience of search. Self-imposed or household *rules* governing searching behavior can affect searching, as can the search *task type* with which youth engage.

Triggers

Different researchers have variously characterized triggers, or motivators, to search, and although researchers title triggers differently, the concept of search initiation is consistent. Bilal (2005) found that children ages 11 to 13 reported four major reasons for using the computer for search: to increase self-confidence, for the challenge of using the web, for discovery of information, and for convenience. Bilal's work does not extend to in-home search use, does not consider search motivators for younger or older children, nor does it re-examine the same children longitudinally. In her pre-computer information seeking work, Kuhlthau (1991) describes triggers as search initiators, arising due to a lack of knowledge or understanding. However, while this characterization of information needs does fit many situations for children, Foss et al. (2012) found that children express a wider range of reasons for initiating search sessions. Children reported triggers such as school, personal interest, playing games, because they were referred by a friend, or due to a daily activity or event in their lives. Slone (2003) found in her study of public library users that children age 7 to 12 were more likely to use computers recreationally and were less goal- or topic-motivated when searching than older age groups.

In the same study of Internet users in a public library, Slone (2003) found that teens aged 13 to 17 were triggered to use the Internet for two major reasons: school and for recreational purposes. Slone's work was based at one time in a library setting, and did not return to the same users at a later time to verify findings. When searching for information for school assignments, Bowler (2010) found in her study of ten adolescents ages 16 to 18 that the students had to balance their curiosity in their topics with a need to refine the amount of information available. One of the findings of this study is that curiosity is not always a positive emotion; adolescents can associate curiosity with feelings of anxiety, and interest in a topic can lead to becoming overwhelmed by information. Adolescents in Foss et al. (2013) reported a wide range of triggers. Most adolescents were triggered to search by school assignments. A unique trigger to adolescents was social reasons for beginning a search, such as interest resulting from conversations with others or to use the computer to watch videos with a friend. Other reasons to search reported by adolescents included personal interests ranging from video games to local news. Overall, in the literature concerning motivators for youth searching, there is no longitudinal work considering how triggers change for the same group of individuals over time, and there is little work considering triggers in the home environment.

Search Stoppers

Examining the reasons youth stop searches can allow researchers, educators, and designers to develop methods to help searchers complete searches successfully. In children, Foss et al.'s (2012) study found the reasons stated for stopping searches ranged

from switching to an activity off the computer, boredom, finding the answer, gathering enough information, because of a parent limiting use, or encountering wrong and unexpected information. Children differentiated between finding the answer and finding *enough* information about the answer, although both led to cessation of a search.

For adolescents, Agosto (2002) explored the concept of search termination. Agosto's study included female adolescents aged 14 to 16. These participants reported stopping their searching for reasons such as finding a website that was acceptable, having physical discomfort related to sitting and searching, boredom, or repetitive information. However, Agosto did not conduct longitudinal research into whether reasons for stopping searches changed over time. Although they did not examine search stopping directly, but rather how to predict search engine switching behavior in adults, White and Dumais (2009) found that the top three reasons for switching to another search engine in adults were dissatisfaction, expecting better results, and curiosity. Frustration was the fourth highest reason for switching. Feild, Allan, and Jones (2010) note that even when successful when searching, adult users can become frustrated. Kuhlthau (1993) describes that adult users are less willing to continue to interact with a system if they are experiencing high levels of uncertainty prior to formulating a query. Little research has been done with children and adolescents about reasons for search termination, and research is needed longitudinally to explore how search termination changes in individuals over time.

Result Selection Criteria

Youth report numerous reasons for selecting a particular result from the list returned by the search engine in response to a query. In a study of information seeking behaviors, Hirsh (1999) found that students in the fifth grade had a number of criteria for selecting a result from a list of results. In her study, the most frequent reasons for choosing a result were if the result was perceived as relevant, if the result gave previously unknown information about the topic, and if the result was interesting. In Foss et al. (2012), children cited a number of reasons for selecting one website over another from the results page on Google. The most frequently reported selection criterion for children for all ages was the summary, or snippet, provided by Google. This method of source evaluation is not new, as other research found that elementary aged children were likely to select print sources to retrieve based on descriptions of the source (Hirsh, 1999). Choosing websites due to recognition or familiarity also increases with age, possibly due to increased knowledge of sources for information; older youth are more likely to have specific websites they rely on for information (Foss et al., 2012). Adolescents in Foss et al. (2013) discussed many reasons for selecting a result from the results page, including selecting a result due to the snippet of text provided by the search engine, or simply because it was the first one on the results page.

Result selection difficulty. Many researchers have established the difficulty children have when selecting a result from the list presented after entering a query, although there is little research with children over the age of 12. A comparison of Google to other search interfaces with differences such as menu structure and density of information (Jochmann-Mannak et al., 2010) found that children 8 to 12 years old

encountered difficulty selecting results. In Google, the children had trouble deciding which sources were related to their search task, and in other interfaces they could not discern that results were clickable. Conversely, Large et al. (1998) found in their study of 11 and 12 year olds that children were able to discern which information source was best when choosing among several CDROMs. However, this study relied on closed databases rather than allowing children to explore the open Internet, and does not reflect the current search landscape. Duarte Torres et al. (2010a) did examine open Internet logs from AOL and found that less relevant results were selected for queries that appeared to be child-generated or related. Duarte Torres et al. also found that searchers of child-related queries were not clicking past the first page of results, reflecting the findings of Druin, Foss et al. (2009) observing child searchers. While the findings of Duarte Torres et al. suggest that result selection is challenging for children, the conclusion that children experience difficulty is incomplete, as the authors used query logs rather than participant testimony or observation. Hirsh (1999) suggests in her findings with elementary-aged children that some difficulty with result selection arises due to the developmental preference in children to have results that exactly match their queries.

The Visual Context

There is research exploring the relationship children have to visual content that is available via the Internet, whether image or video. Large et al. (1998) found that children using CDROM searching tools did not rely heavily on visual information as a primary source, as they infrequently took advantage of multimedia aspects of their programs, preferring instead to read text. In contrast, more recent research has found that there are

some searchers who prefer to search entirely within a visual context (Druin, Foss et al., 2010). Slone (2003) found that children ages 7 to 12 were very interested in visual information and would wait for web pages to load graphics, even irrelevant graphics, before continuing with searches. Other recent work has found that images can disambiguate confusing results pages for children, as children ages 8 to 12 made use of clickable images presented as results (Jochmann-Mannak et al., 2010). This suggests that children may benefit from more visual results pages. There is also growing interest in creating visual search interfaces for children (Gyllstrom & Moens, 2010), although other studies have shown that children prefer to use the same interfaces as adults (Bilal, 2002; Jochmann-Mannak et al., 2010).

For adolescents, in Slone's 2003 study of users of a public library, the participants ages 13 to 17 wanted relevant pictures, as opposed to younger users who were more likely to seek any images as a form of information. This indicates that as Internet users age into adolescence, they become more adept at selecting visual results that are relevant to their information need. However, youth may have different standards for acceptable images depending on the home or library environment. In Foss et al.'s (2013) home study, adolescents frequently discussed image and video content; 68% of adolescents expressed verbal awareness of image and video search in the search engine. Longitudinal research with a group of individuals can establish whether interest in visual content is consistent over time, and can illuminate the best methods for supporting the desire for visual information in youth.

Influencers to Search

Search behaviors in children are often influenced by others (Foss et al., 2012, 2013). Spavold (1990) found that when children ages 9 to 11 are learning how to navigate an unfamiliar database, they rely heavily on peers whom they perceive to have mastery over the system. This was confirmed by the 11 and 12 year olds in Large et al.'s (1998) study, who cooperated by allowing one child to search while others offered suggestions. Hirsh found in her 1999 study of fifth graders in an elementary school that her participants did not mention parents as influencers (although this could be due to low home Internet penetration rates at the time of the study). She also found that children retrieved information for their schoolwork based on perceptions of what their peers would find interesting. This study did not extend past the school environment where the role of other influencers could be examined, or further examine the role of peer influence longitudinally throughout childhood. In Foss et al. (2012), 7-year-old children were most influenced by their parents as a unit and 11-year-old children were most influenced by school, indicating that influencers to search change for youth with age. In the same study, fathers were infrequently mentioned as influencers (by only seven children out of 83) compared to mothers (by 26 children out of 83). Friends were not reported as influencers in young children by Foss et al. (2012).

There are a number of people that influence the searching behavior of adolescents. In one study, high school students reported using a virtual library when prompted by teachers (Valenza, 2007). In Foss et al. (2013), influencers were reported to help adolescents searching by finding sources, giving rules, working with the adolescent on the computer, and helping with keyword formulation. Mothers were the most

frequently reported influencer to adolescents in Foss et al. (2013). In an examination of a body of information seeking literature, Dresang (2005) found that youth have a desire to search on the computer with others and to share their knowledge. This conclusion is based on research conducted in the library setting.

Adolescent social landscape. Adolescents, differing from children, appear to rely on social networks and peers when using the computer, as well as when seeking information. Adolescents frequently discussed social computer use in Foss et al. (2013). While the social use of the computer is not necessarily limited to search behavior, website search functions and the necessity of searching to access information via search are so ubiquitous that social use and search are likely to overlap often. Morris, Teevan, and Panovich (2010) describe social search as to the process of seeking information via one's social networks. Their study with adult Facebook (http://www.facebook.com) and Twitter (http://www.twitter.com) users revealed motivations for seeking answers via social networks over traditional search engines. Social network questioning can allow the asker to phrase questions in natural language and to pose more complicated questions that can be entered as a search query. Additionally, askers have more trust in their social networks, believe that social networks are better resources for recommendation questions, and also believe that search engines cannot answer all of their questions. Wecker, Kollar, Fischer, and Prechtl (2010) created a series of scripts to the left side of Google's search screen to prompt 14-year-old learners to collaborate with a partner in the steps relating to finding information via Google. Researchers found that having prompts available to structure collaborative search throughout the entire search project aided students in conducting more successful searches. However, if these scripts were slowly removed

over the course of a search project, the students were unable to continue to use the knowledge on conducting good searches.

Affect

Some researchers have considered the role of affect, or emotional reaction, in the information seeking process in children. Bilal (2005) discusses that the Internet poses many challenges to children when searching. Not only do children have to develop good search skills, they also must modulate their emotional reactions to the information seeking process in order to be successful searchers. Thus, a greater understanding of the whole searcher is necessary if we are to be able to educate children in search. Bilal terms this view of the searcher as a whole, and not simply made up of search skills, behaviors, or of emotional reactions as separate parts the "affective paradigm" (2005). A few factors can be considered as indicators for negative emotional reaction to searching. Indicating uncertainty, stating "I don't know" could lead to stopping the search process, as Kuhlthau found in her 1993 work. Foss et al. (2012) coded for this statement in their work with children ages 7, 9, and 11, as well for as phrases such as "I have no idea" and "I'm not sure," and also examined the children's responses to the interview question, "Is there anything frustrating about searching on the computer?" The majority of children expressed these uncertainties, and younger children made more uncertainty statements than older children.

For adolescents, Kuhlthau (1991) notes in her work with high school students that the affect of the searcher can change throughout the search process, with the searcher experiencing optimism, frustration, and possibly disappointment at an unsuccessful

search. Burdick (1996) includes a discussion of the feelings of high school age searchers at different points during the information seeking process. Her participants verified many of the emotions from Kuhlthau's work. Uncertainty has long been considered an important part of the search process, becoming more and less prominent throughout different stages of the search (Kuhlthau, 1993). Foss et al. (2013) observed that half of participating adolescents made uncertainty statements during their study. Adolescents also had many incidents of expressing self-doubt, with the participants making negative statements about their search capability, the validity of their ideas, asking for directions from the researchers, spelling ability, and with interpreting information (Foss et al., 2013).

Frustration. In Foss et al.'s 2012 work with children, frustration was extremely common, with almost every child reporting frustration of some kind when researchers inquired whether there was anything frustrating about searching. When expressing their frustrations to researchers, children discussed the frustrations as stemming from sources such as not being able to find the information, errors with software, slowness of the Internet, having too many results, or not having enough information. Additionally, developmental limitations such as spelling, typing, and low reading ability caused frustration in some of the children. In adults, Poddar and Ruthven (2010) report physical reactions to searching in the form of sighs and fingernail-biting.

In Foss et al. (2013) for adolescents reporting frustration, examples of causes include a perceived mismatch between the query entered into the search engine and the results returned, searching for difficult topics, having to sort through many results to find the information, and query formulation is also difficult for adolescents. Similar to

frustrations due to sorting through many results, other researchers have reported frustration in adolescents ages 16 to 18 due to needing to control curiosity during imposed information-seeking tasks, as curiosity can lead to being overwhelmed by the amount of available information (Bowler, 2010). By examining affect longitudinally, it will be possible to determine if the same factors cause frustration and uncertainty over time in individuals or if increased skill development due to experience searching can be an alleviant. The current research landscape does not contain longitudinal studies concerning how the affect of the searcher changes over time.

Rules

The extent to which parents impose rules on children or adolescents regarding their use of the computer can have a large impact on their behavior, both on and off the computer. Parents of 8 to 18 year olds who impose household rules or limitations on their children's use of all media (not just computers) have children who are more likely to be more social, less likely to report boredom, and are more likely to earn higher grades (Rideout, Foehr, & Roberts, 2010). Examples of these rules are restrictions relating to time or television content, with content being more frequent. Foss et al. (2012) describe computer-specific rules imposed by parents on their children; parents often limited their children's access to certain websites (such as YouTube, http://www.youtube.com) and the amount of time spent using the computer. Foss et al. (2012) also describe searching rules that children self-imposed, such as which sources to use, rules about the relevance of results presented on the search results page, and rules about the importance of keywords and correct query spelling.

Foss et al. (2013) observed that 50% of adolescents follow self-imposed rules. Adolescent searchers were more able than younger children to examine the context of the search and deviate from their rules where appropriate. For example, one searcher described that .org and .edu websites are the most reliable, but throughout the interview search tasks, relied on websites such as Answers.com (http://www.answers.com) to find helpful information. In Foss et al. (2013), rules were not always helpful to searchers, but this largely depended on the context of the search task. Agosto (2002) discusses that time constraints were a limitation in adolescent searching. The adolescents in her study operated under imposed and self-generated time constraints.

Task Type

The type of task a user attempts to complete through Internet searching plays a part in altering search behavior. Tasks have been characterized on the dimension of imposed or self-generated (e.g. Gross, 2006; Russell & Grimes, 2007) or as simple ranging to complex (e.g. Byström, 2002; Schacter et al., 1998). In adults, Russell and Grimes (2007) discuss differences in search behaviors for imposed and self-generated search tasks. The findings of this study include that searchers spend more time and formulate fewer queries on tasks that are self-generated. The authors suggest that browsing might be the cause for these findings; that searchers have few alternate queries for their own tasks and that they spend time browsing due to expecting to recognize the information they are seeking. Gross (1999) discusses that imposed query search behavior is affected by the relationship between the imposer and the searcher. Gross (2006) finds

in her results with imposed queries in adolescents that the students consulted more information sources for imposed tasks than for self-generated tasks.

In looking at task type in terms of complexity, Schacter, Chung, and Dorr (1998) examined searching in children ages 11 to 13, characterizing search tasks in two major categories. Finding tasks are tasks that have a definitive answer, while searching tasks indicate problems in which the searcher does not know what information will suffice as an answer. The authors found that children performed poorly on the well-defined finding tasks, but were much more successful when searching for the ill-defined searching tasks. They propose that this is due to the wider variety of answers available for more complex tasks and that these tasks can be answered through browsing, which children prefer over searching. Byström (2002) characterized task complexity in adults in terms of a dynamic interplay between the individual searcher's characteristics and the task. For example, if a searcher can identify needed approaches to solving a task, the task is perceived as less complex. Byström found that more complex tasks, those where searchers did not have a planned approach or knowledge, resulted in broader information seeking strategies, including the consultation of a greater number of information sources. This differs from Foss et al. (2012, 2013) in that researchers measured the task complexity independently of the knowledge of the participant, basing the measure of task complexity on whether the task could be entered as a single query or required parsing into smaller pieces; complex search describes search tasks that contain multiple concepts. If entered in natural language, these queries return no results. Complex tasks must be separated into independent queries that the search engine can process.

Advanced searchers. A variety of research studies have looked at difficult searches in adult searching and have described characteristics of more successful users. Aula, Khan, and Guan (2010) found that successful adults spent less time on the results page, formulated their longest query at the end of their search, used advanced search operators, and formulated queries as questions. White and Morris (2007) defined advanced users as those who used advanced operators (e.g., +, -, ”, site:), and looked for additional behaviors distinctive to this group. They found that advanced users were more likely to click on results farther down the page, revisit pages less, spend less time viewing irrelevant documents, and deviate from the search path less often. Fang, Somasundaram, Si, Ko, and Mathur (2011) identified patterns in searches conducted by expert researchers and compared their patterns to children and general web users. Expert searchers in Fang et al. (2011) used fewer words per query than children or regular web users, and the authors proposed that the ability to formulate a query with fewer words indicates a more clearly articulated information need, as well as a less complex query. Foss et al. (2012, 2013) observed advanced searchers in both children and adolescents, termed Power Searchers. These searchers, identified largely by their approaches to complex search tasks, were able to plan search paths, used higher numbers of vocabulary words, and were aware of more features of the search engine.

Role Literature

As described in Chapter 1, the unit of analysis for sections of the current research was heavily based in roles. Prior research into patterns of behavior displayed by people

socially, children at play, adults in work situations, and in online communities can aid in situating roles as used in the context of this research.

Role Theory

Role Theory originated as a concept surrounding the identification of one's self in relation to one's position in society. As stated by Biddle (1986), "role theory concerns one of the most important characteristics of social behavior- the fact that human beings behave in ways that are different and predictable depending on their respective social identities and the situation" (p. 68). According to the basic principles of role theory, "role theory presumes a thoughtful, socially aware human actor" who acts in accordance with "characteristic behaviors, parts to be played, and scripts for behavior" (Biddle, 1986, p. 69). Roles are present in children, as according to Piagetian developmental theory, young children assign play roles to each other and follow a careful set of rules when interacting socially. All members of the play group adhere honestly to these rules, and consider them to be unalterable (Piaget, 2011/1931).

Role theorists rely on the concept of an individual operating within the bounds of a community. Youth are most certainly members of a community and likely obtain the traits placing them into the framework of search roles from operating as members of a community. However, whether youth roles are the same for on- and offline lives is not established. When conducting searches on the Internet, it is unclear whether youth display roles that are the same as those they would display in the community at large, or whether search roles are a result of their interactions with the interface replacing the concept of community.

Work roles. The concept of work roles is useful to examine when considering how to approach the framework of youth search roles. Huvila (2008) describes the work role as "a distinct set of activities within a work" (p. 802). Huvila further describes work roles as not pertaining to specific professions or organizational structure, and states that individuals may fill multiple work roles and share their work roles with other people. This view of roles fits with the research preceding the proposed study, as youth display multiple roles which are defined by distinct behavior patterns.

Another major description of work roles lies within the work of Contextual Inquiry, a method of collecting field data (Beyer & Holtzblatt, 1998). Within the method, work roles are uncovered by first analyzing how individuals communicate, see themselves within an organization, and use artifacts to accomplish work, among other factors. After observers compile this data, a process of consolidation occurs, in which roles become the predominant way to understand intent and responsibility surrounding work. In applying the role concepts of Beyer and Holtzblatt to the youth searching framework, the meticulous methods of the fieldwork and analysis process are easily adapted from the adult workplace to the home youth search context.

Online Collaboration Roles. Adult contributions to wiki communities can serve as a parallel to youth conducting search work on their computers. Within wikis, members of the larger community act in roles to accomplish needed tasks, falling into roles based on online behaviors. Administrators play a vital role by curating wiki content generated by content contributors, who are highly involved or more sporadic participants operating in domains that are of personal interest (Arazy, Nov, Patterson, & Yeo, 2011). In comparison to youth searching, there are some direct links between the roles of adults

online and the roles of youth when searching. Administrators, with their high level of knowledge and maintenance of community guidelines, mirror the Rule-bound or Power Searcher concepts of Foss et al. (2012, 2013). Content contributors, as experts in limited areas, likewise mirror Domain-specific Searcher concepts (Foss et al., 2012, 2013).

Summary of Literature Review

This chapter began by introducing literature relevant to youth search as identified not only by other researchers, but also by the studies preceding the longitudinal research of this dissertation. The literature represented covered a broad spectrum of factors affecting youth search.

Additionally, as the research of this dissertation relies largely on a framework of youth search roles, prior literature regarding the use of the concept of roles was discussed.

The following chapter will detail the methods of two studies on which this longitudinal research is based. One study was conducted with children, and the second with adolescents. The roles for each age group resulting from the studies are also described.

Chapter 3: Preceding Research

In this chapter:

- Description of preceding work
  - Child study
  - Adolescent study
- Framework of search roles
  - The whole searcher
  - Work models
  - Search behaviors
  - Identifying search roles
  - Summary of searching framework
- Child roles
  - Developing
  - Distracted
  - Domain-specific
  - Non-motivated
  - Power
  - Rule-bound
  - Visual
- Adolescent roles
  - Developing
  - Domain-specific
  - Non-motivated
  - Power
  - Rule-bound
  - Social
  - Visual
- Summary of preceding research

In this chapter, I briefly describe the methods and analysis process of the two major studies that ground the longitudinal study. The first study focused on child searchers, and the second focused on adolescent searchers. Although many of the child study findings that relate to the current longitudinal study will be presented in later chapters, the complete results in the original context of each study can be found in prior publications:

Druin, A., Foss, E., Hutchinson, H., Golub, E., & Hatley, L. (2010). Children's roles using keyword search interfaces at home. *Proceedings of the 28th International Conference on Human Factors in Computing Systems (CHI '10),* 413-422.

Foss, E., Druin, A., Brewer, R., Lo, P., Sanchez, L., Golub, E., & Hutchinson, H. (2012). Children's search roles at home: Implications for designers, researchers, educators, and parents. *Journal of the American Society for information Science and Technology, 63*(3), 558-573.

Foss, E., Druin, A., Yip, J., Ford, W., Golub, E., & Hutchinson, H. (2013). Adolescent search roles. *Journal of the American Society for Information Science and Technology, 64*(1), 173-189.

The chapter then contains an explanation of the philosophical approach of all three studies as well as the details of the process for identifying a search role. The chapter concludes with full descriptions of each role for children and adolescents as established during the earlier studies.

Description of Preceding Research

Child Study

During the study on child Internet searching, I was a co-researcher, recruiting and conducting in-home interviews. I completed the data analysis with contributions from other researchers and co-authored two conference publications (Druin, Foss et al., 2009, 2010) and first-authored one journal article (Foss et al., 2012). Beginning in 2008, we examined how children search on the Internet in the home environment. Boundaries for participation included home Internet access and that children be of the specific ages 7, 9, or 11 to allow us to see meaningful differences across ages. Participants were recruited via social networks, by posting flyers, and by electronic mailing lists, and lived mainly in

the suburban Maryland area, with some participants from rural Virginia, one from Washington DC, and one from Delaware. Over the course of a year, we were able to successfully enroll 83 children and at least one parent per child participant, for a total of 170 individual participants. Researchers video recorded the child interviews and audio recorded the parent interviews when the participants consented to recording, and took detailed notes when participants did not consent to recording.

Two researchers travelled to each home for the first half of the study, with one researcher responsible for note taking and ensuring a quality video recording and the second researcher conducting interviews. For the second half of the study, two researchers attended interviews when possible, but often interviews were conducted independently with researchers acting as their own videographer and note taker. At each home, researchers first conducted parent interviews with the child out of the room to gain background on each child's computer use habits, as well as to provide corroboration for some of the information asked during the child interviews. The parent interview script included questions about the child's experience level, frustrations, house rules, and concluded with the parent's occupation and self-assessment of their own computer skill level. Other demographic information such as ethnicity or income was not collected, as researchers felt that this could be perceived by the participating families as invasive. Following the parent interview, researchers interviewed the child while he or she used the home computer with which they had the highest level of comfort or familiarity. The child interview script included general computer use questions, five search tasks, and concluded with opinions of the search engine. Researchers were careful to position the video camera during the child interviews from a side perspective, recording both the child

and the computer screen to allow for maximum data capture of the child's interaction with the computer. Figure 1 provides an example of ideal camera positioning.

Figure 1. Ideal camera positioning. This angle capture the interactions between the child and the computer occuring during the interview as well as on-screen events.

Data resulting from the home interviews included parent interview notes, parent interview audio recordings, child interview notes, and child interview video recordings. In conjunction with a local transcription service, researchers transcribed all the child and parent interview recordings. As the first stage of analysis, the transcripts were coded within NVivo data analysis software (QSR International, 2013). Coding began with organizing the participant answers to interview questions into categories. Using methods outlined by Strauss and Corbin (1998) in an emergent coding procedure, over time, researchers began to observe patterns in individual children (e.g. following a rule to guide all search tasks) and among children (e.g. many children following the same rule).

Combining the transcript coding with observation of the video and note data allowed researchers to continue to build on and refine the coding categories, following the iterative procedure of Grounded Theory through open coding, axial coding, and selective coding (Strauss & Corbin, 1998).

Adolescent Study

Following the initial research with children, I was the lead researcher during the study on adolescent Internet searching. I recruited participants and conducted in-home interviews with parents and adolescents with the assistance of undergraduate and graduate student researchers. I completed the data analysis with contributions during transcribing, coding, and validating the coding from undergraduate and graduate student researchers. I first-authored one journal article based on this research (Foss et al., 2013). Boundaries for participation in the adolescent study initially were that adolescents be of the ages 15 or 16 and have home Internet access. However, due to low enrollment rates, approximately halfway through the year-long data collection the age range was expanded to include 14 to 17 year olds. Methods for recruitment were slightly refined from those used during the child study; I relied more heavily on personal networks and Parent-Teacher Association (PTA) networks (Foss, Druin, & Guha, 2013). In an analysis of the origin of the adolescent participants conducted after study completion showed that snowball sampling (Miles & Huberman, 1994) was also successful for recruiting some participants (Foss, Druin, & Guha, 2013). Additionally differing from the child study recruitment was that I incentivized participation by offering a gift card to Amazon.com in the amount of $10 or a study t-shirt to the participants. Using these methods led to the

successful enrollment of 38 adolescents and at least one parent per adolescent in the study, for a total of 76 participants.

During the adolescent study, multiple researchers travelled to homes as needed to train undergraduate and graduate students who had joined the study. During these interviews, one researcher took notes and video recorded and the second researcher conducted interviews, with these roles alternating according to the comfort level of the researchers new to the project. Student researchers and I conducted interviews independently after the student researchers were fully trained and felt comfortable. As per the methods for the child study, researchers first conducted parent interviews with the adolescent out of the room to gain background information. The parent interview script was almost identical to the parent script from the child study, and demographic information such as ethnicity or income level was again not collected. Researchers then interviewed the adolescent searching on their most familiar home computer. I used an updated interview protocol to explore several areas absent in the child study: self-rating of early computer skill, how the adolescent learned to search, favorite computer activity, and areas of computer ability and improvement. Lastly, I included a sixth, more difficult, searching task for the adolescent study participants, as the most difficult task from the child study was not challenging enough for the more experienced adolescent searchers.

Again mirroring the child study, the research team split the transcription of the adolescent interviews with a transcription service. We conducted coding on the transcripts within NVivo (QSR International, 2013). I developed the initial categories based on the adolescent responses to interview questions, and then was able to expand and refine these categories using the adolescent interview notes and video recordings. I

did not consult the child code structure in order to allow adolescent patterns to arise naturally. The coding process was iterative, following Grounded Theory methods (Strauss & Corbin, 1998) and resulted in the development of seven adolescent search roles that were similar to the roles I observed in children.

Framework of Search Roles

It is our belief that research in the field of youth searching has not previously established search roles in youth in part due to the large number of participants needed to begin to see the repeated behaviors that distinguish roles from one another. In many studies examining child and adolescent search, there were too few participants to observe all of the search roles established in the child and adolescent studies by the author and colleagues (e.g. Bilal, 2000; Bowler, 2010; Dresang, 2005; Large et al., 1998). The large-scale studies with youth by my colleagues and I led to the identification of the search role framework, as I was able to observe patterns not only within individuals but also across larger groups of youth.

To identify a search role, an observer needs to pay attention to the *whole searcher*; the environment, context, affect, and search processes all affect the ability of youth to access information on the Internet. In order to accomplish this wide view, I adapted four *work models* from literature addressing adult workplace system design (Beyer & Holtzblatt, 1998). When the four models are used in conjunction, applied in a complete and uniform way for each searcher and each search task, they reveal different aspects of the search process. The utility of the work models is to highlight particular s*earch behaviors* that might otherwise be overlooked. When a number of individual

searchers display similar search behaviors, those individuals can be grouped together under a search role. *Search roles* are defined as patterns of searching behaviors, preferences, and habits youth ages 7 to 17 display while searching on the Internet. Search roles cluster youth not solely according to areas of deficit or skill, but through encompassing the entire search experience. The following sections provide a guide to the process surrounding the establishment of the framework of search roles in more detail.

The Whole Searcher

Viewing the *whole searcher* indicates avoiding granular parsing of searches in favor of identifying larger-scale patterns encompassing not simply interface interactions, but also the experiences of the searcher and interactions between the searcher and the interface. To illustrate, a 7-year-old searcher might (predictably) have a lower reading level than the results presented on the search results page, making result selection difficult. In a narrow view, an adult stakeholder to youth search might cease analysis of the youth's search processes and attempt to implement solutions to this simple problem: curating a library of results specifically for young searchers, reading the results to the searcher aloud, visually emphasizing search query terms when they appear in the results list, or perhaps developing an interface that relies heavily on visual search results. In contrast, by taking a wider view, beyond that of identifying a problem and implementing a solution, we might observe the same searcher successfully acquiring desired information despite not being able to understand all of the words on the search result page. In a wide view, the searcher might implement broad strategies to overcome problems on their own: using a search rule such as "choose the first result," adding "for

kids" to the end of their search query, or making use of familiar sites. These successful strategies become apparent when broadening the focus from problem identification and instead attempting to observe search as a process made of many problems, solutions, reactions, and interactions.

Work Models

During the child study, my initial approach to data analysis was with the goal of understanding the whole searcher. I drew upon an existing framework, the Contextual Inquiry work models of Beyer and Holtzblatt (1998), as an existing method for analyzing complex interactions between an individual and their environment. These work models were developed to understand the multifaceted work process of adults, aiming to inform the design of workplace software. At the time of the child study, I drew a parallel between the search process of youth and the work process of adults, and used the work models as a guide to understanding youth search. Through the use of the models, I was able to avoid a narrow interpretation of children's search behaviors.

There are five work models, and four are useful to identifying search roles: the *flow*, *sequence*, *artifact*, and *culture* models (Beyer and Holtzblatt, 1998). The fifth work model, the physical model, is concerned with physical movement through the environment of the workplace, and does not apply to the stationary context of youth Internet search as examined in this research. *Flow* provides focus on the communication style of the searchers when attempting to achieve the work of search, such as how youth communicate with the interface and with their search influencers. *Sequence* brings attention to the process and steps of search and how one event can trigger another, as well

to events that act as barriers to the search processes. Thinking of the interface as an *artifact* of search work places emphasis on the layout of websites and on the search tools used by the searcher. Finally, *culture* draws focus to the affect of the searchers and the context of the search, such as the searcher's beliefs and values.

During the child study, I found that the four models provided an even-handed method for organizing responses and identifying areas for exploration in our data; the descriptions provided in the work of Beyer and Holtzblatt (1998) draw attention to specific areas of interest that are associated with each model. During data analysis, we remained mindful of each model in turn while examining each study participant. For example, while viewing a video recording of a search through the flow model, concerned with communication, one aspect of a searcher's communication with the system might be to recognize and correct errors. Within the sequence model, concerned with processes, a searcher might follow the rule "go through results in order," which pertains to orderly and sequential Internet search process. Resulting from the use of the models, we were able to generate a large number of *search behaviors* commonly present in our participants.

Search Behaviors

Search behaviors are observable actions or verbalizations occurring during the course of an Internet search. During the child study, we identified a large number of search behaviors by using the work models to raise our awareness of a wide variety of actions. Search behaviors include actions taken within the search interface, unprompted verbal comments, responses to interview questions, and events occurring within the

physical environment. Taken individually, search behaviors are not largely revealing for understanding a particular youth's search habits. For example, some youth were aware of a high number of features of the search interface, discussing their use of the autocomplete menu or the number of results returned on the search engine results page. Awareness of features, taken alone, does not build towards an understanding of search patterns or preferences. However, when several search behaviors begin to appear together across multiple youth, we are able to understand how they contribute to the formation of *search roles.* Search behaviors can be conceptualized as the building blocks of search roles.

Identifying Search Roles

Search roles are a collection of search behaviors distinguishing a habitual or preferred method of Internet search. In reaching the goal of identifying search roles through the use of search behaviors, all observable behaviors are useful. However, there are some crucial search behaviors or combinations of search behaviors that when displayed by an individual, define that individual as displaying one role distinctly from other roles. One such example is the ability to parse multi-step, or complex searches. Youth who to understand complex search tasks also tend to know many features of the search engine and be verbal about their experiences with search. The combination of these three behaviors (complex searching, knowledge of features, and verbal) in one individual is unique to one role, but taken independently, the three behaviors could place a searcher in any of the roles.

The strength or magnitude of the search behavior also affects which search roles are associated. For example, while youth in all roles display some knowledge of features of the search engine (such as the existence of the search box), youth who use and

describe many features of the search engine are likely to display a different role than those who can only describe one or two features. Similarly, youth who are highly verbal tend to display a different role from those who are more taciturn.

Important to note is that search roles are dependent on the context surrounding the search. For example, the physical environment, the choice of browser or search engine, or whether the search task is imposed or open-ended can all affect the search role or roles displayed. Additionally, multiple roles can be present in a single youth, and frequently this is the case; one individual might show a search role only for the duration of one search task, and when presented with another search task, he or she might show an entirely different role, and both displayed roles are valid despite their fleeting appearance. Alternately, a searcher can simultaneously display several roles for the duration of numerous search tasks.

Summary of Searching Framework

Arriving a framework of search roles begins with the commitment to view the whole searcher. In order to achieve this broad view, I use work models to encompass all aspects of the work associated with search. Each model draws attention to different search behaviors. When the search behaviors occur in multiple searchers or form patterns among multiple searchers, the behaviors can be grouped as identifiers for a search role. Search roles are combinations of multiple behaviors, and are highly dependent on the context surrounding the search. The following section describes the seven search roles for children and then adolescents in terms of the search behaviors that were used to identify the roles.

Child Roles

These role descriptions are drawn from the work of Foss et al. (2012), and while accurate for youth aged 7 to 11, do not fully encompass the roles as existing for youth of broader ages at the conclusion of the longitudinal study. As described, these roles can overlap or be displayed only for particular search tasks, and they are affected by the context to the search (task difficulty, physical environment, etc.).

Child Developing Searchers

Developing Searchers are the most frequently observed type of searcher in young children. They are very willing to search and are excited by the computer. Their willingness to search is the defining characteristic of the Developing Searcher, and was not observed in all other roles. One participant explained her eagerness:

7-year-old girl:

> Basically, if we're lucky we can raise our hand at school fast enough we can get on the computer, cause there's only four computers.

Developing Searchers are often are persistent in their searching, entering multiple queries for one search task. They have some search and computer skills, such as typing and mouse abilities, but often there are notable difficulties with basic skills, as well as with more complex abilities such as keyword query formulation. Other characteristics in this role are varied, partially because Developing Searchers range in age.

Child Distracted Searchers

Similar to Developing Searchers, Distracted Searchers are willing to search, and are often excited by searching. However, Distracted Searchers begin searching, become

distracted by other things, and are not be able to resume their original task, even with prompting. Distracted Searchers encounter information quite easily by using minimal computer skills such as typing ability, mouse control, and knowledge of how to access the browser. One searcher, a 9-year-old Developing and Distracted girl, while searching for [what dolphins eat], encountered information on Martin Luther King Jr., environmental stewardship, and sea turtles. Although she did not successfully find information pertaining to the search task, she encountered information of more personal interest. Important to note is that this type of search pattern is considered distracted only when the child is unable to redirect his or her attention to the original task.

Child Domain-specific Searchers

Domain-specific Searchers make up the second largest group in the child study. These searchers use their searching ability to gather information around a specific topic of interest (e.g. images of cartoon characters) and their domains motivate the majority of their computer use. Domain-specific Searchers have developed skills and source knowledge around their particular domain, but have not necessarily learned to apply this knowledge in a broader searching context. Other characteristics of this role are similar to Developing Searchers, except that Domain-specific Searchers are not always eager to search if the task is not about their domain.

Child Non-motivated Searchers

Non-motivated Searchers are compliant with directions to search, but do not choose searching or computer use as an activity of their own accord. This disinterest is

the hallmark of the Non-motivated Searcher. As one searcher told us when asked to search for her own interest:

7-year-old girl:

I have no interest in Google.

Non-motivated Searchers have logged comparable numbers of hours to children in other roles on their home computers, indicating that their lack of enthusiasm is not due solely to inexperience. They are aware of the fewest number of features of the search engine. When considering affect, Non-motivated Searchers do not show a sense of excitement towards the affordances of the Internet or searching in the way as many of their peers. If these disinterested behaviors are merely due to factors such as interview tasks or the rapport with the researcher, our inclusion of both imposed and self-generated tasks should have allowed the Non-motivated Searchers to display at least some engagement comparable to children in other roles. Additionally, researchers took time at the beginning of each interview to talk with each participant to establish a level of comfort. Despite their disinterest, Non-motivated Searchers are able to find relevant information with very short search paths; their unwillingness to search makes them very efficient at searching.

Child Power Searchers

Power Searchers use keywords when searching, are able to verbalize their search process when asked, and are reflective, demonstrating an understanding of how the search engine works and verbalizing planned search paths. They often have a high typing and spelling skill level when compared to other searchers, and they display confidence

when searching. Power Searchers uniquely have the ability to appropriately approach complex queries, breaking the query into parts that the search engine is capable of handling, in comparison to children in other roles who type long queries with many phrases or unrelated parts. Power Searchers also understand the tools offered by the search engine, as demonstrated by a searcher, who explains as he searches for [apple pie]:

11-year-old boy:

> And then there's another link down here. And on it it'll say the title which has the link, below it there's a little snippet of text that and anything that contains, uh, your keywords are in boldface. And then below that in green is the um, URL and then it looks like how many um, like kilobytes, of information it is, and then cached which means I guess old versions of that site. And some more pages which is some more pages.

If a child displayed Power Searcher skills, he or she was not coded as a Developing Searcher; these two roles are mutually exclusive.

Child Rule-bound Searchers

Rule-bound Searchers display constrained searching patterns, such as repeating the same steps for every search and frequenting or boycotting particular sites. They verbalize and subsequently follow rules about searching or computer use; these rules can help or hinder the searcher. Rules fall into a number of categories, and while children in all roles have rules that they verbalize, Rule-bound Searchers are more constrained and unwilling to deviate from their search pattern. These children are perhaps more heavily influenced by parents, with parents of Rule-bound Searchers reporting that they search

while sitting with their child at higher rates than for children in any other role. Rule-bound Searchers are also most certainly heavily influenced by teachers and librarians at school, as all of them report influence by school. Additionally, it is possible that Rule-bound Searchers are confident in their abilities and do not deviate from their search patterns because they believe their rules are helpful in allowing them to access information.

Child Visual Searchers

Children characterized into the role of Visual Searcher display and verbalize a desire to retrieve information from visual sources such as pictures or videos. This preference for visual information is not incidental; these searchers begin searches with the intention of looking in visual sources, and do not merely opportunistically click on visual search results. However, they frequently inappropriately apply this preference for visual information. For example, one 7-year-old boy began watching a news broadcast on cnn.com (http://www.cnn.com) while searching for the Vice President's birthday rather than reading the text containing the answer on the same page. Visual Searchers are much more likely to refer to images or video verbally than were children in other roles.

Adolescent Roles

When comparing the adolescent roles to the roles identified for younger children in Foss et al.'s (2012) study, there are several key differences. First, the absence of the role of Distracted Searcher in adolescents is notable. Distracted Searcher children are characterized by a tendency to become easily off-task when searching and encounter information that does not relate to the topic they are searching. It is possible that

adolescents are more experienced with Internet use and therefore are less likely to become distracted by webpages or advertisements. Additionally, adolescents are likely more aware of social expectations placed on them when participating in a research study, and are therefore more likely to remain focused. Second, a new role arose for adolescents: Social Searchers. Social Searchers are mainly motivated to use of the computer by social factors, and are described further below. The younger children in Foss et al.'s (2012) prior study did not mention incidents of social computer use or social search strategies, but this type of computer use is prominent in adolescents.

Another major difference between the roles in children and adolescents lies within the Power Searcher role. In younger children, one metric used to identify Power Searchers was the ability to solve the complex search question, "Which day of the week will the current Vice President's birthday be on next year?" Twenty percent of the younger children were considered Power Searchers based on their ability to complete this query. When examining just the oldest children from Foss et al. (2012), the 11-year-olds, 45% were able to successfully complete this task. It was therefore necessary to include an even more difficult search task for adolescents. Adolescent Power Searchers are characterized by other abilities as well (described below), but the ability level for complex search tasks seems to increase with age.

Adolescent Developing Searchers

Developing Searchers are the most frequently observed type of searcher in younger children as well in adolescent participants. Developing Searchers have a limited knowledge of search tools and display unplanned search paths, as they are unable to

verbalize their search process when asked and often have varied approaches to solve a single task. Adolescent Developing Searchers display difficulty when confronted with complex search tasks. Adolescent Developing Searchers may have an awareness of features of the search engine or of the browser, such as autocomplete features, although their explanations of these features lack evidence of complete understanding. One participant explained Google like this:

16-year-old girl:

> Interviewer: Can you show and explain to me how Google works?
>
> Interviewee: Okay yeah. Okay this is Google. And this search bar right here, you can type anything you want to know about in that search bar. And then you hit search and Google will type all around the world and all the computers and all the information and they will pull it up, and like popular pages, and they have pictures.

In this description, the searcher does not mention specific tools of the search engine and does not understand how Google retrieves or presents results, although she can explain how to retrieve information in a way that meets her needs.

Adolescent Domain-specific Searchers

Domain-specific Searchers use their searching ability to gather information around a specific topic of interest, for example, basketball players' statistics. They have developed skills and source knowledge around their particular domain. Adolescent Domain-specific Searchers appear very similar to their younger counterparts, although their particular domains may be more sophisticated. For example, in young children the

domain of interest may be online games, but in adolescents the domain may be specific games such as *World of Warcraft*™. Domain-specific Searchers display expertise within their domains similar to the expertise displayed by Power Searchers, but this expertise does not always translate to searches outside of the domain of interest. For example, this searcher discusses his familiarity with sources about skateboarding and ability to retrieve skateboarding information from the Internet:

15-year-old boy:

Interviewee: Yeah. And after I watch skate videos, it gets me pumped to go look at skate websites, and I usually go to CCS. And look at what's on sale, shoes, skateboards. Like my skateboard broke so I actually need a new one. Yeah, if not just Skate Warehouse. Skate Warehouse is actually better because they have boards.

Interviewer: So you know all this stuff? How did you find out all this stuff?

Interviewee: I honestly don't know. I think what I did is like when I first started skateboarding, I just went onto YouTube and just like places to get boards offline and just found them and then just be like religious with it.

However, this same searcher is unable to solve the most difficult search task regarding Michael Jackson's music:

Interviewer: All right, so the last search that I have is a little different. Do you think Michael Jackson's music was more popular in 1983 or 2009, and why?

Interviewee: Is 2009 when he died?

Interviewer: Look it up.

Interviewee: I feel kind of grimy typing this in. [when did Michael Jackson die]. Yeah he died in 2009. Um, probably the first date you gave me.

Interviewer: 1983?

Interviewee: Yeah, I mean people started going over his stuff after he died, but he was more of a phenomenon back in the day.

When discussing skateboarding, this searcher has a set of websites he is aware of and consults enthusiastically, but he does not have a set of websites he can rely on for retrieving unknown information, and instead responds to the Michael Jackson task with an opinion.

Adolescent Non-motivated Searchers

Non-motivated searchers are compliant with directions to search, but do not generally choose searching or computer use as an activity. This disinterest strongly aids in identifying Non-motivated Searchers. Non-motivated adolescents have used their home computers for comparable numbers of hours as adolescents in other roles, so their lack of enthusiasm is not due solely to inexperience. When considering affect, Non-motivated Searchers do not show a sense of excitement towards the affordances of the Internet or web searching in the way that is observed in many of their peers. This role appears similar in children and adolescents, with little variation due to age. As an example of a Non-motivated Searcher's response to a search task, consider this exchange:

Interviewer: Okay. I have one more search. Do you think Michael Jackson's music was more popular in 1983 or in 2009 and why?

Interviewee: Do you want a search for that?

Interviewer: Uh-huh. Yeah, however you think you would find it.

Interviewee: Oh, because it's the day he died. I can't really find. Oh, here. It says, "In the early 1980s, Jackson became a figure in popular music." I guess maybe he's more popular back then.

The searcher displays a reluctance to conduct a search, enters only one query, and does not visit a website, instead reading from the snippet provided, displaying a short search path.

Adolescent Power Searchers

Power Searchers as adolescents possess higher levels of searching skill than searchers in other roles. Many of the skills are the same for children and adolescents, but are simply more advanced in older youth. For example, while both child and adolescent Power Searchers may be aware of sources and have an ability to use advanced features of search engines, Adolescent Power Searchers on average are aware of over twice as many features of the search engine compared to child Power Searchers. Adolescent Power Searchers are able to verbalize their search process when asked, and are reflective, demonstrating an understanding of how the search engine works. As one searcher describes her understanding of how to use Google:

16-year-old girl:

> So if I were to search, if I wanted to know what um, video camera I had, then I would just [define: video camera]. . . .Oh, and if I'm looking for images, for a project, then I just go to Google images. . . .And you type in keywords that you're looking for. So keywords would be like proper nouns, because words like *of* and *the*, those are filtered out because they're not very important and they are used in everything. . . .And the more words that you have that are the same, the higher up it'll pop up in the search.

Power Searchers often have better typing and spelling skills when compared to younger searchers, and they display confidence when searching.

Adolescent Rule-bound Searchers

Rule-bound Searchers display constrained searching patterns, repeating the same steps for every search. They verbalize and follow rules about searching or computer use frequently. These rules fall into a number of categories, such as rules about trusting the website used. For example:

> Interviewer: So why did you pick Wikipedia [(http://www.wikipedia.org)] as your first one?
>
> Interviewee: Because it was the first one, so it was easy. Wikipedia always gives you like a basic broad idea, but I mean teachers are always like, "Wikipedia is not reliable information," but I would go with something that is like .org or .edu, cause those are like reliable.

Interviewer: So you clicked on Wikipedia because it gives you a broad overview, but generally you like picking .edu or .org websites for reliable information?

Interviewee: Yeah, I would never use Wikipedia if I had to write a project on dolphins.

While children in all roles have rules that they verbalize, Rule-bound Searchers are more constricted and unwilling to deviate from their search pattern. Rule-bound Searchers are also heavily influenced by teachers and librarians at school, as all of them report influence by school, and also by watching friends searching. Child and adolescent Rule-bound Searchers appear very similar in their searching habits.

Adolescent Social Searchers

Social Searchers are identifiable by their use of social networking or communication websites as the primary and favorite activity on the computer, whether searching or not. They also instigate conversations with other people on and offline while using the computer, although this behavior was not observable during this study, and was instead documented as anecdotes by the adolescent. For example, one participant reported:

16-year-old girl:

Yeah, my friends will come over and we just watch random stuff on YouTube that we find.

Social Searchers are broadly triggered to search by images, music, conversations, personal interests, and school. They make use of all social aspects when using the

computer, for example completing homework assignments with friends using programs such as Skype (http://www.skype.com). They additionally refer to socially searching at a higher rate than adolescents in other roles. Social Searchers were not observed in younger children in Foss et al. (2012).

Adolescent Visual Searchers

Adolescents characterized into the role of Visual Searcher display a desire to retrieve information from visual sources such as pictures or videos. Use of Google Images is common.

> Interviewer: So can you start off by searching for information on dolphins? And explain to me what you are doing and what you did?
>
> Interviewee**:** Okay, I'm typing in "dolphins" on Google. Umm, I'm going to go look at pictures first and I'll see what they look like.

While younger children often inappropriately applied this preference for visual information by searching for images when doing so would clearly not answer the search task, adolescents appear to be more discerning in their use. The preference for visual information is not incidental; Visual Searchers begin searches with the intention of looking in visual sources, and do not merely opportunistically click on visual search results. They mention different people as influencers, including siblings, adults at school, and friends, but not at high rates when compared to other roles.

Summary of Preceding Research

This chapter presented descriptions of the methods of two studies investigating first how children and then how adolescents search on the Internet. These studies provide the basis for the continuation of the research in the current longitudinal study. Outcomes from the two preceding studies included the identification of search roles. The method of role identification was described above, followed by descriptions of the seven child and seven adolescent roles.

The following chapter will describe the research methods of the longitudinal study. Descriptions of the role of the researcher, participants, data collection procedures, and the analysis methods are included.

Chapter 4: Research Methods

In this chapter:

In Chapter 3, I presented the methods for data collection and analysis for two studies on youth searching that have served to guide the longitudinal study methods. I have also established a method for arriving at a framework of roles in both children and adolescents. In this chapter, I will describe my role in the research process, the longitudinal participants, the methods used during the longitudinal study for collecting data, and the multi-phase process of the data analysis.

Role of the Researcher

I have been the lead researcher for the longitudinal searching study documented in this thesis. I planned the approaches to recruitment, data collection, and analysis to ensure that when carried out, a longitudinal study would result in high reenrollment, quality data, and a strong contribution to the field of youth searching. For the planning stages of this study, I have been responsible for developing revised versions of the interview protocols, requesting new camera and data storage equipment, and training undergraduate and graduate students to act as co-researchers. In conducting data collection, I have been the

primary researcher, and have personally conducted or been present at all but one interview; I scheduled two interviews at the same hour on the same evening; a co-researcher familiar with the previous studies and trained in using the longitudinal protocol conducted this interview. Finally, I conducted the data analysis in accordance with previous methods, but with additional phases added to ensure completeness of analysis: I re-coded the roles of the child study participants, I conducted Grounded Theory transcript coding to allow for the emergence of any new themes within the data followed by coding of the longitudinal transcripts per the standardized observation protocol resulting from Foss et al. (2012), and I created longitudinal case studies of individual participants. I was aided during the early stages of this research by sponsors at Google and by my academic advisor, and during the longitudinal study I have received feedback at key points and my academic advisor has reviewed my written thesis.

I am familiar with the themes that have emerged from the child study and the adolescent study as well as many of the participants from their child study participation. It is possible that due to my knowledge of themes of interest in the child and adolescent study data that I asked a higher number of follow-up or perhaps leading questions in order to ensure these themes were present within the longitudinal data as well. It is also possible that I treated individual youth differently during the longitudinal study based on my knowledge of their search behaviors during the child study. As strategies to avoid these types of bias, I watched the video recording of each interview shortly after it was conducted while remaining attuned to possible alterations needed in my interviewing style. Additionally, I attempted to have other researchers conduct interviews when

possible, as the other researchers were less familiar with not only the participants but also the areas of interest in the participant responses.

Longitudinal Participants

The longitudinal study participants all were also participants in the child searching study and therefore form a panel for longitudinal examination (Saldaña, 2003). Participants were ages 7, 9, and 11 in 2008 and 2009, and in the intervening years have aged to range from 10 to 15 years old. I recruited based on the child study list of participants, with contact via email primarily, and telephone if I did not receive response by email. Recruitment was hampered by the lack of updated contact information due to the long span of time between the child study and the longitudinal study (three or four years, depending on whether the interview occurred at the beginning or end of the year-long child study) (Foss, Druin, & Guha, 2013). To address this problem, it was useful that our research team knew some of the participants personally, as I was able to use personal networks to reach some potential participants. I did not offer incentives for participation, reflecting the child study of 2008 to 2009. Participants for the longitudinal study lived in suburban Maryland or rural Virginia areas with most attending public schools, although some were homeschooled. I re-enrolled 51 of the original 83 child study participants, resulting in a youth participant retention rate of 61%. I interviewed at least one parent per youth, again reflecting the child study methods. One longitudinal interview was discarded; I attempted to conduct an interview with a participant who had moved to another state via Skype, but was unable to complete the interview due to poor connection speed. By discarding this interview, I was left with 50 participants. The prior studies did

not collect demographic data from the participating families beyond age and gender, as we felt collecting information on ethnic background, income level, or other factors would be overly invasive, decrease participation levels, and not be useful during data analysis, and I continued this practice during the longitudinal study.

Data Collection

Two graduate students and one undergraduate student assisted me in data collection; I trained the assisting researchers in the interviewing and data collection techniques used in this study prior to fieldwork. Preparation with the assisting researchers included mock interviews to create familiarity with not only the flow of the interview protocol, but also with the type of answers youth were likely to give. The assisting researchers acted as note takers for at least three interviews with participants prior to shifting into the position of interviewer, participated in researcher debriefing sessions after each interview, and I ensured the students were comfortable with the procedures prior to interviewing.

Two researchers (when possible) attended each longitudinal in-home interview. The assisting researchers and I interviewed both the re-enrolled participant and at least one parent. Youth interview lengths ranged from 19 minutes 37 seconds to 54 minutes 13 seconds. One researcher verbally engaged the youth participant while the second researcher ensured a quality video recording from a side perspective to capture the searcher as well as the computer monitor. The second researcher when present was additionally responsible for note taking; writing down the exact queries entered by each participant as well as details such as which result the participant clicked on or exact

spelling of queries, as the ability of the camera to capture computer monitor activity is limited. Parent interview methods mirrored the child study, and the longitudinal parent protocol can be viewed as Appendix A.

Youth Interview Protocol and Search Tasks

During the longitudinal research, I used and updated version of the child study protocol, including new questions and a more difficult search task. The differences between the child and longitudinal study scripts can be viewed in Table 1.

Table 1
Differences between the Study Scripts

Child study (Foss et al., 2012)	Longitudinal study
N/A	What things do you know how to do on the computer? What things could you improve on or learn how to do?
N/A	Were you beginning, intermediate or advanced at using the computer last time we interviewed you?
N/A	What is your favorite thing to do on the computer? Will you tell me about it?
Have you ever used the computer to look for information?	N/A
How much do you search the web for school? How much do you search the web for fun?	N/A
N/A	How did you learn how to search on the computer?
N/A	If you needed help when searching, who would you want to help you? What do they help you with? Do you search with anyone? When?
Can you search for information on dolphins and explain to me what you did?	Can you search for information on squirrels and explain to me what you did?
Can you search for information on what dolphins eat and explain to me what you did?	Can you search for information on what squirrels eat and explain to me what you did?
Have you ever used Google to find information on the computer? Why haven't you used Google?/Why do you use Google?	N/A
Do you use something other than Google to search? Why?	What sites do you use to search?
N/A	This question is a little different. Do you think Michael Jackson's music was more popular in 1983 or in 2009, and why?

The longitudinal interview protocol had three main sections. Beginning with general searching experience questions, the interview then segued into six searching tasks. The interview tasks included *open-ended* (self-generated) and *imposed* tasks. The imposed tasks were further defined by whether they were *one-step* or *multi-step* (complex) tasks. Additionally, the order of the search tasks allowed for an increasingly detailed view of participant search preference and skill, as the tasks became more specific as the interview progressed. The open-ended questions were included to observe the youth searching in the most naturalistic fashion possible despite the interview setting. Imposed tasks allowed ease of comparison across individuals, as each participant was presented with the same task. The one-step search tasks allowed researchers to observe typical search habits such as browser and search engine choice, as well as skill and familiarity with search and the computer. The multi-step search tasks established the upper threshold of search skill. The interview script concluded with general opinion questions about Google, search frustration, and a question asking the participant to describe an ideal searching tool. The entire longitudinal youth interview protocol is included in Appendix B, and Table 2 connects each interview search task to its purpose.

Table 2
Purposes for Interview Search Tasks

Task	Purpose	Type of Task
How do you usually search on the Internet?	Browser choice; Domains; Knowledge of features	Self-generated
Can you look for information on squirrels?	Search ability; Affect	Imposed, One-step
Can you look for information on what squirrels like to eat?	Navigation style; Keyword use	Imposed, One-step
If you searched on Google for your own interest, what would you search for?	Domains; Source knowledge	Self-generated
Which day of the week will the Vice President's birthday be on next year?	Task parsing; Keyword vs. natural language	Imposed, Multi-step
Was Michael Jackson's music more popular in 1983 or 2009? Why?	Task parsing; Upper search ability	Imposed, Multi-step

Resulting Data

The data resulting from each interview consisted of two sets of detailed notes, one for the parent interview and one for the youth interview. The notes generated from the interviews provided information such as clicking behavior, spelling of queries, and exact query entries of the participants, as these details can be difficult to capture via video recording. Additional data was an audio recording of the parent interview and a video recording of the youth interview. Following each interview, I transcribed the video recording and audio recording of each interview to allow for analysis of the transcripts in the qualitative data analysis program NVivo (QSR International, 2013). The transcripts provided a faithful representation of the dialogue of each interview.

Methods of Analysis

There was a multi-phase process to code the collected data. First, I recoded the participants' original interview roles using expanded data; the existing role coding did not account for search behaviors throughout the entire interview. Instead, the existing role coding relied on search behaviors for search tasks two through five only. I secondly completed emergent coding of the transcripts from the longitudinal youth interviews using Grounded Theory (Strauss & Corbin, 1998), followed by *a priori* coding of the interviews per the standardized observation protocol generated during the child study as the third phase (Lazar, Feng, & Hochheiser, 2010; LeCompte & Preissle, 1993). As the fourth phase, I used the longitudinal video recordings, notes, and the transcript coding to code for longitudinal roles. Finally, I completed case studies to understand how search behaviors changed over time in selected youth.

Child Study Role Recoding (Phase 1)

During the child study analysis, role coding was based in observations of the searches rather than drawn from a combination of the whole video, notes, and transcript coding, as was the approach for the longitudinal study. To remedy the discrepancy between the coding processes, participant child study roles were recoded using whole-video observation, notes, and the child study code structure. This phase preceded any other coding to reduce researcher bias resulting from knowledge of role occupancy in the longitudinal data. Outcomes for the role re-coding were that 76% of the 50 participants remained in their roles as coded during the child study; 12 participants had minor shifts in their role occupancy. These shifts are visualized in Figure 2.

Emergent Transcript Coding (Phase 2)

I began data analysis on the interview transcripts using the Grounded Theory approach of Strauss and Corbin (1998). Using Grounded Theory to emergently or openly code the longitudinal child transcripts allowed me to discover new data arising during the longitudinal study, preventing too narrow a focus. Emergent coding was additionally necessary due to the significant changes in the technology landscape since 2008 and 2009 when I conducted the child study analysis. In the intervening years for example, there has been an increase in mobile technology, with youth more likely to carry cell phones and devices (Lenhart et al., 2011). Due to changes such as this, as well as any unforeseen changes, it was important to begin the analysis of the longitudinal transcripts as openly as possible.

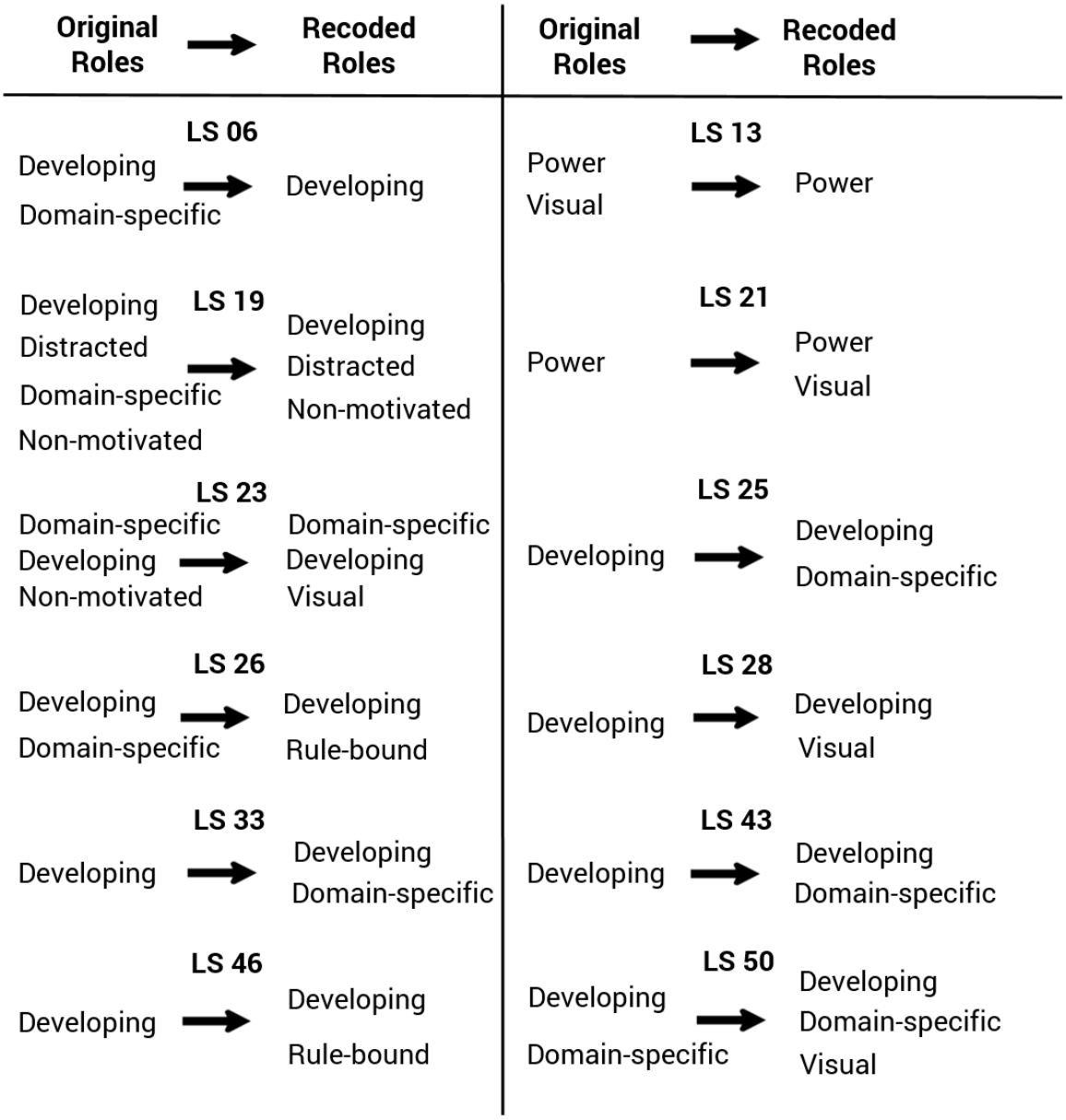

Figure 2. Shifts based on role recoding. Original roles are to the left of each column, and recoded roles are to the right of the columns.

Transcript analysis began with open coding to identify new categories and properties of categories. Following open coding analysis, axial coding allowed connections between newly identified categories and subcategories to become more explicit (Strauss & Corbin, 1998). I then moved into selective coding to identify whether

additional categories were needed or if certain categories were not needed due to infrequency. This sorting, comparing and contrasting was carried out until the data was saturated, or no new codes or categories emerged. As stated, I conducted this coding on the interview transcripts using NVivo qualitative data analysis software (QSR International, 2013).

Once I established updated emergent codes based on the longitudinal study transcripts, I returned to the transcripts from the child study and coded for the same categories and properties identified in the longitudinal transcripts. By coding all of the transcripts according to the same categories, I was able to accurately and completely compare search behaviors across time in the study participants. Appendix C contains the code structure resulting from the emergent transcript coding.

A Priori Transcript Coding (Phase 3)

As the third phase of analysis, I followed the code structure from the child study (Appendix D) in a closed or *a priori* coding procedure where I only examined the longitudinal transcripts for categories identified during the child study (LeCompte & Preissle, 1993). In the same manner as the emergent coding structure, the *a priori* coding structure contains coding categories and properties of those categories that aid in identifying search roles, as well as explanatory definitions for how to apply the categories and properties. For example, the definition of the category "Rules" is "Statements made by child during the interview explaining usual behavior or guidelines helping them to search that they are able to verbalize. Do not have to be adhered to by the individual child- this category is attempting to gather all the rules kids have together and analyze

them as a whole." One of the properties (or sub-categories) of the category of "Rules" is "Don't use Wikipedia", and this is further defined as "Child states that Wikipedia should not be used or is an unreliable site." Following the definitions within the child study code structure, I used NVivo to identify the categories present within the longitudinal transcripts.

Transcript coding inter-coder reliability. Upon completion of the emergent and *a priori* transcript coding, a second researcher familiar with the research, but not the coding structure, provided inter-coder reliability. For this process, I gave the second researcher the emergent and *a priori* longitudinal study code structures and 10% of the interview transcripts, which were randomly selected using a random number generator (Haahr, 2006). Initially, the second researcher was unable to accurately code the transcripts. Problems included the second researcher coding single-instance categories multiple times or coding categories intended to collect responses to a single question throughout the entire transcript. For example, "Triggers" is only coded for as responses to the interview question, "What makes you look for information?" The second researcher misunderstood the usage and coded triggers throughout the interview transcript.

To alleviate these problems, the second researcher and I discussed our approach and I revised the code structures for clarity by indicating explicitly how to apply each coding category. Additionally, I abridged the code structures; the second researcher did not code data I identified by using text search queries. For example, the second researcher did not code the transcripts for the numerous vocabulary words, as these are easily and reliably identified within NVivo using text search functions. The second researcher used Microsoft Word to insert comments in the text of the transcripts (see Figure 3). These

comments contained the second researcher's coding. I then entered the second researcher's coding into NVivo and ran coding comparison queries on the categories contained in the abridged code structures.

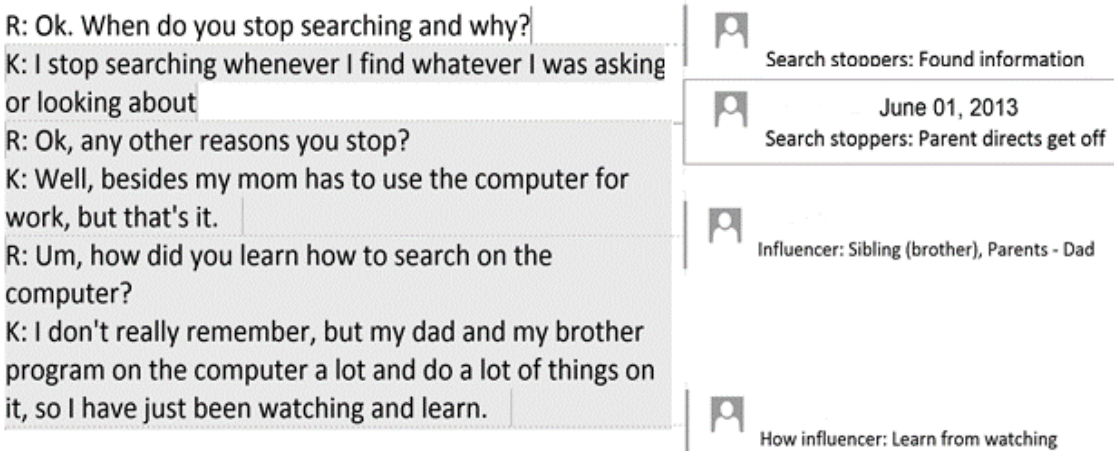

Figure 3. Coding by a second researcher. Using Microsoft Word, a second researcher applied the emergent and *a priori* codes to interview transcripts using the comments feature.

NVivo provides Cohen's Kappa as a measure of coding agreement for comparing two raters by assessing coding by the raters at the character level in a document. Kappa ranges from zero, indicating no agreement between coders, to a value of one, indicating complete agreement between coders (Lazar et al., 2010). Figure 4 (NVivo 10 Help, N.D.) provides the scale used in this study for ascertaining whether agreement was strong between two coders. Calculated for five transcripts, the second researcher and I had an overall Kappa value of 0.77, indicating excellent agreement. Lazar, Feng, and Hochheiser (2010) provide the interpretation of the Kappa score that a value above .60 indicates "satisfactory reliability" (p. 298).

Kappa value	Interpretation
Below 0.40	Poor agreement
0.40 – 0.75	Fair to good agreement
Over 0.75	Excellent agreement

Figure 4. Interpreting Kappa values. This chart from NVivo's help documents illustrates the interpretations for researcher coding agreement values. (NVivo 10 Help, N.D.)

Longitudinal Role Coding (Phase 4)

In order to code for roles, I used the categories and properties defined in the longitudinal emergent and *a priori* code structures with my observations from watching the interview videos. I additionally used the interview notes as a reference to ensure full understanding of all search behaviors, as the notes contained data that was not available from watching the videos or reading the transcripts. By combining all of the data, I was able to understand each participant's entire process of search, and was able to note commonalities among the participants. I remained open to the possibility of new search roles emerging, of one role splitting into two distinct roles, or the need to redefine an existing role during this study. As my ability to reliably code for roles was established by inter-coder reliability checks during Foss et al. (2012, 2013), I completed this phase of analysis independently.

Case Studies (Phase 5)

In order to address the third research question, "How do changes occur over time for individual youth searchers?", I drew upon case study methods to provide an in-depth view into individual searchers. Using a multiple-case replication design, I examined three youth in the same manner (Yin, 2009). This approach allowed me to describe change in individuals in terms of observable search behaviors, participant report, parent perspectives, and I additionally drew upon my contextual observations having visited the home environment of all participants at least once. The case study approach was useful as a test to the theoretical framework of roles as case studies can draw attention to alternate theories or extend current theories (LeCompte & Preissle, 1993). I considered factors

such as role, age, gender, and role shifts over time when I selected the case studies and attempted to include representative as well as challenge cases (Yin, 2009). To analyze the case study data, I relied on parent interview data as well as youth interview data, as this provided me a broader perspective of the contextual factors surrounding changes over time.

For each search behavior, I examined factors that would aid in understanding how change or stasis occurred in the roles of each case study youth. The case study approach drew attention to specific instances of search behaviors as examples and uncovered the reasons behind the search behaviors displayed by the participant. Additionally, I was able to explore the interplay between different search behaviors to discover whether combinations of different behaviors produced unique or typical changes in the examined youths' roles.

Summary of Research Methods

Chapter 4 presented my role as a researcher during the longitudinal study, introduced the participant group, and gave an overview of the data collection process and the protocol implemented in the longitudinal research. The multi-phase analysis method was additionally described to clarify how the results contained in the following chapter were obtained.

The following chapter will describe the findings from this research. A detailed examination of role changes in participants opens the chapter. Following this, the observed search behavior findings are presented. As there are numerous search behaviors discussed, they are divided into the areas of skill-based behaviors, alternate searching strategies, support behaviors, and responses to interview questions for clarity.

Chapter 5: Results

In this chapter:

- Longitudinal examination of roles
- Skill-based search behaviors
- Alternate searching strategies
- Support behaviors
- Responses to interview questions
- Summary of results

This chapter presents the data resulting from the multi-phase analysis process described in Chapter 4. The findings regarding the roles, their relationships to each other, individual participants' shifts in role, and roles related to participant age opens the chapter. These findings address the first research question of the study, "What are the transitions in search role occupancy over time in youth?" Detailed findings regarding search behaviors follow, and are grouped into skill-based search behaviors, alternate searching strategies, non-search support behaviors affecting search ability, and participant responses to direct interview questions. The findings regarding search behaviors address the second research question of this study, "What are the changes in search behaviors over time by role and by age?"

Longitudinal Examination of Roles

The first research question of this study concerns the shifts in role displayed by participants over time. The following sections present the relationships among the roles for the child study and the longitudinal study using separate visualizations, followed by a systemic visualization of participant role movement over time. A close examination of how participants from each child study role transitioned into each

longitudinal study role is included. Participant age for both studies in terms of role is also addressed using visualizations.

Child and Longitudinal Study Roles

During both studies, participants often displayed traits of multiple roles, as different search tasks completed during the interviews highlighted behaviors specific to different roles. For example, when asked to demonstrate a search for their own interest, a participant might display traits of the Domain-specific role, but when completing the complex search task regarding the Vice President's birthday, the same participant could show Power Searcher traits. In instances of displaying multiple roles, participants were coded into all appropriate roles.

For the 50 child study participants in 2008, there were seven roles: Developing, Distracted, Domain-specific, Non-motivated, Power, Rule-bound, and Visual. In the longitudinal study, the same 50 participants showed eight roles; the eighth role of Social Searcher was only observed during the longitudinal study. The largest change in role frequency between studies was for the 13 Social Searchers observed during the longitudinal study. Participants most frequently displayed the role of Developing during both studies, although there were more Developing Searchers during the child study than during the longitudinal study. Ten of the child study Developing Searchers moved into the longitudinal role of Power Searcher, accounting for all of the growth to the Power role. Domain-specific was also a frequently observed role during both studies, and there were near equal numbers of participants displaying Domain-specific traits across studies. There were also comparable numbers of Visual and Rule-bound Searchers during each

study. There were slightly more Distracted and Non-motivated Searchers during the child study; the role of Distracted nearly vanished during the longitudinal study. The changes in observed role frequency by study are visible in Figure 5.

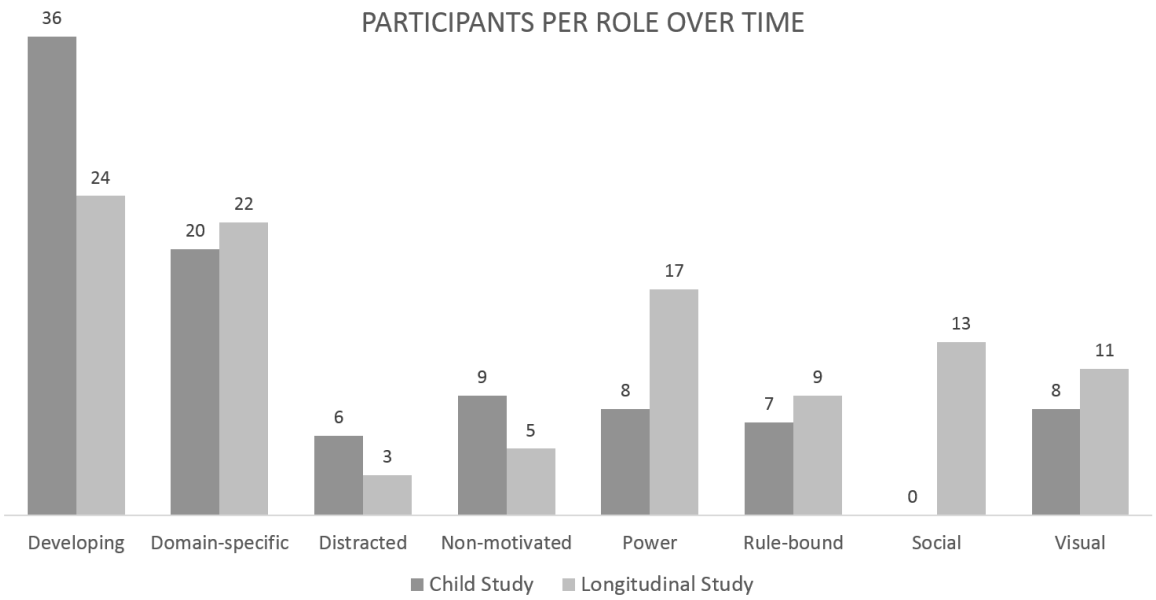

Figure 5. Participants per role over time. Number of participants displaying each role during the child and the longitudinal study.

Individual participants in both studies frequently showed the traits of multiple roles. In these instances, the participants were coded into all applicable roles; one participant could be a Developing, Domain-specific, and Visual Searcher, displaying three search roles. Child study participants displayed between one and four roles per participant. The longitudinal study youth also displayed between one and four roles per participant. During the child study, each participant displayed 1.88 roles on average and as longitudinal study participants, the youth showed 2.08 roles on average. Table 3 shows the distribution of child and longitudinal study participants in terms of the number of roles displayed. Child study participants were most likely to display only one search role while longitudinal study participants most often displayed two roles. Similar numbers of

participants during both studies displayed three roles, and four roles was uncommon, only displayed by three participants in each study.

Table 3
Number of Roles Displayed by Participants per Study

Number of Roles	2008	2013
1	21	13
2	17	23
3	9	11
4	3	3

Per Study Role Relationships

As discussed, participants during the studies could show traits from more than one search role, creating relationships between the roles. Examining role relationships at the pair level, strong role pairs have a high percentage of participants who display both roles, and roles that are weakly connected have lower percentages or no participants who display both roles. Understanding how the roles relate to each other is useful to adult stakeholders concerned with youth search; if some roles are frequently observed in conjunction, the strong role relationships allow similar intervention techniques. However, weak role relationships also importantly show where separate instruction and design interventions are needed.

NodeXL (Smith et al., 2010) is a tool that works within Microsoft Excel to facilitate the exploration of social networks by visually displaying the relationships among pairs of objects. Using NodeXL, I created two graphs; one of the role relationships formed during 2008, Figure 6, and the second of role relationships formed during 2013, Figure 7. When compared against each other, these graphs show how the role relationships changed between the studies.

In each graph, the search roles are represented by light blue vertices. The size of the vertices is larger for roles with more participants. Vertices are connected to each other by an edge line if any participants displayed both roles. Edge weight, or the thickness of the lines connecting the roles, is based on the percentage of participants from either role who display both of the connected roles. Noticeable in the graphs are small dark blue loops attached to some roles; the loops represent participants who only displayed the role to which they are associated. Visually, the graphs use the same parameters for vertex size and edge weight to allow for comparison. However, the graphs do have different role layouts, as I placed the roles to reduce visual clutter caused by edge crossings. These graphs display all of the role pairs in both studies, but it should be noted that participants displaying three or four roles cannot be traced in the graphs beyond the pair level.

Comparing the graphs reveals some differences between role relationships during the studies. For 2013, there is much more overlap between roles, as there are more thick edges connecting role pairs in Figure 7. In comparison, youth in 2008 were commonly coded as both Developing and Domain-specific Searchers but showed no other strong connections in Figure 6. The loops indicating a participant showing only one role are more common in the 2008 graph, and in both studies participants with a single role were most likely to be Power, Developing, or Non-motivated Searchers. Power Searchers in 2008 are only paired with Visual Searchers, and so are relatively isolated, whereas 2013 Power Searchers are connected not only to Visual but also strongly to Domain-specific and Social longitudinal roles. Despite its crowded appearance, the 2013 graph has only three more edges than the 2008 graph; an appropriate increase when accounting for the additional Social Searcher role.

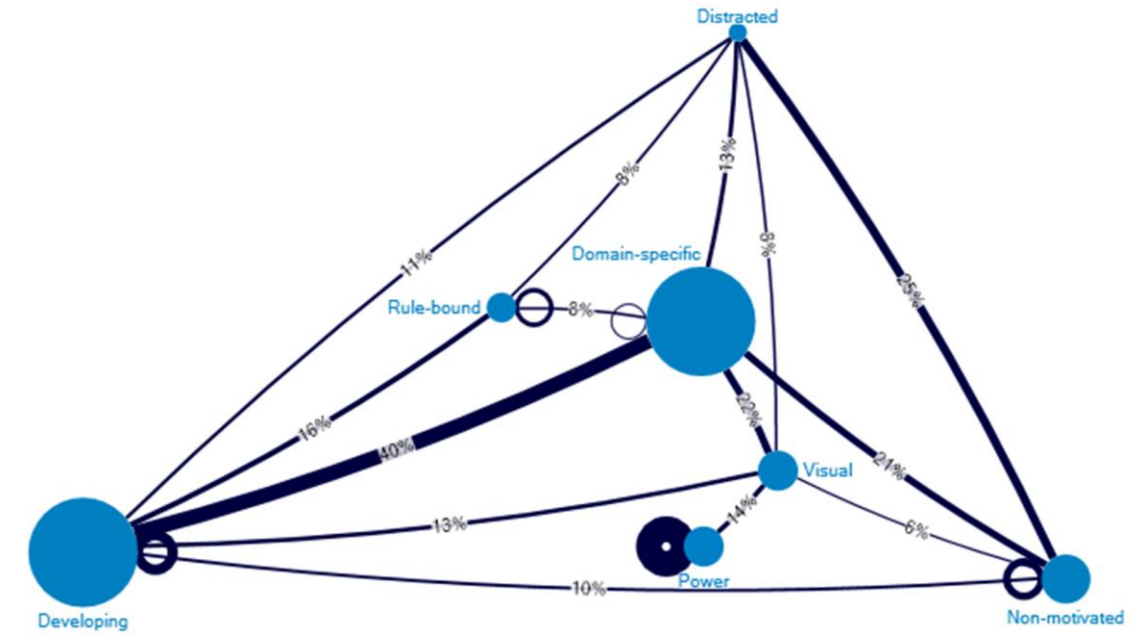

Figure 6. 2008 role distribution and relationships. Each role is represented as a light blue circle, with larger circle size indicating higher numbers of participants. Connecting lines are thicker where a higher percentage of participants display the role pair. Dark blue loops represent only one role displayed.

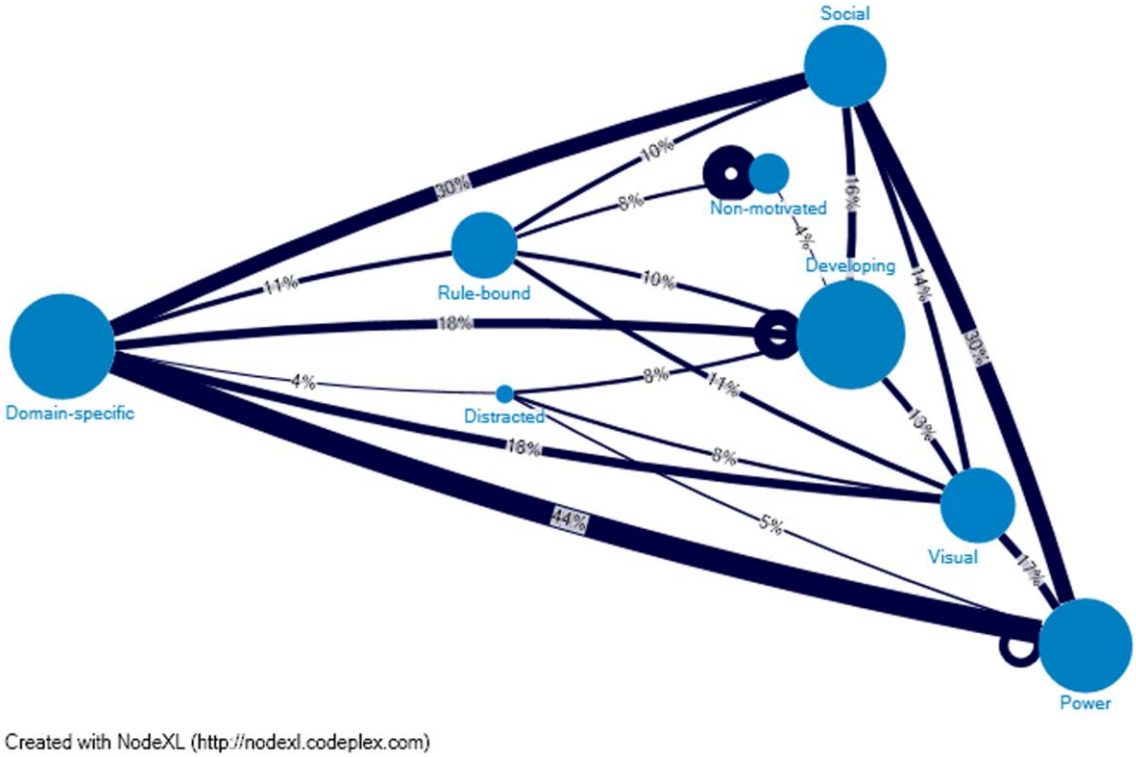

Figure 7. 2013 role distribution and relationships.

Role Shifts over Time

In directly addressing the first research question of this study as to the differences in roles youth display over time, a visualization of the patterns of participant shifts from child study roles into longitudinal study roles is useful. I again used NodeXL (Smith et al., 2010) to create a single graphical representation connecting child study roles to longitudinal study roles. In Figure 8, the 2008 study roles are displayed as green vertices in the center of the graph and the 2013 longitudinal roles are displayed as black vertices towards the left and right margins. Vertex size indicates the number of participants per role; the larger circles represent more participants. Roles are connected by directed edges of varying width; width is dependent on the percentage of the total participants in the 2008 role who shifted to the connected 2013 role. The layout of vertices in Figure 8 is solely to reduce the number of edge crossings; the position of the roles in relation to each other has no meaning. Additionally, in order to improve readability, the graph is filtered to exclude shifts of less than 28% participants between roles, so only the largest, most common movements between roles are displayed.

In examining Figure 8, there are several predominant features regarding transitions from child study roles to longitudinal study roles. The heaviest connecting lines are from the 2008 Power role to the 2013 Power role, and from the 2008 Non-motivated role to the longitudinal Developing role; these are likely patterns of shifts in role over time. The 2013 Developing and Domain-specific roles are connected strongly to many 2008 roles. In contrast, the longitudinal Visual, Rule-bound, and Non-motivated roles are connected strongly to only one 2008 role.

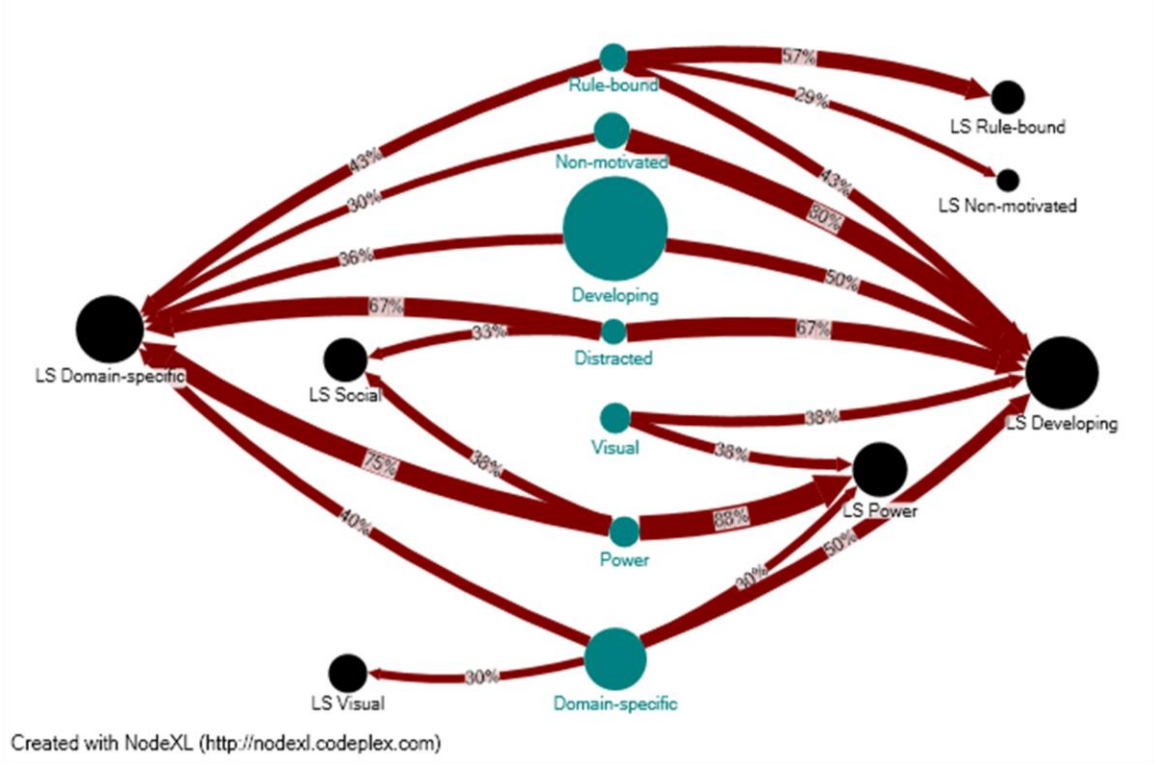

Figure 8. Shifts from 2008 roles to 2013 roles. The green circles represent 2008 roles while black circles represent 2013 roles. Larger circles show roles with more participants. The width of the connecting lines indicates the percentage of participants shifting between the connected roles.

It was uncommon for two or more participants to display the exact same role shifts over time, as observable when studying Figure 9. In this graph, the 50 participants appear aligned vertically in the center, with edges connecting each participant to the role or roles displayed in 2008 (in green to the left) or in 2013 (in black to the right). The position within the graph of the individual participants and the associated roles has no meaning; each element is positioned to reduce edge crossings to allow for readability. The main pattern apparent from this view of the role shifting is that most participants displayed unique combinations of roles when looking across both studies, although displaying some of the same roles is common.

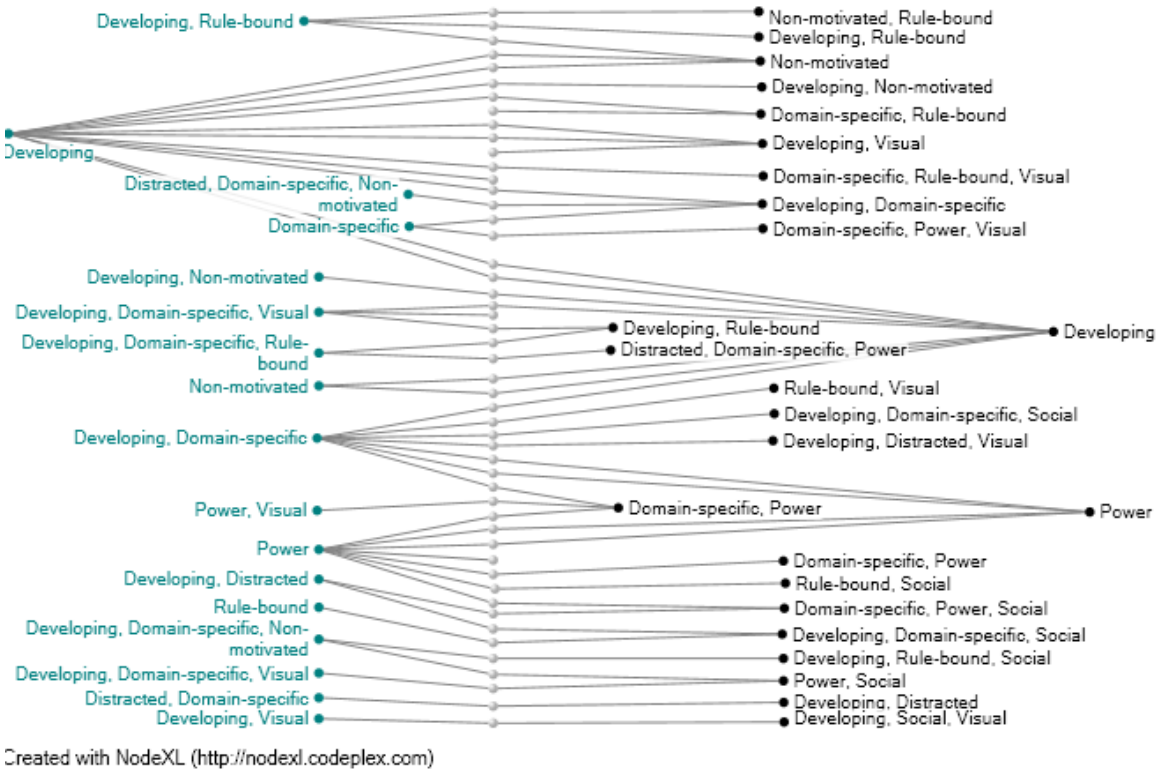

Figure 9. Role shifts for all 50 participants. 2008 roles are to the left in green and 2013 roles are to the right in black. Each participant is represented by a sphere in the center of the graph.

Role Dispersion and Composition

Each 2013 longitudinal role consisted of participants previously showing 2008 roles; participants in the 2008 child study roles dispersed into varied longitudinal roles. Of interest is which child study roles feed into which longitudinal study roles, as this can provide insight into the types of changes youth are likely to experience over time and how to provide educational and interface design support for common role shifts. The complete graphs of shifts per role are presented in the following sections, allowing an unfiltered view of the shifts out of the child study roles and into the longitudinal study roles.

Developing Searchers. Thirty-six Developing Searchers were identified during 2008, representing 72% of the searchers participating. For 2013, there were 24 Developing Searchers, representing less than half of the participating searchers at 48%. During both studies, the majority of Developing Searchers were the youngest participants.

Referring to the the bottom portion of Figure 10, which shows shifts out of the 2008 Developing role, 2008 Developing Searchers shifted into all eight 2013 roles. Fifty percent of the Developing Searchers were stable over time, shifting from the 2008 role of Developing to the 2013 role of Developing. The next-largest shift was for 36% of the 2008 Developing Searchers youth moving into the 2013 role of Domain-specific. The top of Figure 9 shows participant movement into the 2013 Developing role from 2008 roles other than Developing. The largest movement was from 80% of the participants previously displaying the role of Non-motivated Searcher into the 2013 Developing role.

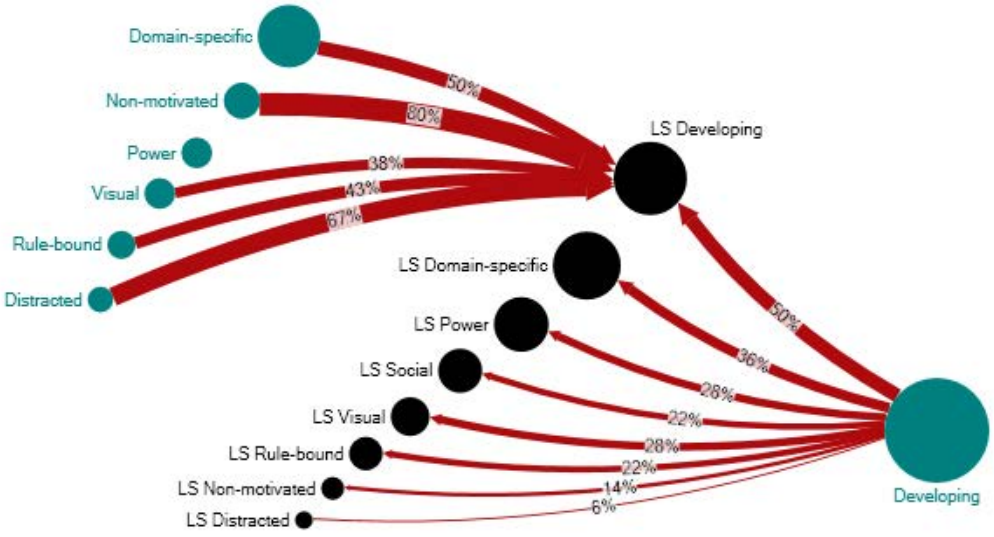

Figure 10. Developing Searcher role shifts. Child study roles are green circles, longitudinal study roles are black circles.

Distracted Searchers. During the child study, six youth were Distracted Searchers, representing 12% of the total participants. Only three participants, or 6% of the total participants, were Distracted Searchers during the longitudinal study. For both studies, Distracted was the least populated role. Child study Distracted Searchers were all either 7 or 9 years old, but during the longitudinal study, one Distracted Searcher was age 15 while the other two were in the youngest age bracket. Of the child study Distracted Searchers, only one remained a Distracted Searcher during the longitudinal study, as is visible in the bottom portion of Figure 11. For the remaining youth moving out of the role of Distracted Searcher, 67% moved into to the roles of Domain-specific and Developing and 33% became Social Searchers. The longitudinal Distracted Searcher role was comprised of participants from every child study role except Power.

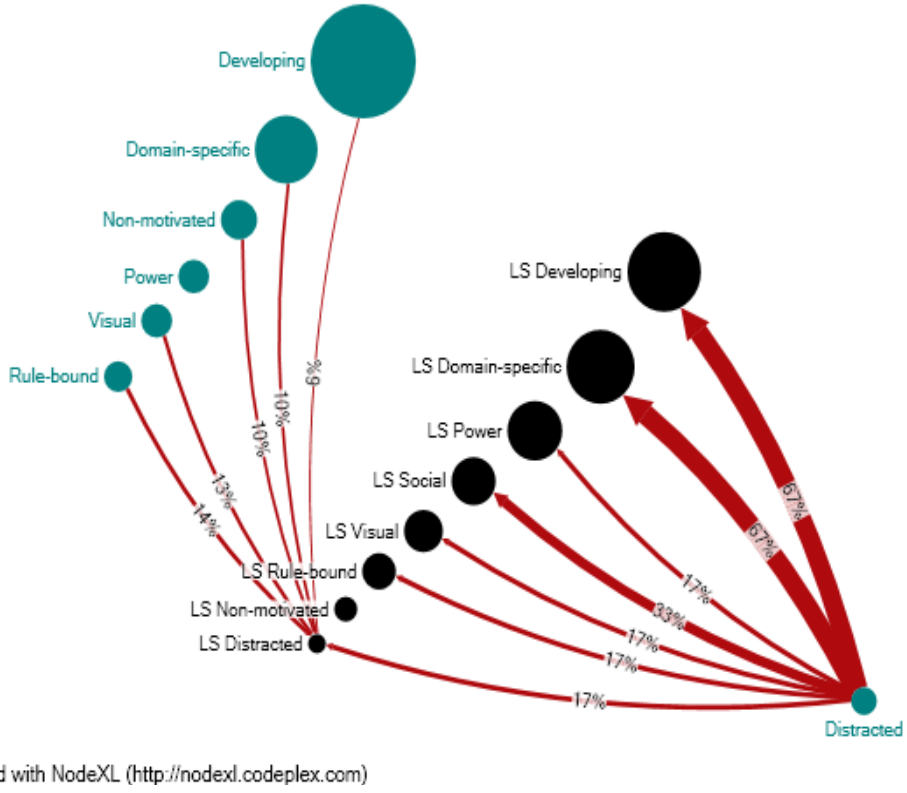

Figure 11. Distracted Searcher role shifts. Child study roles are green circles, longitudinal study roles are black circles.

Domain-specific Searchers. For 2008 participants, 40% were Domain-specific Searchers. The number of searchers in the Domain-specific role increased slightly during the 2013 study; 44% of longitudinal participants were Domain-specific Searchers. 2008 Domain-specific Searchers were largely age 7. During the 2013 study, Domain-specific Searchers were more evenly distributed among the three age brackets.

Forty percent of Domain-specific Searchers were stable in their occupancy of the role and remained Domain-specific Searchers during the 2013 study, as is visible in the bottom portion of Figure 12. In 2013, 50% of the Domain-specific Searchers became Developing Searchers, 30% became Power Searchers, and 30% moved into the role of Visual Searcher. For the youth moving into the longitudinal role of Domain-specific, the largest shift was for 75% of the 2008 Power Searchers moving into the longitudinal Domain-specific role.

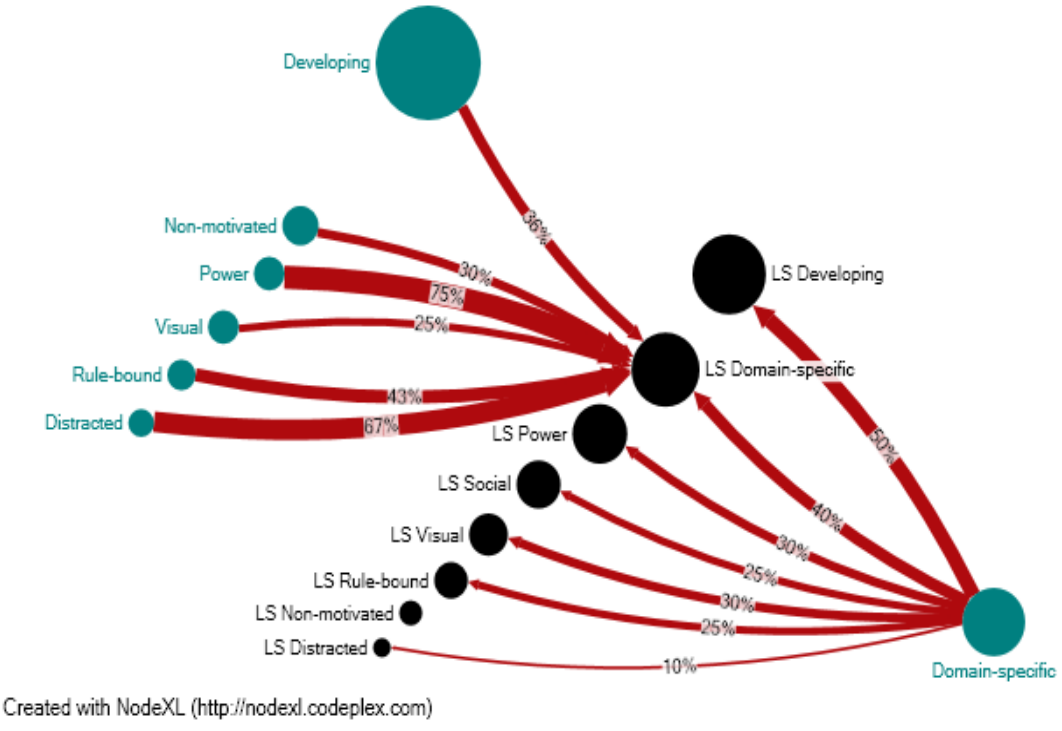

Figure 12. Domain-specific role shifts. Child study roles are green circles, longitudinal study roles are black circles.

Non-motivated Searchers. There was a decrease in the number of Non-motivated Searchers during the longitudinal study; 18% of youth were Non-motivated during the child study, and only 10% youth were Non-motivated during the longitudinal study. During the child study, 67% of Non-motivated Searchers were age 7, but during the longitudinal study, Non-motivated Searchers were more likely to be age 14 or 15, as 60% fell into the oldest age bracket.

There was no stability for this role; the Non-motivated Searchers from 2008 all moved into new roles, and the 2013 Non-motivated motivated youth were all new to the role. Non-motivated Searchers shifted mainly into the role of Developing during the 2013 study, as visible as a heavy line in the bottom portion of Figure 13. For the five new Non-motivated Searchers, all were Developing Searchers during the child study. Longitudinal Non-motivated Searchers had the fewest number of roles as child study participants; only child study Rule-bound and Developing Searchers became Non-motivated Searchers.

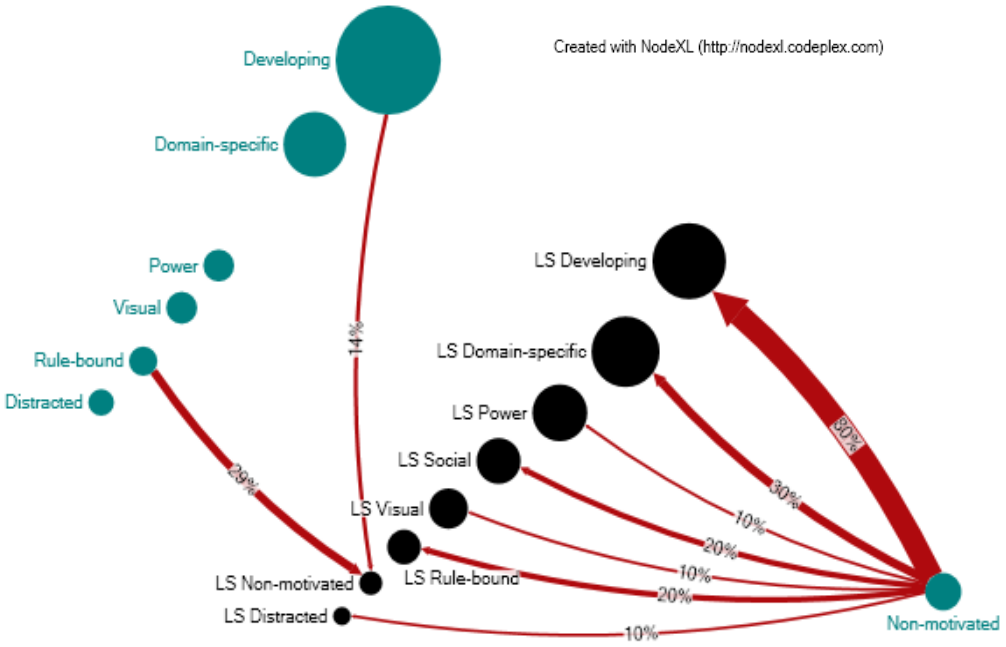

Figure 13. Non-motivated role shifts. Child study roles are green circles, longitudinal study roles are black circles.

Power Searchers. The searchers displaying the highest level of search skill, Power Searchers, became more prevalent during 2013. Sixteen percent, or eight searchers, were Power Searchers during 2008, while during 2013, 24%, or 17 of the participants were Power Searchers. Older 2008 participants were more likely to display Power Searcher traits; no 2008 Power Searchers were age 7, 38% of Power Searchers were age 9, and 63% were age 11. During 2013, while older participants were still more likely to be Power Searchers, some participants in the youngest age bracket also displayed the role; 18% of Power Searchers were 10- or 11-year olds, 35% of Power Searchers were 12- or 13-year-olds, and 47% of Power Searchers were 14- or 15- year-olds. See Figure 14 for role shifts.

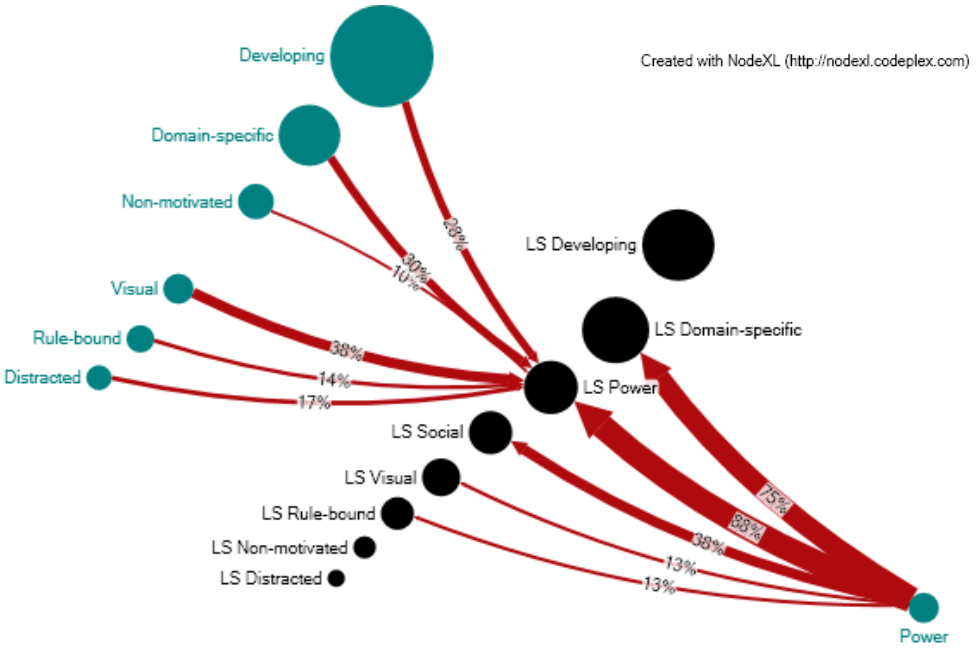

Figure 14. Power Searcher role shifts. Child study roles are green, longitudinal study roles are black circles.

Of the eight original Power Searchers, only one moved out of the Power Searcher role during the longitudinal study; 88% of the Power Searchers were stable in their role occupancy. The searcher shifting out of the Power role instead became a Rule-bound and

Social Searcher. The child study Power Searchers also showed other roles as longitudinal participants; 75% became Domain-specific Searchers and 38% transitioned into Social Searchers. For the 10 youth shifting into the Power role, all 10 were Developing Searchers during the child study, however, the longitudinal Power Searchers were formerly members of all child study roles.

Rule-bound Searchers. The role of Rule-bound had 14% of the 2008 participants. During 2013, 18% of the total participants were Rule-bound Searchers. By age, 2008 participants were more likely to display the Rule-bound role at older ages. In 2013, participants were most likely to be Rule-bound Searchers at ages 12 or 13 and least likely at ages 14 or 15. In terms of stable participants; 57% of the Rule-bound Searchers were Rule-bound during both studies, as can be seen as a heavy line in the bottom portion of Figure 15. For the youth shifting into the role of Rule-bound Searcher, 25% of Domain-specific and 22% of 2008 Developing Searchers became 2013 Rule-bound Searchers. No child study Visual Searchers became longitudinal Rule-bound Searchers.

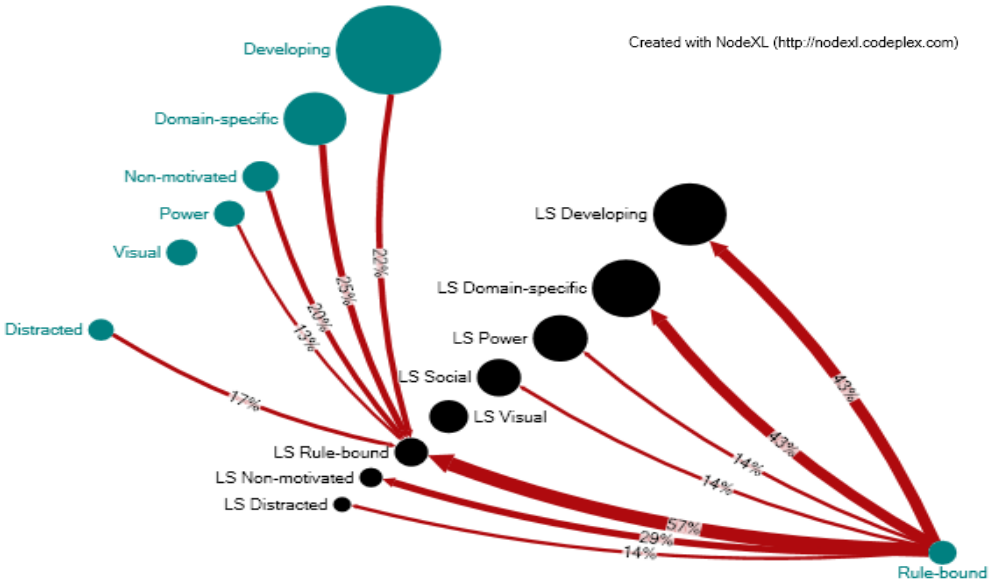

Figure 15. Rule-bound Searcher role shifts. Child study roles in green, longitudinal study roles in black.

Social Searchers. The role of Social Searcher was not observed during the child study, but 26% of youth fell into the role during the longitudinal study. Social Searchers occurred in every age bracket; 23% of 10- or 11-year-olds, 46% of 12- or 13-year-olds, and 31% of 14- or 15-year olds displayed the role of Social Searcher. 2008 Power Searchers were most likely of all the roles to transition into Social Searchers, as 38% of the child study Power Searchers followed this pattern. Participants from all of the child study roles became longitudinal Social Searchers. Figure 16 shows the percentages of participants from each child study roles shifting into the role of Social Searcher.

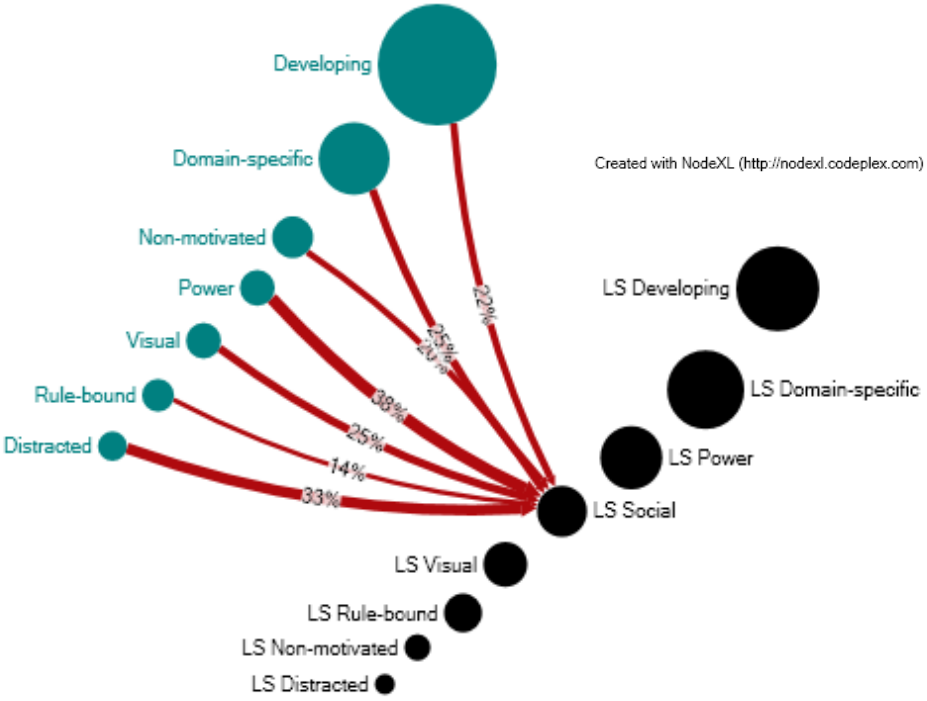

Figure 16. Social Searcher role shifts. Child study roles in green, longitudinal study roles in black.

Visual Searchers. Sixteen percent of the child study participants were Visual Searchers, while during the longitudinal study there was an increase to 22% for the role. Child study Visual Searchers were most frequently in the youngest age bracket; 50% of child study Visual Searchers were are 7, 25% were age 9, and 25% were age 11. During

the longitudinal study, the youngest participants were again most likely to be Visual Searchers; 45% for longitudinal Visual Searchers were in the youngest age bracket, 36% were in the middle age bracket, and 18% were the oldest participants.

Only two of the original eight Visual Searchers remained in the role during the longitudinal study; the role stability was 25%. For the child study Visual Searchers, 38% transitioned into longitudinal Power Searchers, 38% became longitudinal Developing Searchers, and 25% shifted into longitudinal Domain-specific Searchers. For the prior roles of the longitudinal Visual Searchers, 30% of Domain-specific Searchers and 28% of child study Developing Searchers transitioned to the Visual role. No child study Rule-bound Searchers became longitudinal Visual Searchers, as there is no edge connecting the roles in the top portion of Figure 17.

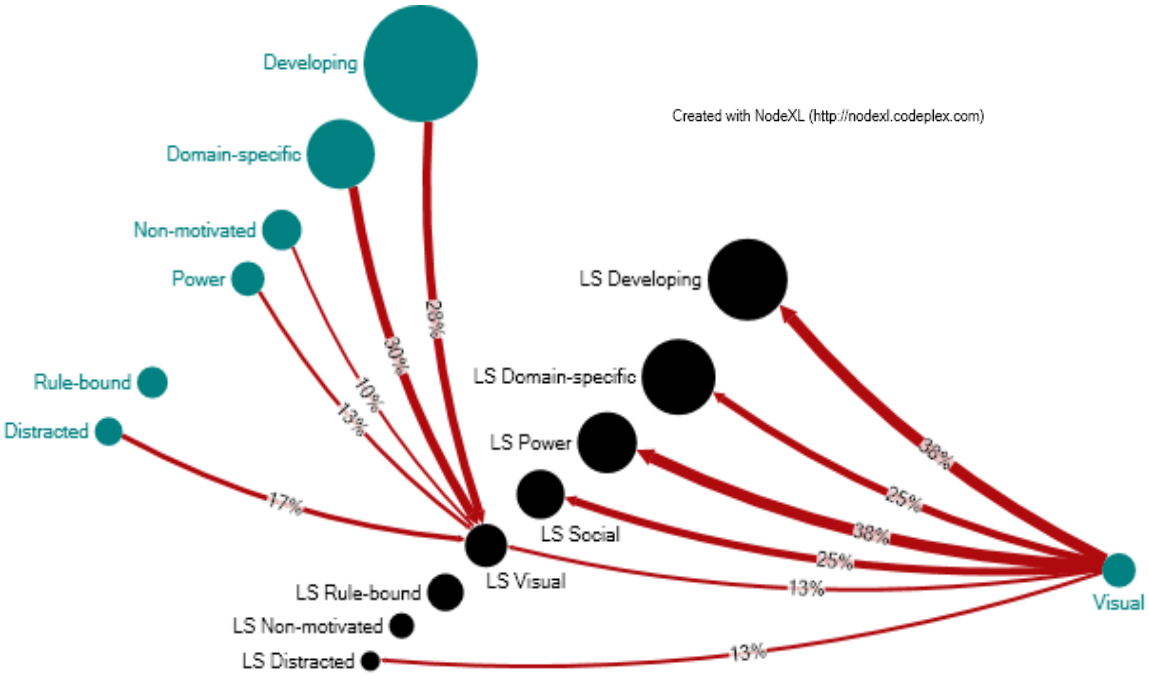

Figure 17. Visual Searcher role shifts. Child study roles in green, longitudinal study roles in black.

Roles by Age

The youngest participants during both studies were more strongly associated with fewer roles than participants in the older two age groups. Looking at Figure 18, which displays the age-role connections as a complete system across both studies, reveals that participants age 7 in 2008 were most likely to be Developing or Domain-specific Searchers. At age 9, participants were most likely to be Developing Searchers, while at age 11 in 2008, there is a more even distribution of youth into varied roles. For 2013, the youngest age group, age 10 and 11, was again most likely to display the role of Developing, while older participants were more evenly distributed into the roles.

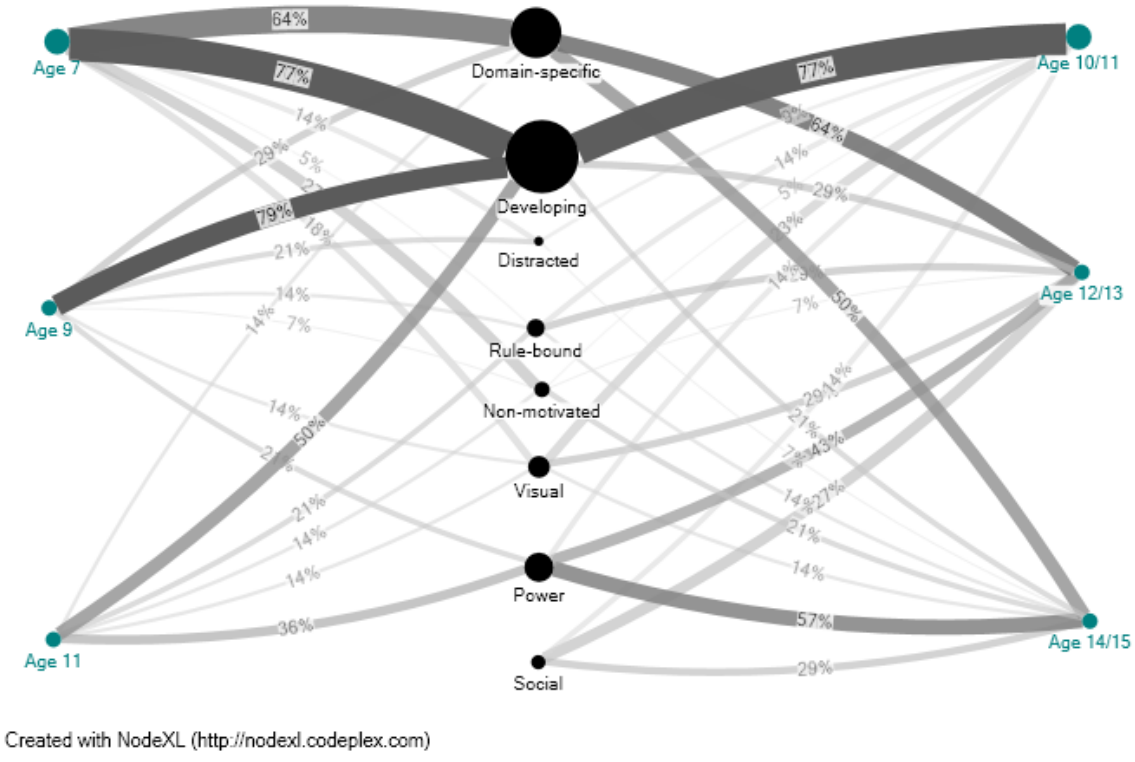

Figure 18. Percentage of participants by age displaying each role.

As age is a vital factor when examining youth, Figures 19, 20, and 21 depict the connections between the 2008 study and 2013 age groupings and the roles; these graphs show the information from Figure 18 in isolation for each age group. In these graphs, edge width is based on the percentage of participants of each age group who displayed the connected role. The size of the vertices has no meaning; the number of participants in each age bracket is equal for both studies as the same youth participated, and the role vertices represent the child and longitudinal study roles in aggregate, where the numbers of participants are not equal. In Figures 19, 20, and 21, the roles are displayed in grey in the center, the child study ages are displayed in green at the top left, and the longitudinal study ages are displayed in black at the bottom right of the graphs.

In Figure 19, the strongest connections are between both age groupings and the role of Developing. Many of the 7-year-old child study participants were also in the role of Domain-specific. There is no connection between the youngest child study participants and the Power Searcher role (the lack of connection to Social is due to the role not being present in the child study participants). The bottom portion of Figure 19 shows the youngest longitudinal participants connected to every role, including Power. The role of Non-motivated is much less common for the youngest longitudinal participants than it is for the youngest child study participants, as is the role of Domain-specific.

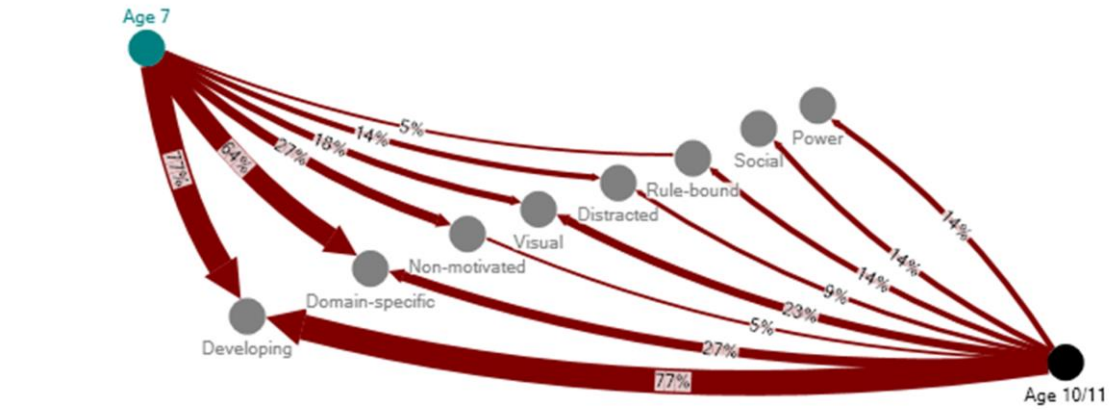

Figure 19. Shifts in roles over time for the youngest participants. The youngest participant group was age 7 during the child study and age 10 and 11 during the longitudinal study. The participants at each age are displayed connected to the roles. Edge width is thinner for lower percentages of participants. N=22.

For Figure 20, the strongest connection is between the child study participants in the middle age group, aged 9, and the role of Developing. These same participants as 12- or 13-year-olds are instead most connected to the role of Domain-specific. There are no participants age 12 or 13 connected to the role of Distracted, although this role was not uncommon for the 9-year-olds during the child study.

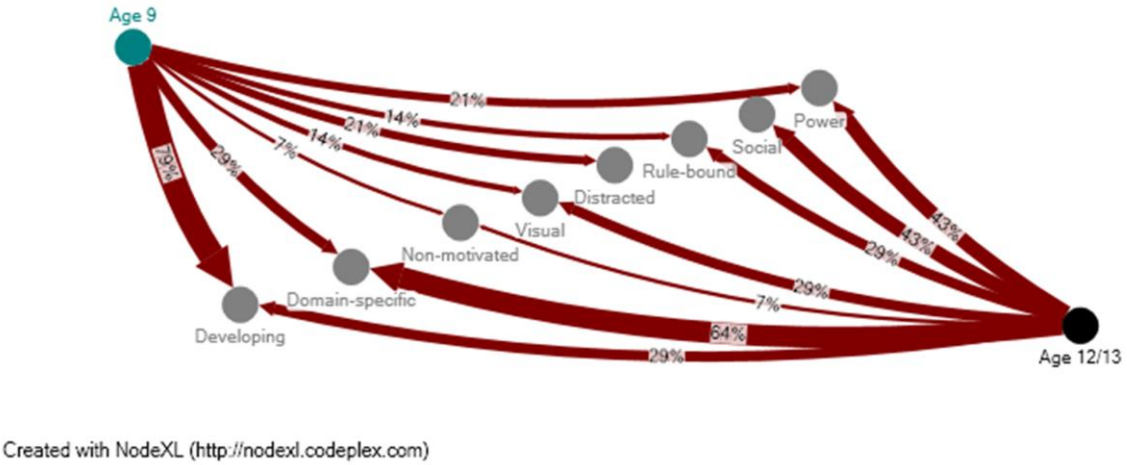

Figure 20. Shifts in roles over time for the middle age group of participants. The middle group was age 9 during the child study and age 12 and 13 during the longitudinal study. The participants at each age are displayed connected to the roles. Edge width is thinner for lower percentages of participants. N=14.

For the 14- or 15- year-olds displayed at the bottom of Figure 21, the strongest connections are to the roles of Power and Domain-specific. As 11-year-old child study participants, these youth were instead most often associated with the role of Developing. No participants in the oldest child study age group, those aged 11, fell into the role of Distracted. Similar percentages of participants in the oldest group fell into the roles of Non-motivated, Visual, and Rule-bound during both studies; most change for this age group was in the shift away from Developing and into Power and Domain-specific.

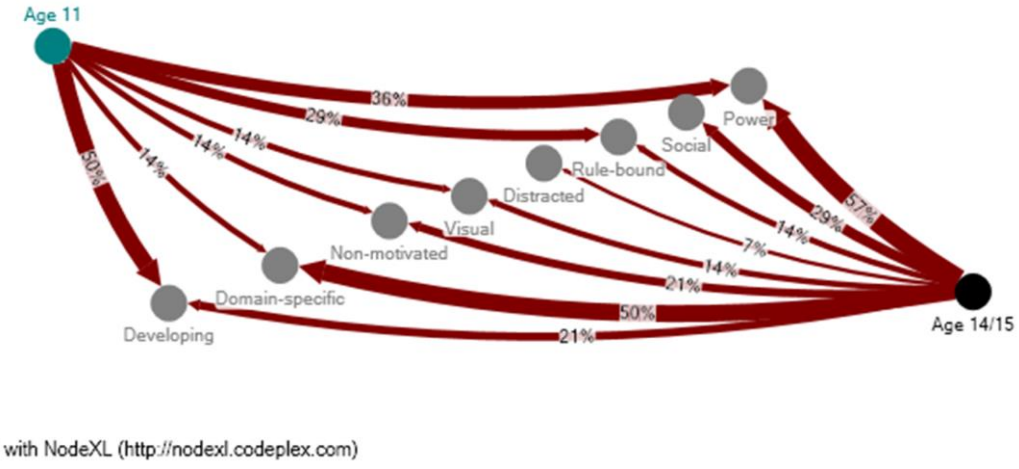

Figure 21. Shifts in roles over time for the oldest participants. The oldest participants were age 11 during the child study and age 14 and 15 during the longitudinal study. The participants at each age are displayed connected to the roles. Edge width is thinner for lower percentages of participants. N=14.

Skill-based Search Behaviors

The second research question inquires how search behaviors change over time in youth through looking at changes by role and by age. This section regarding search skill and the following sections on alternate searching strategies, support behaviors, and responses to interview questions address the changes in search behaviors in youth over time.

Some search behaviors, when present in an individual youth, can allow for more successful Internet searching. These search behaviors are grouped together in this section as skill-based search behaviors. Skill-based search behaviors consist of knowledge that can aid youth in overcoming typical breakdown points as they progress through the stages of a search. These search behaviors are: knowledge of interface features, knowledge of sources, awareness of advertisements, high computer-related vocabulary, verifying information,and the absence of expressing in-context frustration. The behavior of aiding others is included as well as helping another person when searching indicates the helper possessesskills above the level of or different from the person they are helping.

Knowledge of Interface Features

Most participants during both studies used the Google search engine, mainly by choice, but also as the default engine of their browsers. This consistency allowed for comparison of participant awareness of search engine interface features, ranging from the textbox for query entry to hidden advanced searching tools.

When participants either verbally explained a feature of the search engine or verbally explained and used a feature, they were coded as having knowledge of that feature. Participants who simply used specific features but did not combine use with verbal explanation were not coded as having knowledge of the feature. Displaying knowledge of features could occur at any point during the interview, but participants were especially likely to mention features in response to the interview question, “Can you pretend I’ve never searched before and show me how it works?” Thirteen features were prominent enough to engender mentioning by the participants during the child study:

advanced search, link color (already visited site), autocomplete, "Did you mean", "I'm Feeling Lucky", language tools, maps, next page, number and speed of results, quotation marks operator, related searches, shopping, and the AppBar (containing filtering tools such as images or quick access to Google products such as Gmail).

During the longitudinal study, participants discussed all of the child study features, with the addition of five others; some longitudinally discussed features were present in 2008 and some features were new to the Google search interface since the child study: further advanced operators, query terms appearing in bold text, Google Easter Eggs (see Figure 22), the Knowledge Graph (concise results presented on the right side of the search results page, see Figure 23), and sitelinks (the main result with additional pages from that result listed below, see Figure 23).

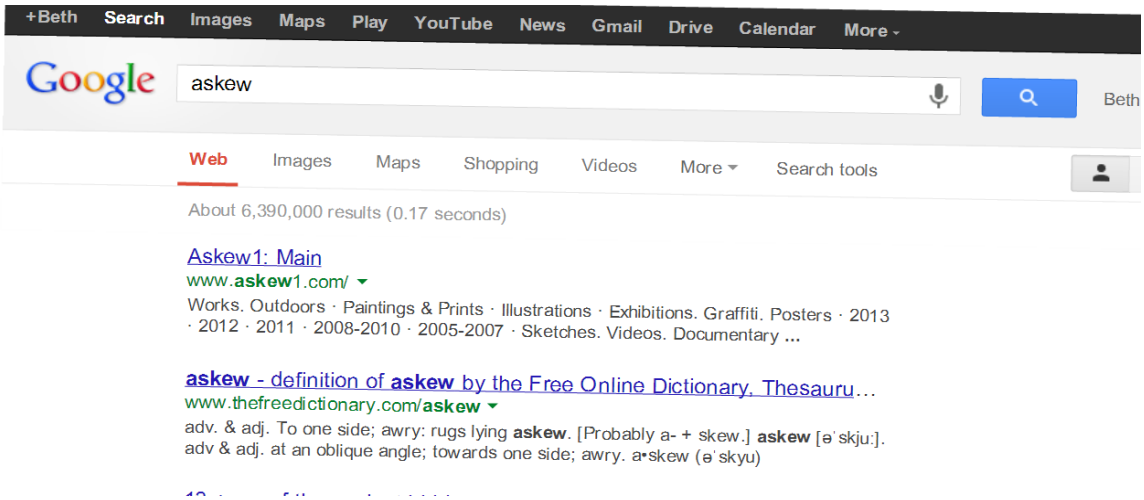

Figure 22. An example Google Easter Egg. Entering the query [askew] rotates the screen view slightly.

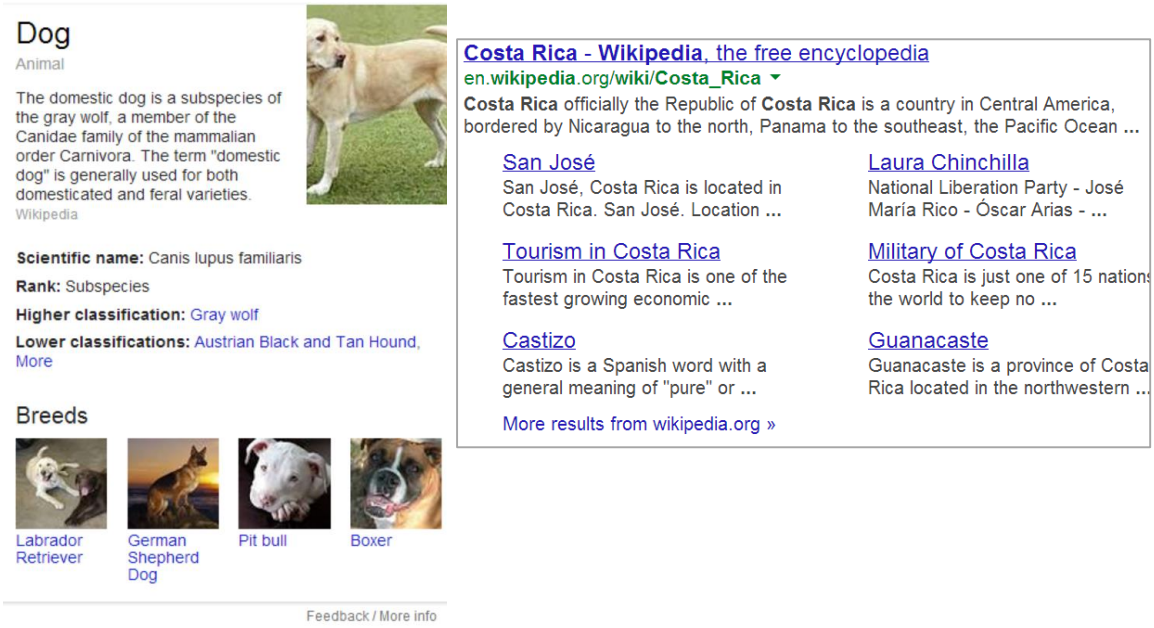

Figure 23. An example Knowledge Graph and Sitelinks. Examples of the Google features Knowledge Graph (from June, 2013) and sitelinks based on the query [costa rica] (from September, 2013).

Sixty-six percent of the child study participants demonstrated knowledge of features, discussing at least one feature at some point during the interview. The most commonly discussed feature was the ability to go to the next page of search results. However, most of the searchers did not venture past the first page of results. Of the 13 participants who discussed that there were additional results pages, only six clicked through to see more results. The second-most common feature discussed by the child study participants was the autocomplete, or query suggestion box, which was mentioned or mentioned in combination with use by 20% of child study participants. “Did you mean” was discussed by 18% of child study participants, making it the third-most commonly discussed search engine feature. Given that many of the study participants had spelling difficulty, it is not surprising that “Did you mean” and autocomplete were

common features of which the participants were aware. Google Maps and the number and speed of returned results were each mentioned by 14% of child study participants.

For the longitudinal participants, 80% of youth discussed or discussed and used at least one feature of the search engine. The most frequently mentioned feature for the longitudinal youth was the AppBar, by 35% of longitudinal youth. The longitudinal study version of the AppBar was more prominent than during the child study due to the black background (as can be seen in Figure 23), and perhaps this visual draw contributed to the participants' increased awareness of it as a feature. Verbal references to the AppBar occurred when a participant discussed the contents of the AppBar as a whole:

14-year-old girl:

> And if you want to change your search maybe from web to images, maps, shopping, and there's a bunch of other tools you can use.

Mentions such as this were not additionally coded into the related categories, such as shopping or maps. When the participants discussed individual parts of the AppBar in isolation, the features were coded into the associated category (in this case, maps) but not into the AppBar category:

15-year-old boy:

> Looking for some place, you can go to maps. . . .

Twenty-eight percent of longitudinal participants discussed the related searches on the search results page. This is a surprising finding given that the related searches are placed at the very bottom of the list of results. Similar to the child study participants, the longitudinal participants were highly aware of the autocomplete and next page features, as 26% of longitudinal youth discussed or discussed and used autocomplete and 24%

discussed the next page of results. Again, similarly to the child study participants, only three of the 12 youth discussing multiple results pages actually clicked past the first page of results. The fourth-most common feature reported by the longitudinal study participants was the number and speed of search results returned by the search engine; 20% of longitudinal participants discussed this feature.

Only 20% of the participants mentioned the same feature in both studies. This is expected, as the participants spontaneously volunteered information about the search engine features rather than responded to researcher questions about the features. Additionally, the changes to the Google search interface over time made discussing some features longitudinally difficult. For example, the Did you mean feature was not present for all of the misspelled queries entered by the longitudinal participants, as depending on the query, the alternatives "Showing results for" of "Including results for" may have been displayed. Therefore, the less-frequent mentions of the Did you mean feature during the longitudinal study may have been due to interface changes, not changes in the participants. Autocomplete was most likely to have stable participant mentions with 8% of participants discussing it during both studies, followed by the AppBar, discussed by 6% of participants during both studies. The numbers of child and longitudinal participants discussing each feature are available in Figure 24.

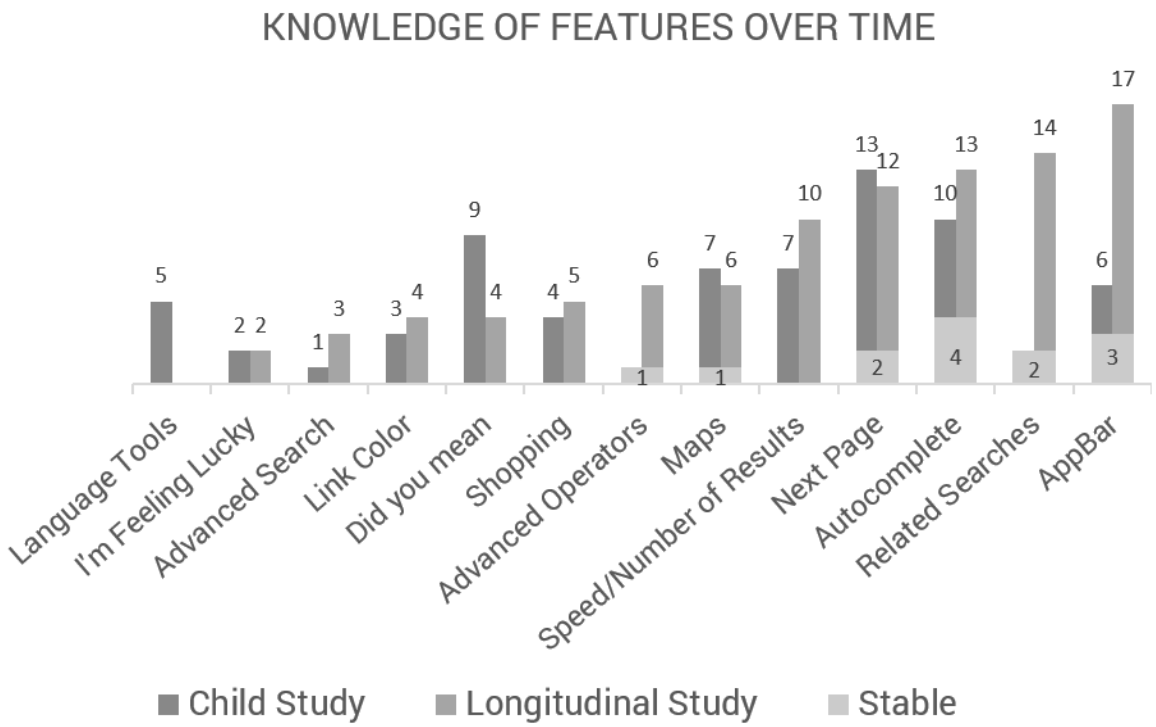

Figure 24. Knowledge of features over time. Number of child and longitudinal participants who discussed each interface feature.

Power Searchers were more familiar with search engine features than youth in other roles during both the child and longitudinal studies (see Figure 25). Power Searchers also showed the least amount of growth in knowing features between the studies; Rule-bound Searchers also showed little increase over time. Of all the roles, Domain-specific Searchers showed the most amount of increase over time in knowing features. Non-motivated Searchers also displayed an increase in awareness of features during the longitudinal study. Distracted Searchers discussed the fewest features during both studies, and the longitudinal Social Searchers were highly aware of search engine features.

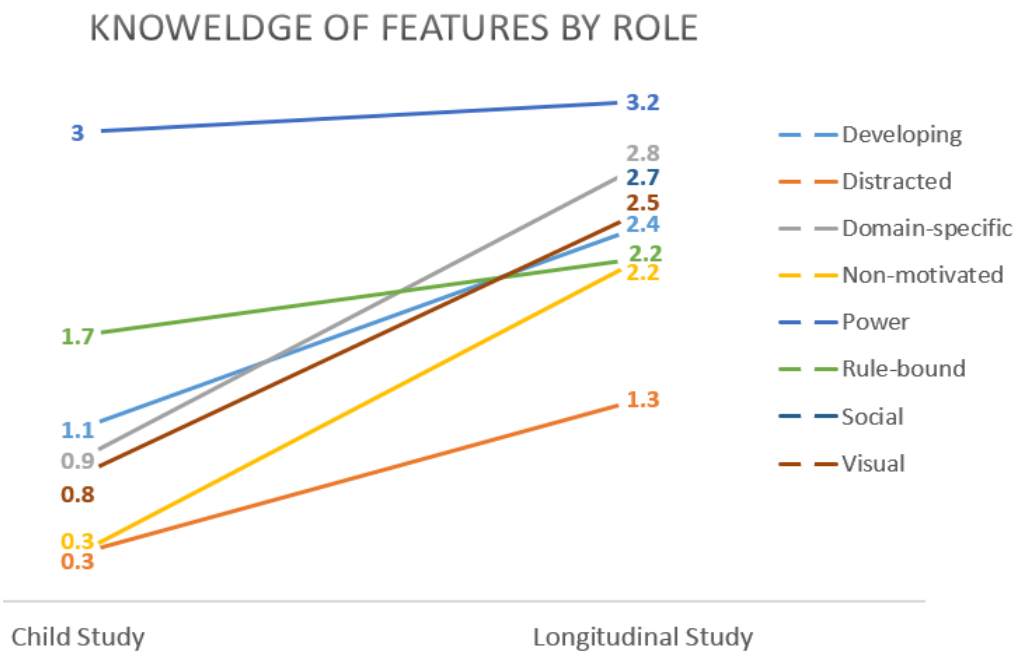

Figure 25. Knowledge of features by role. Average number of search engine features discussed by child and longitudinal study participants by role.

Each age group of participants increased during the longitudinal study in the number of features known per participant. The oldest group in the child study, the 11-year-olds, showed a smaller increase than did the middle and youngest groups of participants, and as longitudinal participants, these searchers were aware of more search engine features than longitudinal Power Searchers. Figure 26 illustrates the number of features discussed by each age grouping of participants during the child study and during the longitudinal study.

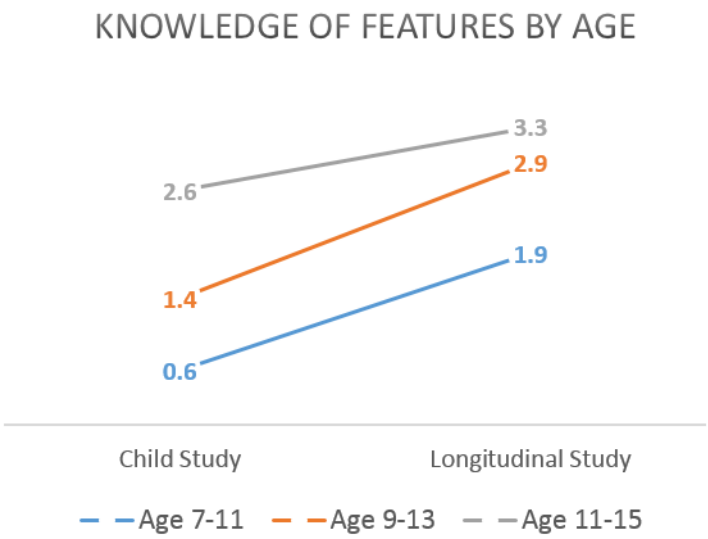

Figure 26. Knowledge of features by age. Average number of search engine features discussed by child study and longitudinal study participants by age.

Knowledge of Sources

Knowing sources for information is widely useful; beyond being able to trust an information source or bypass search altogether, youth more easily choose a result when they are aware of the source presented on the search engine results page, as evidenced by the frequent reporting of selecting results due to website recognition. During the longitudinal study, all youth showed large improvement from the child study frequency of knowledge of sources. The unilateral increase in source knowledge suggests that becoming familiar with specific resources is an obtainable, if not unavoidable, skill.

On occasion during the child and longitudinal study interviews, the youth discussed websites with which they had prior experience, knew the content, had visited before, or knew would contain particular types of information. Indicating knowledge of sources occurred both prior to beginning a search as well as in response to recognizing a

website from the results page. For example, this searcher participating in the child study reported knowing sources prior to beginning his search:

11-year-old boy:

I usually already know what stores I want to go to like Amazon or Lego.com.

In general, the longitudinal participants knew more details about their known sources. One searcher in the child study described Wikipedia with little depth:

11-year-old girl:

Interviewee: Wikipedia has everything really.

Interviewer: Ok, why'd you pick Wikipedia?

Interviewee: Cause it has everything that, it usually has every, like all the information that you need.

In contrast, a searcher in the longitudinal study explained Wikipedia in much more detail:

13-year-old boy:

Interviewer: Ok, and why did you click on the Wikipedia page?

Interviewee: Because I find Wikipedia, although you might not be able to source it, you can go to sources- you can't cite it yourself- you can go to the places where you found its sources.

During the child study, 32% of participants discussed their prior experience with websites. Knowing sources was much more prevalent during the longitudinal study: 84% of longitudinal participants discussed websites with which they were familiar. Twenty-eight percent of participants displayed stability, discussing knowledge of sources during both studies.

During the child study, Power Searchers were most aware of websites for information, followed closely by Developing Searchers. Child study Visual Searchers did not report knowledge of any sources. For the longitudinal study, Visual Searchers showed the greatest amount of increase in awareness of sources. All of the longitudinal Domain-specific and Social Searchers knew and discussed sources for information. This is an expected result, as Domain-specific Searchers are defined by their frequenting of specific websites, and Social Searchers use specific websites to facilitate their social Internet use. Longitudinal Power Searchers were aware of sources at a very high rate as well. See Figure 27 for full percentages of participants knowing sources by role.

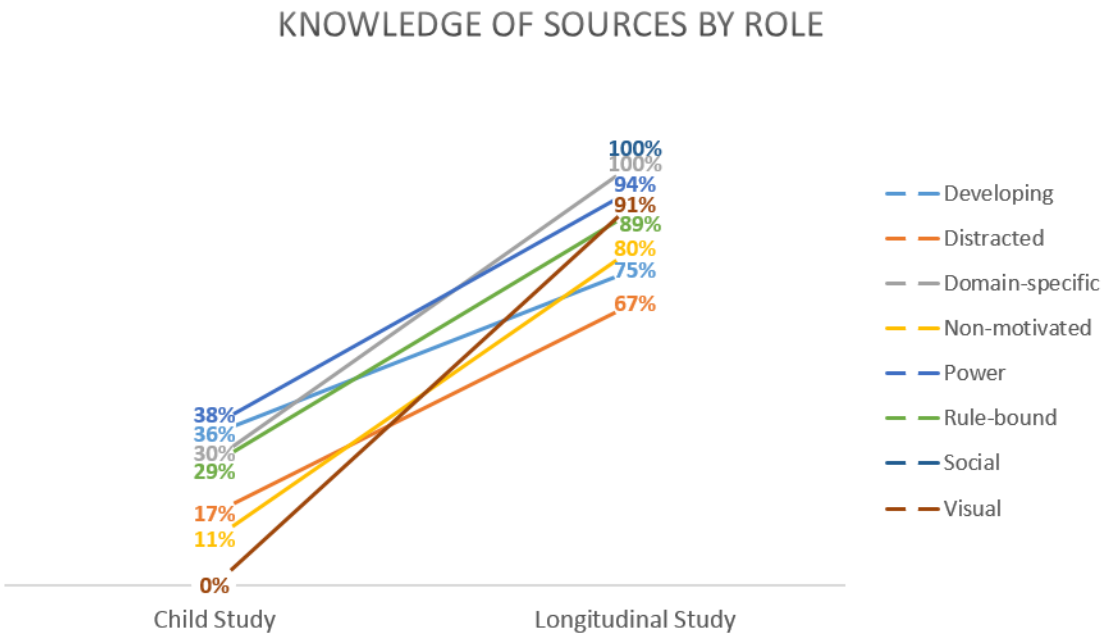

Figure 27. Knowledge of sources by role. Percentage of participants aware of at least one source for information by role.

For specific roles, all longitudinal Social and Domain-specific Searchers demonstrated knowledge of sources. Youth in these two roles notably engage with the computer in contexts differing from youth in other roles; to socialize with other people or

to pursue specific interests. The high source knowledge for these two roles seems to indicate that any computer use, whether playing online games or chatting with friends, can contribute to improvement in search-related skills.

Participants in all age groupings showed an increase from the child to the longitudinal study in awareness of sources. Figure 28 shows the trends by age regarding knowledge of sources. The largest increase was for the youngest participants, who were aware of sources at a much lower percentage than other age groups during the child study. The youngest longitudinal study participants, age 10 and 11, had not reached the same level of awareness of sources as the older two groups of longitudinal participants, but they had surpassed the oldest participants from the child study, those aged 11. This indicates that the search landscape has shifted to make children in 2013 more aware of information sources than they were in 2008.

The middle and oldest participant groups were closely matched in percentage of participants knowing sources during both studies, both showing 93% of participants aware of sources during the longitudinal study. This indicates not only a levelling of source knowledge by age 12 to 13, but also that not all participants become aware of sources.

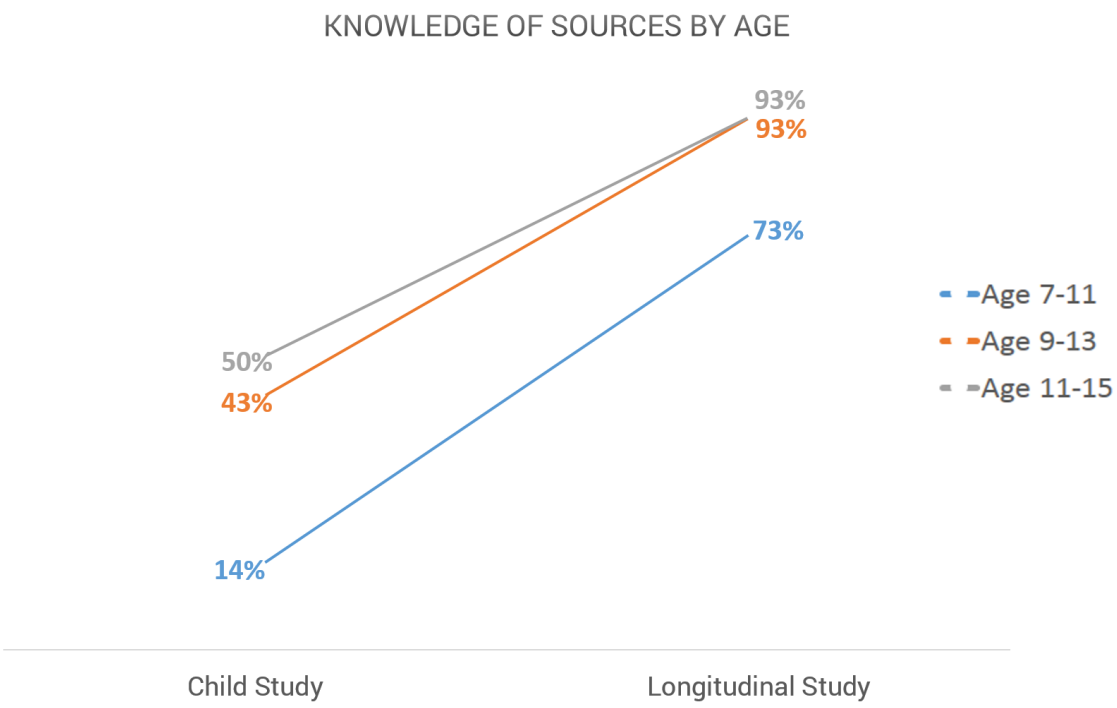

Figure 28. Knowledge of sources by age. Percentage of participants by age who were aware of at least one source for information.

Advertisement Awareness

Advertisements present on the search engine results page or within websites posed difficulties for searchers who could not distinguish content from advertisements. Participants who were able to identify the presence of advertisements had an advantage when searching; they could avoid information dead-ends, but also access sponsored websites when advantageous to their search process. Awareness of advertisements during the search studies was the verbal mention of advertisements by the participants during the interview. Advertisements were generally discussed during the interview in two contexts: as criteria for judging a website's credibility or as a dislike in response to the interview question, "What is bad about the results page?" During the child study, only 14% of participants mentioned the presence of advertisements. The youth in the longitudinal

study were much more aware of advertisements, as 48% of longitudinal participants mentioned advertisements.

As displayed in Figure 29, few participants by child study role discussed the presence of advertisements. Child study Power Searchers were most likely to be aware of advertisements, and at a much higher percentage than the next-highest child study role. Developing Searchers and Domain-specific Searchers mentioned advertisements during the child study, but at low percentages. During the longitudinal study, the roles were closely distributed, with the exception of Distracted Searchers, who did not discuss advertisements during either study. Social Searchers ranked highest in awareness of advertisements during the longitudinal study, closely followed by Non-motivated Searchers. Of roles with participants who were aware of advertisements, Rule-bound Searchers discussed advertisements least frequently.

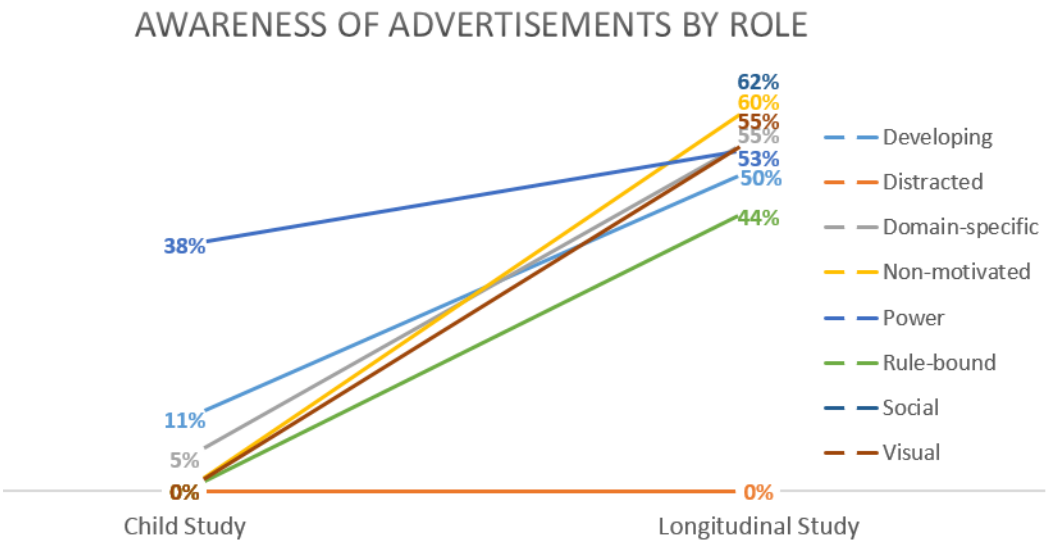

Figure 29. Awareness of advertisements by role. Percentage of child or longitudinal study participants by role discussing the presence of advertisements on webpages or in the search engine interface.

During the child study, only three roles had youth who indicated their awareness of advertisements on the Internet. For two of these roles, Developing and Domain-specific, the percentages of advertisement awareness were very low. However, despite few child study participants being aware of advertisements, the longitudinal participants, with the exception of the role of Distracted, were aware of ads at percentages comparable to each other. Social Searchers were most aware of ads; it is likely that Social Searchers come into contact with more advertising content due to their use of social media platforms. Longitudinally, Rule-bound Searchers were less likely than most other roles to discuss advertising content; possibly their adherence to repetitive search patterns makes them less likely to encounter advertising content.

During 2008, awareness of advertisements increased as participant age increased; all three age groups showed an increase in discussions of advertisements (see Figure 30). It is notable that no 7-year-old participants were aware of advertisements, but once reaching age 10 and 11, these same participants were more aware of ads than the participants who were also age 11 from 2008. This indicates that youth in 2013 are more aware of advertisements than youth in 2008. The oldest participant group showed a less dramatic increase in advertisement awareness when compared to participants in the middle and youngest age groups. The oldest participants were also eclipsed in discussions of advertisements during the 2013 study by participants in the middle age group. Possibly, older participants discussed advertisements at lower percentages during 2013 because they were proficient at navigating with advertising on-screen; the advertisements became the norm for their interactions with the Internet and did not draw notice in the same way as for younger youth.

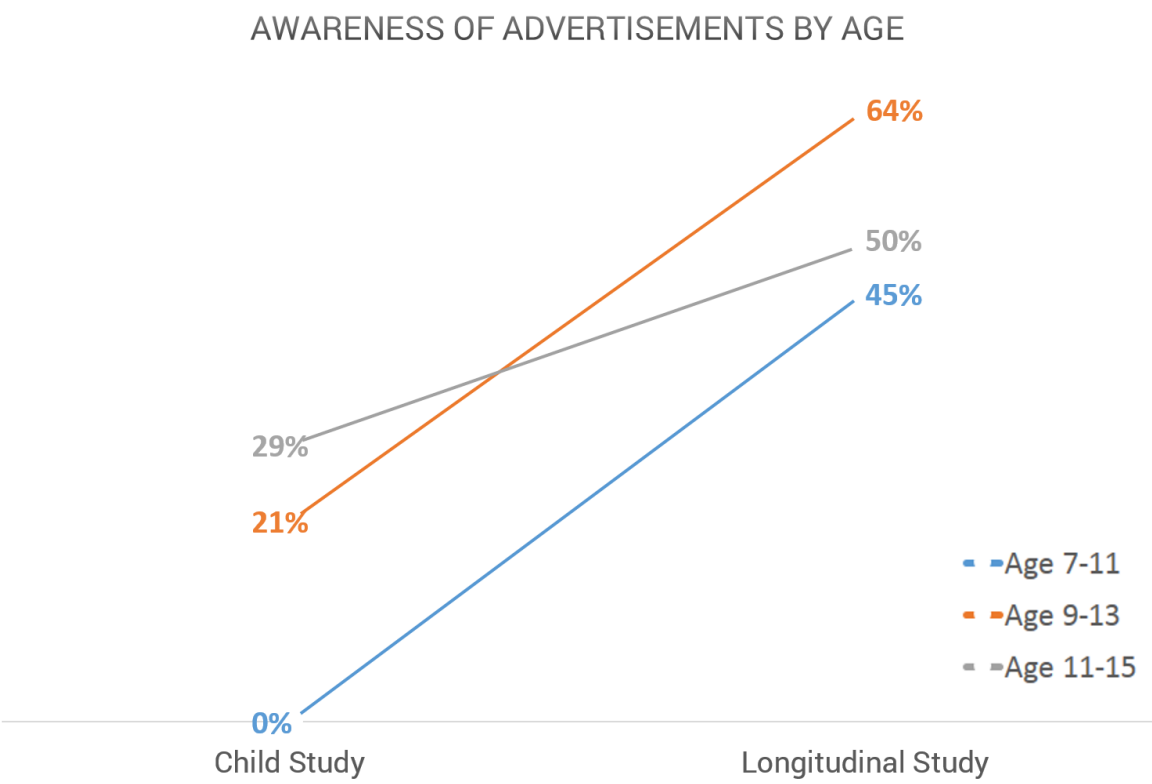

Figure 30. Awareness of advertisements by age. Percentage of child and longitudinal study participants discussing advertisements by age.

Vocabulary

Using topic-specific language is another indication that a searcher is comfortable and familiar with computers and searching. Additionally, using specific terms regarding computers and search allows youth to communicate more directly with peers and adult stakeholders to search regarding their search discoveries, explorations, and questions. In 2008, researches developed a list of computer and search vocabulary words from the interview transcripts. There were 24 words or terms included on the vocabulary list compiled during the child study: backspace, bookmark, browser, cache, click, copy and/or paste, cursor, delete, double-click, download, favorite, homepage, keyword, link,

log on/off, screen, scroll, search button, search engine, spacebar, tab, type, URL or address bar, and username. See Figure 31 for term use by participants in each study.

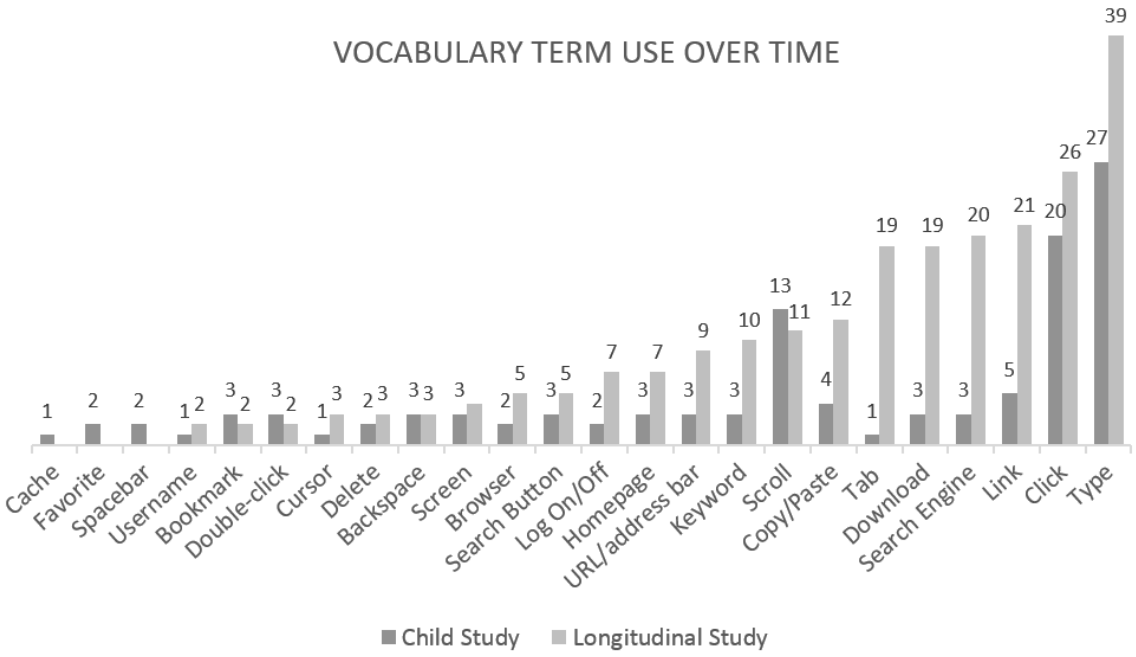

Figure 31. Vocabulary term use over time. Number of child and longitudinal study participants using computer vocabulary words.

During both the search studies, researchers were careful to discuss interface features and computer-related concepts without using jargon or technical terms, instead using the most generic language possible. For example, if a researcher wanted to comment on the participant's result selection, a typical statement might have been, "So, you picked that one from the list," as opposed to, "You clicked on the first result." The approach was due to the observation that if a term was used by the researcher first during the verbal exchanges, the participants tended to follow the researcher's lead by incorporating the term into their speech. Because of this tendency, vocabulary word use was only counted if the participant used the word prior to the researcher using the word

during the interview. Additionally, even if a participant used a term repeatedly, it was only counted once per interview.

During the child study, 66% of participants used at least one vocabulary word. Some participants used multiple terms, up to a total of nine terms for one 11-year-old boy, but on average, the 50 child study participants used 2.08 terms each. The most common terms used were click, type, and scroll, used by 54%, 44%, and 26% of child study participants respectively. The remaining terms were used much less frequently; link was used by 10% of child study participants, copy and/or paste by 8% of child study participants, and the rest of the terms by 6% or fewer child study participants.

Vocabulary term use from the list compiled during the child study was expectedly much more frequent when applied to the longitudinal study transcripts. Out of the 50 participants, 98% used at least one of the vocabulary terms. On average, the longitudinal participants knew 4.44 terms each, ranging up to 12 terms for a 15-year-old Power Searcher (the same boy using the most terms during the child study). The most frequently used terms for the longitudinal participants were type (78% of participants), click (52% of participants), link (42% of participants), search engine (40% of participants), download (38% of participants), and tab (38% of participants).

Some words were used only during the child study or more often during the child study. The term scroll was used slightly less by longitudinal participants than by the child study participants; 26% of child study participants used the term compared to 22% of longitudinal study participants. Double-click and bookmark were used by 6% of child study participants and only 4% of longitudinal study participants. The terms spacebar, cache, and favorite, although used by the child study participants, were not used at all by

the longitudinal study participants. There were new terms that the longitudinal participants used that were not used at all by the child study participants: social, app, tablet, mobile, swipe, and device, as examples. These findings reveal that the vocabulary of technology as used by youth in this study evolved over time.

Participants in every role used more terms during the longitudinal study than during the child study, as displayed in Figure 32. Power Searchers during both studies used more vocabulary words per participant than other roles. Domain-specific Searchers showed the largest increase in term use between the studies, followed by Visual Searchers. Youth in these roles in 2008 infrequently used vocabulary terms and displayed multiple roles less frequently. The vocabulary repertoire increase for Domain-specific and Visual Searchers can be at least partially explained by their higher likelihood of displaying multiple roles in 2013, and in particular, the higher likelihood of displaying the role of Power as well as the role of Domain-specific or Visual.

While showing a large increase between the studies, Non-motivated Searchers used the fewest terms per participant during both studies. All of the roles had 100% of participants use at least one vocabulary word during the longitudinal study with the exception of Non-motivated, with only 80% of participants using at least one vocabulary word. Despite using fewer words than participants in all other longitudinal roles, 2013 Non-motivated Searchers used a comparable number of words to the well-versed child study roles.

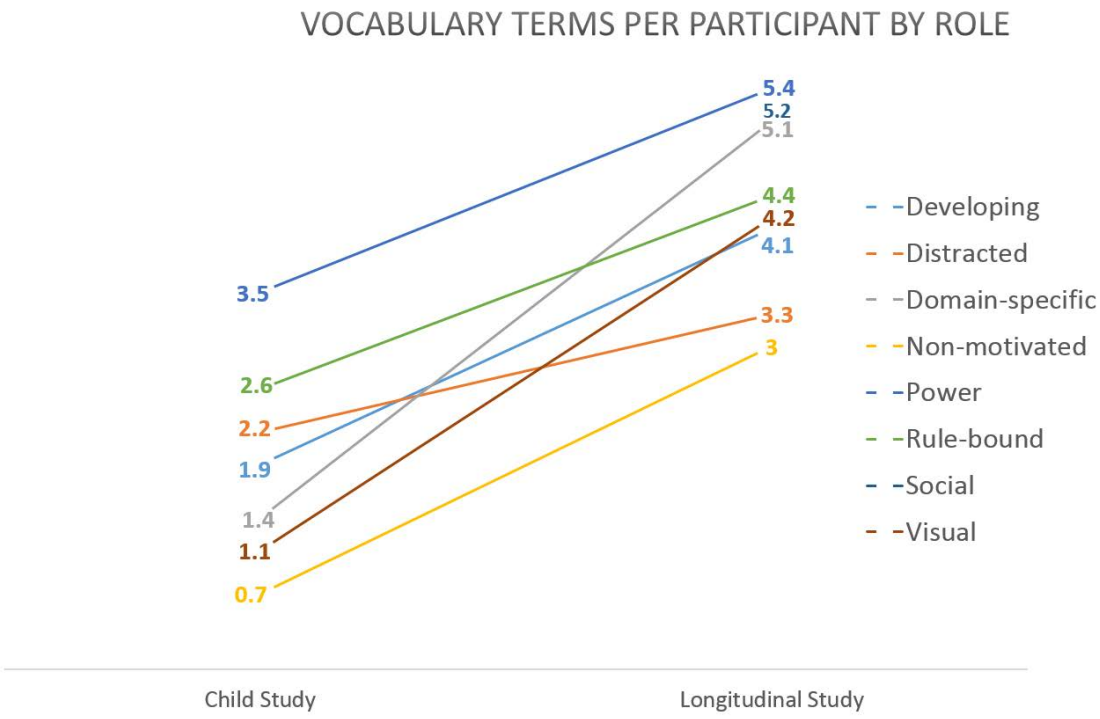

Figure 32. Vocabulary terms per participant by role. Average number of vocabulary words used by participants in each role during the child and longitudinal studies.

By age, the youngest participants in both studies, those aged 7 during 2008 and 10 or 11 during 2013, knew fewer terms per participant than participants in the middle or oldest age groups. The youngest participants also showed vocabulary term use closer to rates displayed by Non-motivated searchers, although they did show an increase in computer-related vocabulary during 2013. The middle and oldest age groups knew comparable numbers of terms per participant during both studies, and additionally knew comparable numbers of terms to Power Searchers during both studies. Given the similarity of rates of term use by the two oldest age groups, it might appear that youth gain their computer vocabularies at age 12 or 13, and show little continued improvement. However, this interpretation does not account for evolving computer vocabularies; terms such as mobile, social, or apps were new in 2013 and are not included in Figure 33.

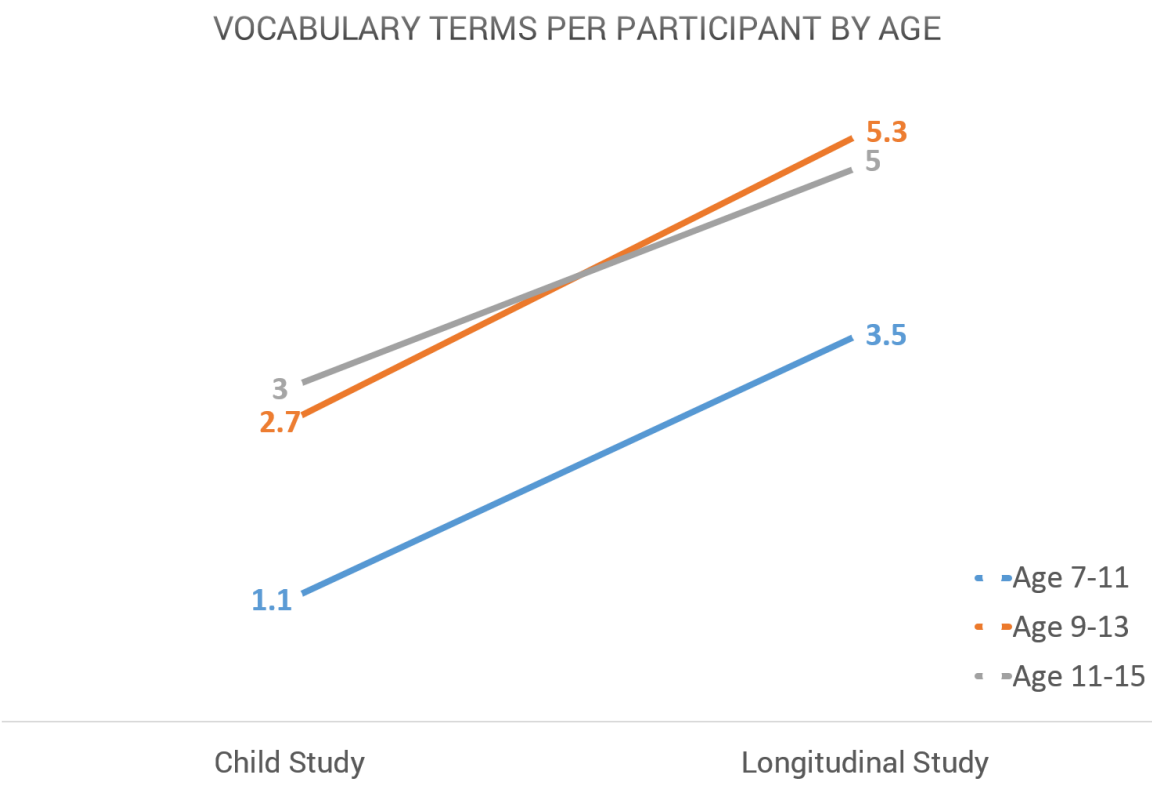

Figure 33. Vocabulary terms per participant by age. Average number of vocabulary words used by each age group of participants in each study.

Aiding Others

Helping others served as an indication of skill, as youth reporting helping likely were in possession of skills or knowledge at a different level than the people they helped. Some of the longitudinal participants discussed ways they helped other people with search or with different computer problems, although this helping behavior was entirely absent for child study participants. Discussions about helping other people happened spontaneously during some interviews, and during others, the youth described helping others in response to the interview question, "If you needed help when searching, who would you want to help you?" Twenty-two percent of the longitudinal participants discussed helping others in various ways:

11-year-old girl:

Interviewer: Cool. Ok. Um, do you ever search with anyone?

Interviewee: Um, if we're doing a joint project at school, then maybe. I know a lot about American history, just because in first grade we did a lot of work on it and so I got really interested in it. And looked it up a bit. Quite a bit, a lot. But if somebody among my friends, for a little while that was literally all I talked about. So they know that if they're doing a thing on that in World Studies or History or something, then they'll call me and say, “Yeah I need help, the Internet is being stupid.”

13-year-old boy:

Interviewee: Well, usually I'll get on and I'll stay on unless someone has a problem that they need to fix in the other part of the library.

Interviewer: So you're helping people and staying on the computer?

Interviewee: Well, it's mainly helping the other librarians set up their computer stuff.

13-year-old girl:

Interviewer: And what do you search for when you're with your family?

Interviewee: Really almost everything. I help my sisters with their homework. And my dad I help with everything cause he's not very good at computers, and my mom doesn't really need that much help, but sometimes I'll just look up stuff for us both together that we're both interested in.

13-year-old boy:

Interviewee: Um. I know how to mess with like uh, like settings, like if there's a real problem, I'm pretty good at figuring it out; I'm pretty good at figuring out stuff.

Interviewer: You have an example?

Interviewee: Um, well one time my uh, my grandma totally messed up her settings in Microsoft Word, so I had to, we have this program that we can, I can remotely access her computer, and I fixed it.

The examples given above show that the longitudinal participants helped others in person and remotely; older family members, younger siblings, and friends all received help. No child study participants discussed aiding others with searching or other computer activities, suggesting that the earliest-acquired search skills are not shared among youth.

The roles showed a wide and even distribution of percentages of participants discussing helping others. All roles except Non-motivated discussed helping others during the longitudinal study (see Figure 34). Visual Searchers were most likely to help others, at 45%, followed by Power and Distracted Searchers at 35% and 33% respectively. Longitudinal Visual Searchers display other skill-based behaviors at above-average rates, and youth in this role are likely in possession of helpful and novel information to pass to others due to their unique preference for visual search. The most-skilled role of Power also frequently reported helping other people, followed closely by Distracted Searchers. Distracted Searchers displayed skill-based search behaviors at low percentages, but report aiding others despite their low skill level.

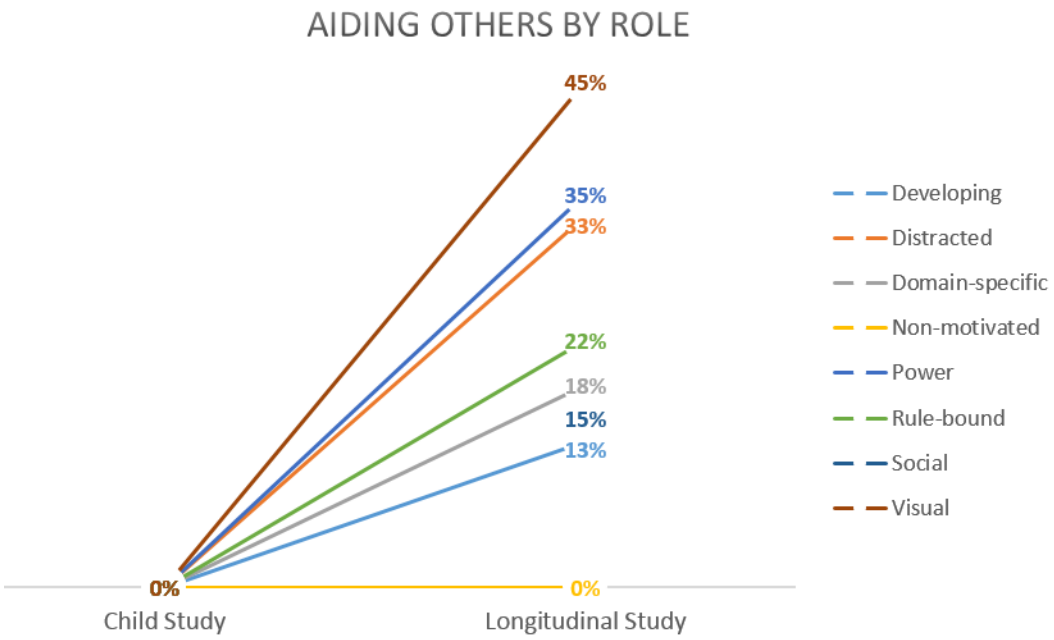

Figure 34. Aiding others by role. Percentages of participants by role reporting aiding others with computers.

By age for the longitudinal study participants, the participants in the oldest age group in the longitudinal study were much less likely to discuss helping other people to search or use the computer than the participants in the younger two age brackets (see Figure 35). The oldest longitudinal participants also reported co-use of computers at lower percentages than younger longitudinal participants, as will be reported in an upcoming section. Aiding others, while not always conducted in-person, seems to be more likely for participants who are co-located, possible explain the low percentage of older youth who report helping others to search.

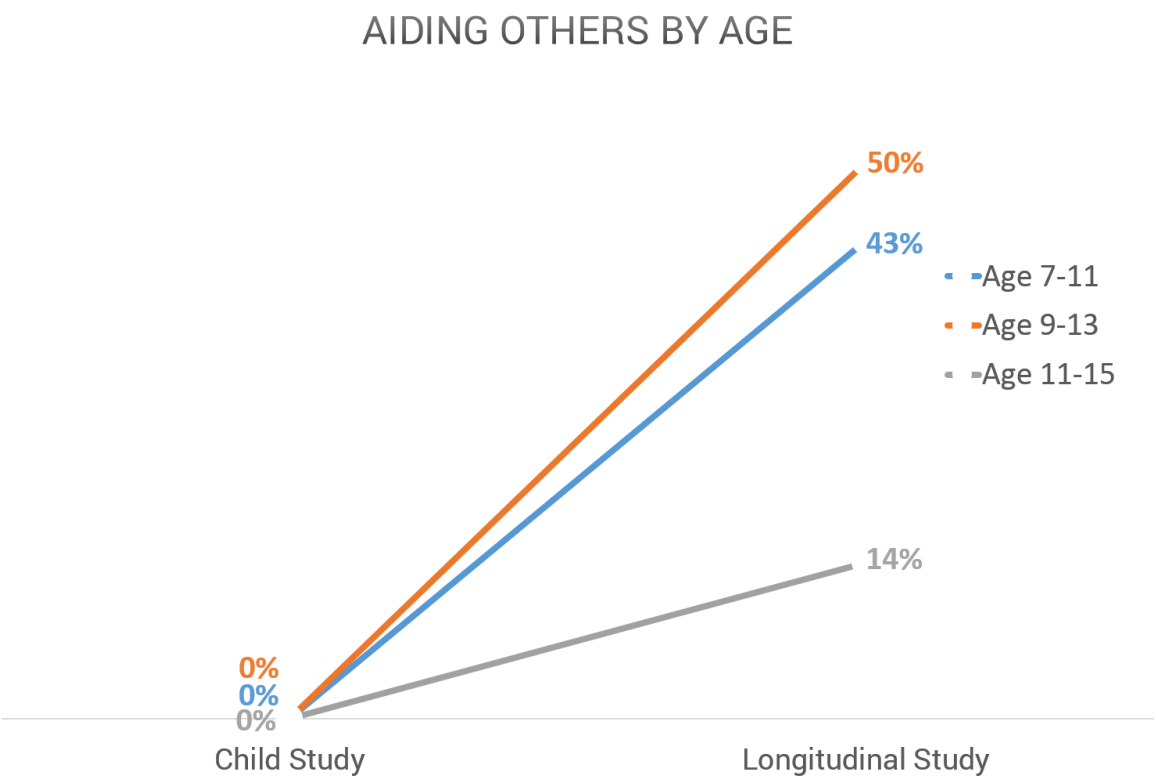

Figure 35. Aiding others by age. Percentages of participants in each age group discussing helping others on the computer.

Verification

Using multiple websites to verify of compare information indicated increased participant skill and awareness of varying website quality available via the Internet. Participants during both studies discussed using multiple websites to verify that found information was correct or simply to compare what two sources said about the same topic. This fact-checking was deliberate as explained by the participants; youth often discussed their process and reasons for verifying information. Ten percent of the child study participants checked found information against at least one other website while verbalizing their actions a total of eight times during the interviews. For the longitudinal

participants, 30% of youth verified information while verbalizing their intentions a total of 20 times.

For the child study searchers, verification of information was an intentional and explicit strategy, often used to compare information obtained from two different sources.

9-year-old girl:

> Because after I go on the Internet and compare it to the books, I just compare to see which one gives me the most information.

11-year-old boy:

> Yeah, I saw it was in Wikipedia. But I'm probably going to check it out. And I'll probably check it against other stuff.

Longitudinal study participants had similar patterns of wanting to compare information from multiple sources. In other cases, participants used two sources to check the correctness of their answers or to ensure that information was consistent across sources when finding inconsistent information.

10-year old girl:

> Interviewer: Cool, so say you were like- you don't have to search anymore on that- but you found two different answers, right?
>
> Interviewee: Um hum.
>
> Interviewer: So what do you normally do when that happens?
>
> Interviewee: Um, I don't know. Uh, I just go to another one and see which one is more common.

15-year-old boy:

I clicked on the second result, uh, second search, cause I wasn't exactly sure about my first answer, like I was pretty sure, like it was probably correct, but if you want to know, you want to get it from multiple sources, corroborate. Corroborate your evidence, so I just I wanted to make sure that was right, so I was just double-checking.

15-year-old girl:

Interviewee: Yeah, so sometimes I'll look on there, um, when I'm doing like my artist research, like have to look up van Gogh, I'll look up Wikipedia and like, ok, ok, it says the correct date, correct where he lived, where he was born, but I'll never use that as my first source, I'll check like other websites after that.

Interviewer: Ok. How come you check other websites?

Interviewee: Cause sometimes the information changes.

Interviewer: Um hum.

Interviewee: And whichever one I'm most comfortable with, I tend to stick to that one, but sometimes it's interesting to find out, ok, why is this one different from this one?

Interviewer: How do you know which one you're most comfortable with?

Interviewee: Um, whichever one I've been on more, or I'll ask a friend which one she's used before. So. Yup.

Of the five child study participants verifying found information, four also verified information during the longitudinal study, making verification a stable strategy.

In 2008, Domain-specific and Developing Searchers used multiple sources at low percentages, and Visual, Distracted, and Non-motivated Searchers did not use multiple sources at all. Visual Searchers were the most likely role to verify information using more than one website during the longitudinal study, followed by Power and Non-motivated Searchers. Rule-bound Searchers were the most likely role during 2008 to report verifying information, as displayed in Figure 36. During the longitudinal study by contrast, Rule-bound Searchers did not discuss verification at all. By following their strict searching guidelines, Rule-bound Searchers may avoid encountering the incorrect information that propelled youth in other roles to verify using more than one source. In this case, the rules followed by Rule-bound Searchers might be helpful and lead to the extinction of verification over time for youth in the role as an unnecessary step in the search process.

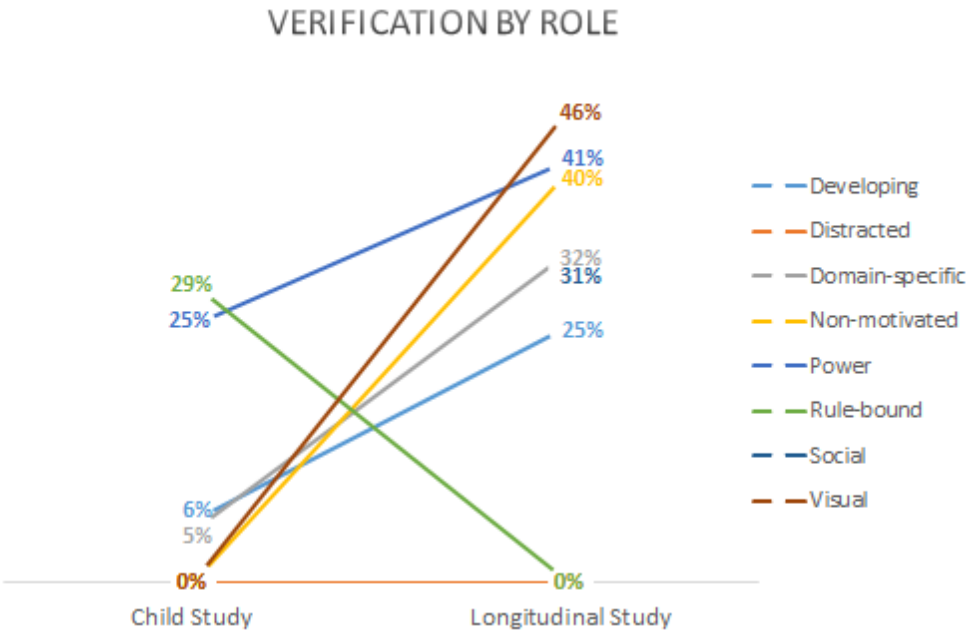

Figure 36. Verification by role. Percentage of participants by role checking found information against a second or third source.

For some youth, mainly over the age of 10 to 11, attempting to ensure the correctness of information lead to the strategy of verifying facts using multiple sources. Youth under the age of 11 described a different pattern of verification; youth at younger ages compared information across sources as a routine, regardless of their perceptions of whether the information was correct. Participants during each study were more likely to verify information at older ages, as illustrated in Figure 37.

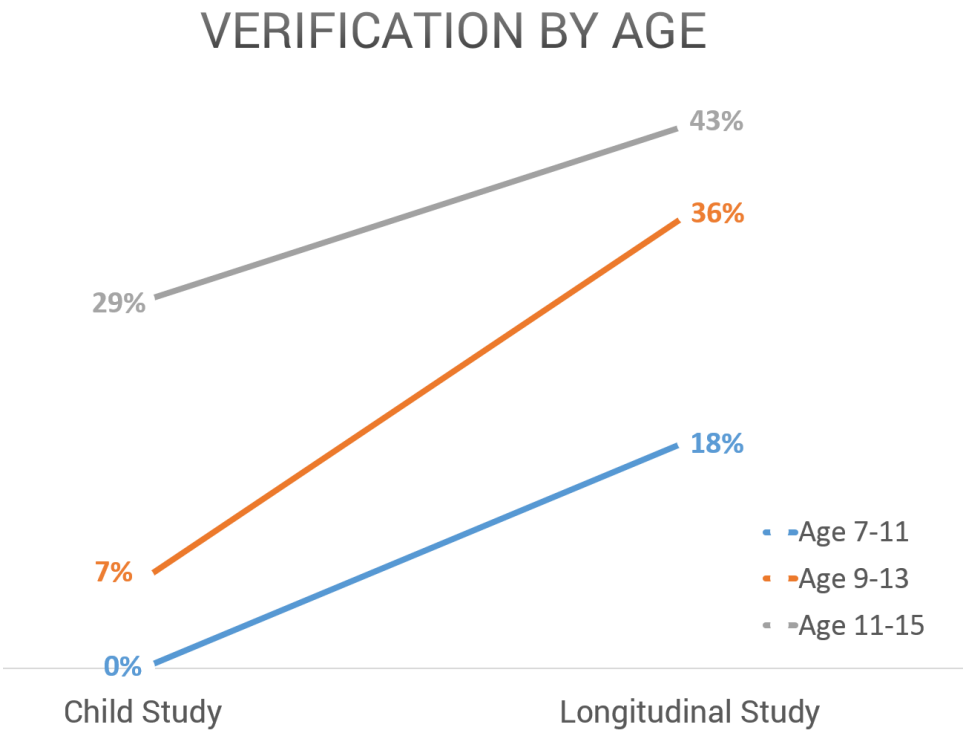

Figure 37. Verification by age. Percentage of participants in different age groups using multiple sources.

In-context frustration

During the child and longitudinal study interviews, the participants occasionally had verbal expressions of frustration. These were often accompanied by physical gestures, such as banging the mouse, sitting back from the computer screen, or changes in body posture. Exhibiting frustration during the interview was generally indicative of the participants experiencing difficulty with the search tasks, although it is possible that the

observed frustration was due to the interview context itself, as researchers did not ask the longitudinal participants to explain the source of their frustration. By using video and transcript data in combination, it was possible to identify instances when the child study participants made verbal statements of frustration; these instances were difficult to identify just from interview transcripts as the tone of the participant's voice was important. Child study examples of in-context frustration include:

7-year-old girl:

Are you trying to make me learn?

7-year-old boy:

Interviewer: Oh, ok, so did you find what you were looking for?

Interviewee: No! Whatever.

9-year-old boy:

I'm an idiot, I'm a complete idiot.

In-context frustration was not limited to the younger child study participants. Participants during the longitudinal study also expressed their frustration verbally to the researchers. Some examples of these statements are:

10-year-old girl:

It just um, *bugs me* so much, that it doesn't work all the time.

11-year-old boy:

Interviewer: And what sites do you use when you're searching, like which sites do you search on I mean?

Interviewee: Like usually National Geographic [(http://www.nationalgeographic.com)]. I already told you.

13-year-old boy:

Interviewer: Ok, would you do anything else if I weren't sitting here?

Interviewee: I would probably look for something other than squirrels.

During the child study, 22% of participants expressed frustration while being interviewed. A comparable 24% of longitudinal participants expressed frustration. Four youth were consistent, expressing frustration during the child study and during the longitudinal study. There were more instances per frustrated participant during the longitudinal study, with an average of 2.42 compared to 1.90 instances during the child study. These findings are counterintuitive, as the increased skill level present in the longitudinal youth as a group would seem to forestall in-context frustrations. Longitudinal participants may have felt comfortable with the familiar researcher from their child study participation, and were therefore more likely to express frustrations. Alternately, the more articulate longitudinal participants may have been able to accurately express their emotions when searching.

By role, some roles increased in displays of in-context frustration between the studies while other roles decreased (see Figure 38). Non-motivated Searchers communicated frustration at a much higher percentage than all other roles during the longitudinal interviews and increased their already high percentage of in-context frustration from the child study. Youth in the Non-motivated role were not only low in skill, but also preferred to not use the computer; either factor could contribute to in-context frustration. Comparing in-context frustration to explicitly reported frustration during the longitudinal study for this role reveals that Non-motivated Searchers experienced the most in-context frustration while reporting no frustrations at the highest

percentage of all the roles. This may suggest that Non-motivated Searchers are unwilling to admit or to discuss their challenges with search. By contrast to Non-motivated Searchers, Power, Rule-bound, and Social Searchers all had low levels of in-context frustration during both studies. Power and Social Searchers displayed high levels of skill; Rule-bound Searchers, while lower in skill, relied on planned strategies when searching; these search habits produced familiar and predictable results, reducing in-context frustration.

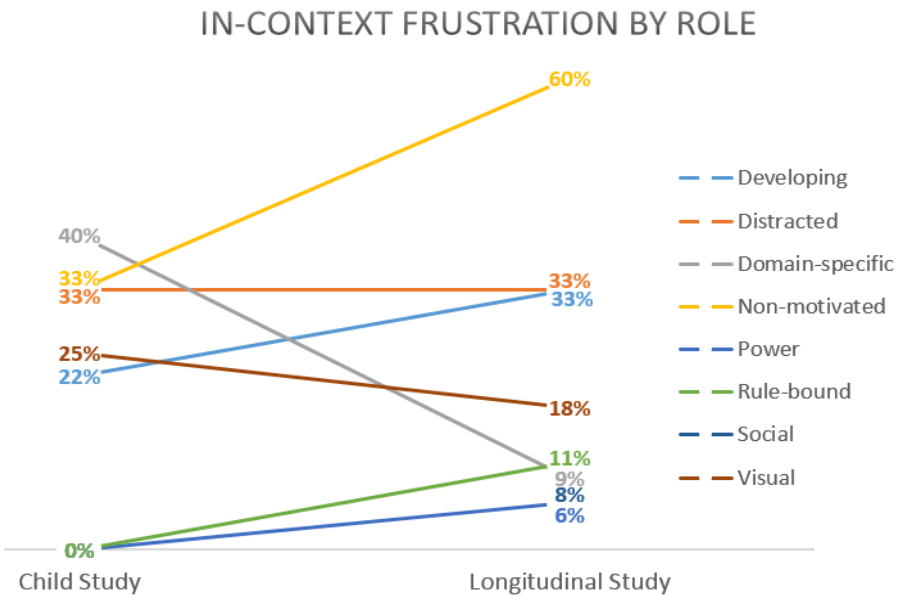

Figure 38. In-context frustration by role. Percentage of participants by role expressing frustration to the researcher.

Within each study, in-context frustration was less prominent as age increased. The youngest participant group, while the most frustrated, showed a decrease in in-context frustration between the child and longitudinal studies. The middle and oldest participant groups both experienced an increase in frustration during the longitudinal study, however, the oldest participants remained minimally frustrated. This finding again lends support for lower skill levels causing in-context frustration, as younger participants

displayed skill-based behaviors at lower percentages. Figure 39 displays the in-context frustration by age groupings for both studies.

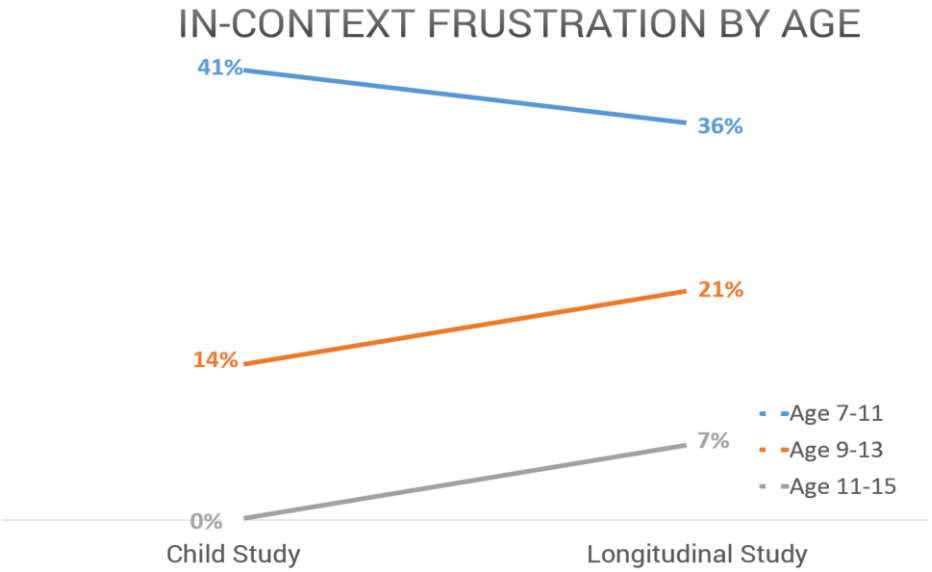

Figure 39. In-context frustration by age. Percentage of participants by age expressing frustration to the researcher.

Alternate Searching Strategies

The search behaviors in the following section illustrate prepared strategies or non-traditional approaches to retrieving information. Participants displaying these search patterns were generally able to discuss their intentions, allowing insight into why they used varying strategies to retrieve information. The alternate searching strategies are: using offline information, awareness of the quality of information, result selection criteria, and following self-imposed rules. Taken together, these search behaviors can show ways the search interface might currently be failing youth, causing them to adopt alternate strategies, as well as ways to better support youth to allow them to bypass these strategies when desired.

Use of Offline Information

In contrast to the perspective that all information is available to youth on the Internet, many of the participants discussed information obtained, used, or existing in an offline context. These statements stood out from the usual dialogue between the participants and the researcher, given the context of an interview taking place while the participants searched using a computer or device. The statements regarding offline information were identified in the longitudinal transcripts, followed by examination of the child transcripts for similar statements in order to provide a comparison for the use of offline information over time. Examples of statements from child study participants regarding offline information include:

7-year-old girl:

> Interviewee: You know the searching book? There's this searching book. I don't know, if you spell it, it would probably tell you all about it.
>
> Interviewer: Is it on the computer or do you hold it in your hands?
>
> Interviewee: You hold it in your hands. And the next time I'm in the library I will ask them, and when I get it I will say, "Hey, I finally found the book now I can start this all over again…"

9-year-old boy:

> I usually stop searching when like I found what I need and maybe I've written it down on a piece of paper or something.

The longitudinal participants discussed offline information in similar ways as the child study participants:

10-year-old boy:

Interviewer: Ok. All right, so um, why did you click on National Geographic?

Interviewee: Well, um, I know a little about National Geographic. And I knew that it was a pretty reliable source. I knew that it was like a magazine.

13-year-old girl:

And usually my second resource would be going to the library and finding books about it.

15-year-old girl:

If I can't find information, there's always um, which is, I find that it's like rare that I can't find something, um, but there's always encyclopedias and books and everything.

For the child study participants, 20% of the youth made 19 separate references to obtaining, using, or retaining information offline. Longitudinal study participants had similar rates of statements about physical media, books, or off-line information. Twenty-two percent of longitudinal youth made 14 separate statements about offline information. Half of the individual youth discussing offline content were stable over time, repeating their mentions of information off the computer from the child study again during the longitudinal study.

The child study participants most often discussed offline content as independent from information available online. Interpreting the quotes from the longitudinal participants regarding their use of offline information indicates that older youth use their

understanding of offline information to inform online choices, rather than rely on offline information as stand-alone sources. Additionally, the small longitudinal study decrease in using offline sources in numbers of participants as well as frequency of mentions per participant coincides with the dramatic longitudinal study increase in knowing online sources for information as discussed above. Youth appear to move away from books and physical media around age 11, transferring their print source knowledge when applicable to websites.

Examining role trends relating to talking about offline information content reveals mixed trends (see Figure 40). During the child study, Distracted and Non-motivated Searchers were most likely to discuss using offline information. As participants in these roles display few skill-based search behaviors, using offline sources to obtain needed information may be more accessible than searching using the computer. However, Distracted and Non-motivated Searchers did not discuss offline information at all during the longitudinal study, and presumably met their information needs via the computer despite their persistent lower skill levels. Searchers in the roles of Power and Rule bound also decreased in reported use of offline sources longitudinally. As they were adept at computer use and highly likely to know online sources, Power Searchers may not need to supplement their information seeking offline. For Rule-bound Searchers, the guidelines they follow may not be present for offline information seeking; searching the Internet is more comfortable when following self-imposed boundaries. Developing, Visual, and Domain-specific Searchers increased over time in their discussions of offline content,

with Domain-specific Searchers most likely to discuss offline information during the longitudinal study.

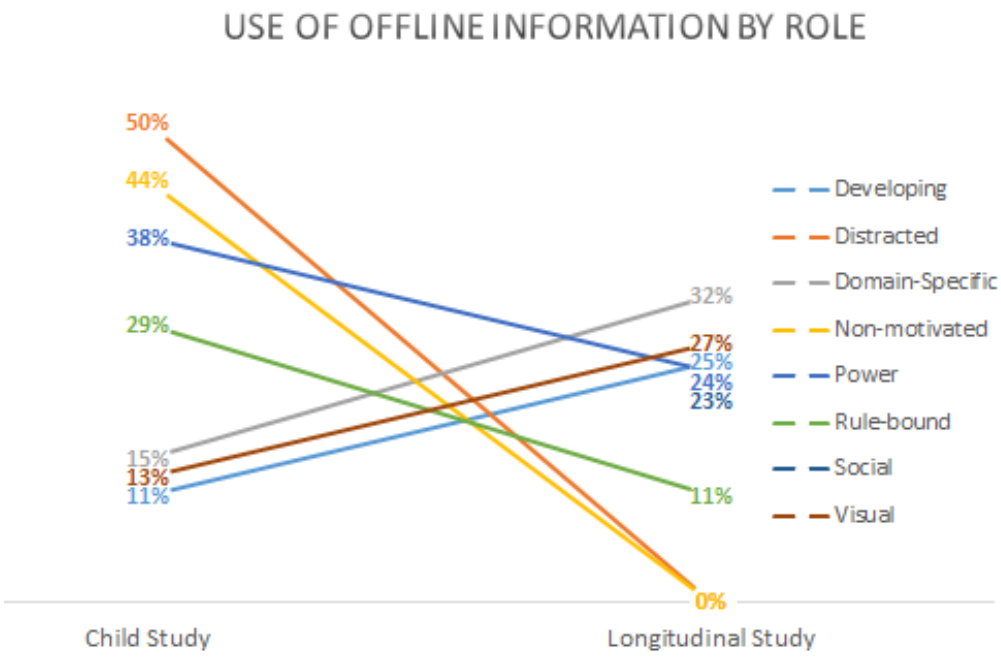

Figure 40. Use of offline information by role. Percentage of participants by role discussing offline sources for information.

By age, the youngest participant group showed an increase from the child to the longitudinal study in discussions of offline information. The percentage of oldest participants discussing offline content, those aged 11 and 14 or 15, decreased between the studies. For the middle age group, participants aged 9 and 12 or 13, discussions of offline information remained stable over time. Figure 41 shows the trends in offline information over time for each age grouping.

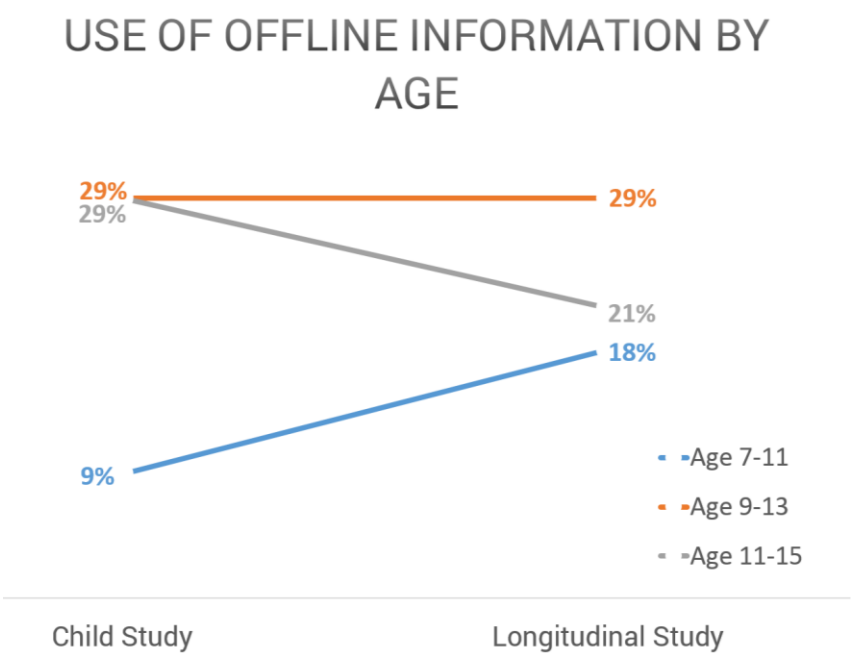

Figure 41. Use of offline information by age. Percentage of participants in each age group discussing offline information sources.

Quality of Information

The concept of the quality of information retrieved from the Internet was prominent during the longitudinal study. The longitudinal participants expressed a desire to find information on websites that was truthful, correct, credible, and that they felt they could trust. The desire for high quality information was closely linked to the trends of result selection criteria and self-imposed rules; the context of many of the discussions of quality information was a participant explaining why he or she chose a particular result or explaining his or her usual search behaviors. Even with this overlap, the desire for and awareness of information that was reliable, trustworthy, and credible stood out as an independent trend.

The same concept of information quality was present to a lesser extent during the child study upon reexamination of the data. The child study participants frequently

discussed reliability and quality in terms of the information from the Internet reinforcing knowledge they already had. For example:

9-year-old girl:

Interviewer: And you clicked on search. How come you clicked that?

Interviewee: Cause I think the answer's wrong.

11-year-old boy:

Interviewee: This is a good one.

Interviewer: How do you know?

Interviewee: Cause it's a picture of fish and fish is what dolphins eat.

Although the participants used varying terminology, the core idea of acquiring information from quality sources was present for the longitudinal participants.

10-year-old girl:

Interviewee: Um, this. I'm going to National Geographic cause I trust them.

Interviewer: Oh, cause you trust them?

Interviewee: I trust them, they usually have correct information**.**

11-year-old girl:

Wikipedia, anybody can write anything about it. Um, and but here, this is like ancient egypt.co.uk, so this is the British Museum, so this is like certified.

13-year-old boy:

I mean Wikipedia is a reliable source, right? Even though it is made by other people.

Twenty-two percent of child study participants talked about reliability, with 25 total mentions during the study. Seventy-four percent of the longitudinal study participants discussed reliable information 82 times during the interviews. Individually, only eight participants did not discuss reliability during either study and six participants discussed reliability during both studies; while prominent, reliability does not appear to be a stable concern.

Discussions of the quality of information on the Internet consisted of participant opinions and criteria for determining whether information was trustworthy. Discussions of reliable or trustworthy information sources showed a large increase between the child and longitudinal studies for all roles and age brackets. Youth discussing the quality of information reflected many of the same sentiments as youth displaying the more precise search behavior of verification; both groups of youth were concerned with the accuracy of information. For both studies, higher percentages of youth discussed reliable information, with youth following through using multiple sources to verify information at lower percentages.

For all roles, finding quality information increased in importance over time. The roles of Power and Rule-bound had higher percentages of participants discussing information quality than other roles during the child study; during the longitudinal study however, the eight roles were more closely distributed. Rule-bound Searchers during both studies discussed the quality of information at rates comparable to searchers in highly-skilled roles. This may indicate they were following a successful but unshared rule regarding information quality. Figure 42 contains the complete percentages of participants discussing information quality by role.

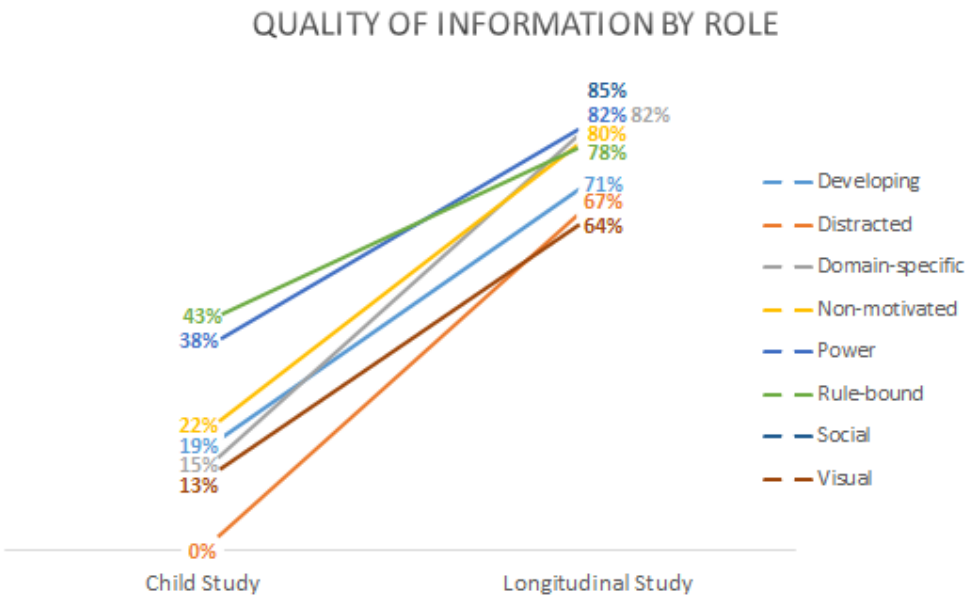

Figure 42. Quality of information by role. Percentage of longitudinal and child study participants by role discussing the quality of retrieved information.

The oldest participants were stable over time in expressing the need for reliable information. While being the most likely age group to discuss reliability during the child study, the oldest participants were the least likely age group to discuss reliability during the longitudinal study. The middle and youngest age groups showed large increases between the studies, with participants in the middle age group most likely to discuss quality of information during the longitudinal study. For the participants at different ages, the concept of reliability was somewhat different. The child study participants judged reliability of new information based on how the new information aligned with their existing knowledge. The longitudinal participants in contrast often focused on the source of the information as providing credibility, and expressed fewer concerns regarding the information itself. Figure 43 illustrates the quality of information trends for each age group of participants during the studies.

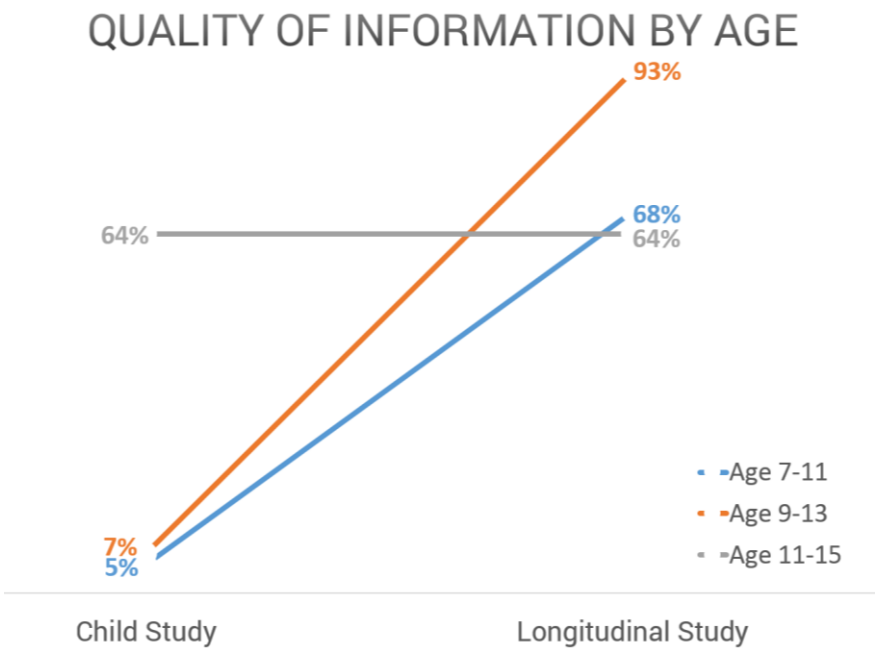

Figure 43. Quality of information by age. Percentage of participants by age discussing the quality of retrieved information.

Result Selection Criteria

For each of the five (child study) or six (longitudinal study) search tasks, researchers asked the participants to explain why they chose particular results over others from the search engine results page. Although the question was sometimes phrased differently, researchers followed the general format of asking, "Why did you pick that one?" for each result chosen by the participant. The child study responses to this question fell into six major categories: selection due to influence from another person, because the website was child-friendly, because the website was reliable, because the youth was following a self-imposed searching rule, due to website recognition, or because of the snippet or website title drawn from the website and presented on the search engine results page. The longitudinal youth reported a narrower range of reasons for selecting one website over another than the child study participants, with four reasons provided as

compared to six reasons provided during the child study; no longitudinal participants reported choosing a website because it was child-friendly or because of influence from another person.

During the child study, researchers were not always consistent in asking youth to explain their result selection criteria after each of the search tasks, but the data show 78 reasons for selecting a result as given by 68% of participants. All of the youth in the longitudinal study reported reasons for selecting results, as researchers were careful to ensure asking about result selection criteria. The most commonly reported result selection criteria during both studies was due to the snippet or website title, and this criteria is illustrated by the following exchange between a researcher and a child study participant:

9-year-old boy:

Interviewer: Why'd you pick that one?

Interviewee: Cause it usually has a lot of information.

Interviewer: How'd you know?

Interviewee: Cause it has a long summary.

Fifty-four percent of child study participants reported selecting a result based on the snippet or website title. During the longitudinal study, 80% of longitudinal participants reported this criteria. Website recognition was the next most common criteria for result selection, reported by 22% of child study participants and by 48% of longitudinal participants. Participants typically described website recognition similarly to this child study participant:

11-year-old girl:

I might go to this one because I know Yahoo! [(http://www.yahoo.com)].

Only 12% of child study participants reported following a self-imposed rule when deciding on a website from the results page. Following rules was reported by 36% of longitudinal youth. Frequently, participants were following the rule choose the first result, or as in the following example from a longitudinal study searcher, the rule results get worse:

13-year-old girl:

> Interviewer: Ok, so you said you clicked on the first one, how come?
>
> Interviewee: Because as you go farther down the list it normally gets less and less specific.

Reliability of selected websites was reported by 32% of longitudinal study participants and 6% of child study participants. Eight percent of child study participants reported selecting websites due to the perception that the website was child-friendly, and only one child study participant stated choosing a result due the influence of another person. The most common reason provided for result selection in both studies, reading the snippet, was also the most stable reason, with the highest number of youth reporting it during both studies. Participants reported the four result selection criteria common to both studies in the same order of frequency, indicating the stability of the importance of each criteria. The differences in numbers of participants reporting each result selection criteria between the studies and the number of stable participants are viewable in Figure 44.

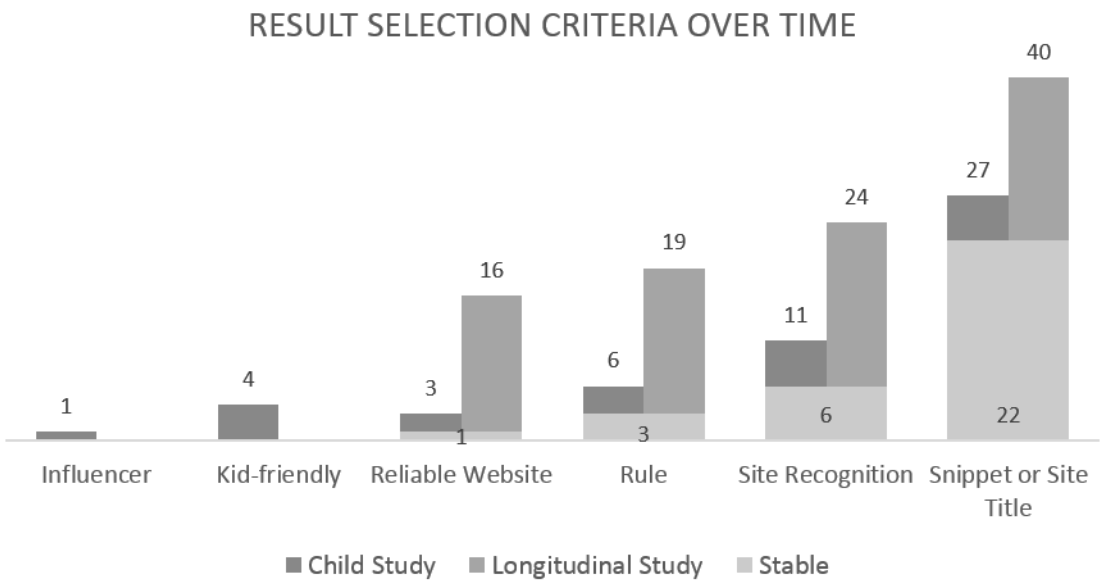

Figure 44. Result selection criteria over time. Number of participants in each study discussing reasons for choosing a result from the search engine results page.

Figure 45 shows percentages of participants by role giving reasons for selecting results that are common to both studies. A high percentage of child and longitudinal study Power Searchers preferred using website recognition or the snippet when selecting results, and were less likely to follow rules about result selection. Distracted Searchers during the longitudinal study shifted into selecting results for reliability and website recognition, while Non-motivated Searchers were highly likely to select results based on self-imposed rules or due to the snippet and website title. Developing, Rule-bound, and Domain-specific Searchers, while showing increases in reporting of result selection criteria during the longitudinal study, did not greatly change their preferences; these roles used many criteria evenly when selecting results.

The findings regarding result selection criteria by role present an unclear picture. With the exception of the role of Rule-bound, the roles are not consistent between the studies in reasons provided for selecting one result over another. In addition, the

percentages of participants by role reporting a particular criteria range widely within one study, with some roles highly likely to report the criteria and others not reporting it at all. Due to these findings, result selection criteria are unlikely to aid in role identification, as they appear not to generalize to the level of role.

Figure 46 shows the criteria for result selection presented by age rather than role. By age, result selection criteria is fairly consistent. All age groups showed increases in reporting result selection criteria during the longitudinal study, likely due to greater diligence in asking. The oldest age group was more likely during both studies to follow rules, recognize sites, or read the snippet or website title than participants in the middle or youngest age groups. It is possible that by age 11, youth have established their patterns for result selection.

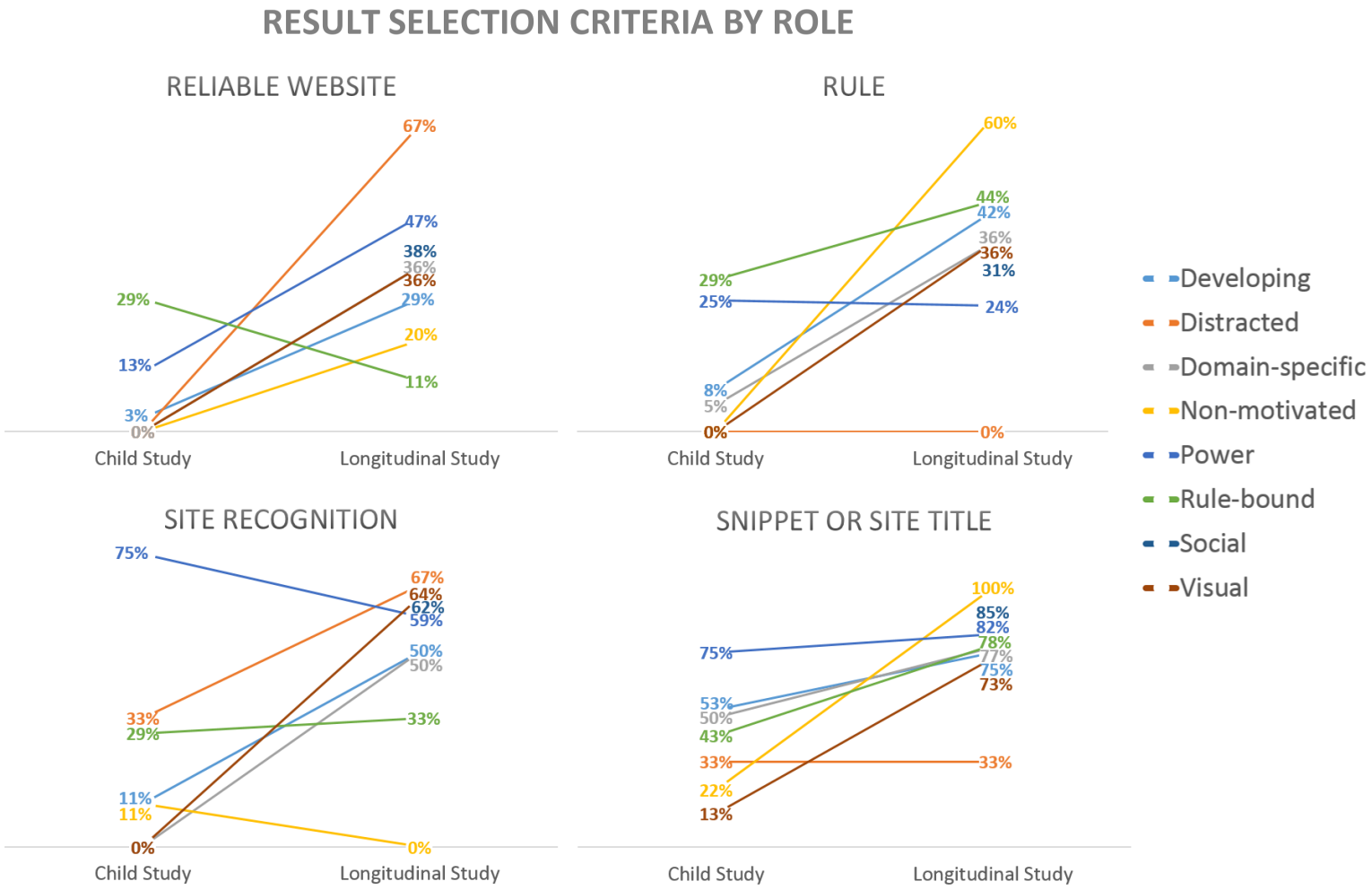

Figure 45. Result selection criteria by role. Percentage of participants by role reporting each of four reasons for selecting results from the search engine results page.

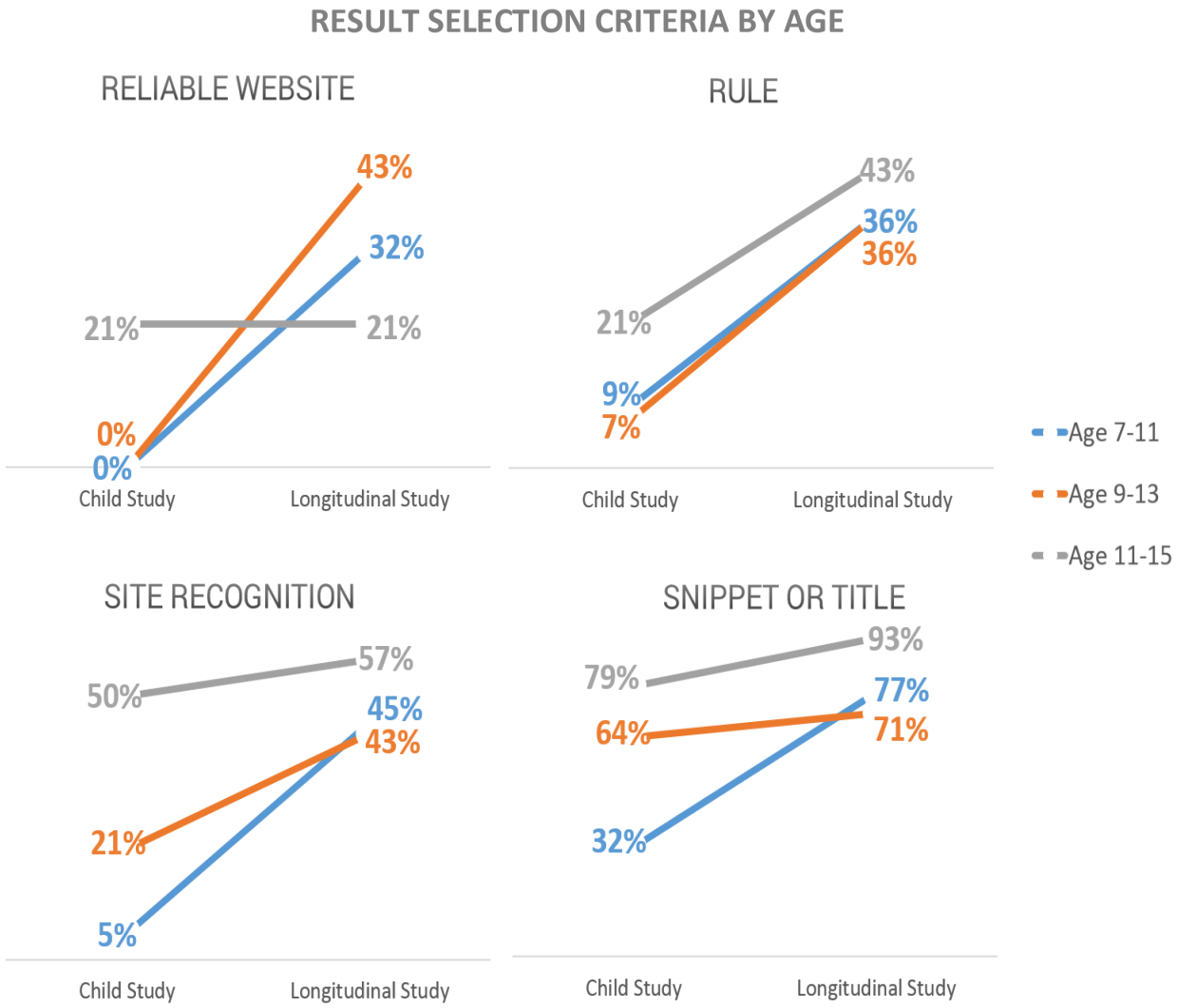

Figure 46. Result selection criteria by age. Percentage of participants by age reporting each of four reasons for selecting a result from the search engine results page.

Self-imposed Rules

During the course of the child and longitudinal study interviews, the youth occasionally made declarative statements explaining their usual search behavior or dictating how correct searching should be conducted. Statements that stood out from other interview conversation as particular guidelines or strong statements guiding search behaviors were coded as self-imposed rules. When applied as general guidelines to aid in decisions regarding search, self-imposed search rules are helpful to youth. Rules speed the processes of query formulation and result selection and can serve as bridges for points of confusion. Only when rules are applied unconditionally or habitually do they raise problems for the searcher. Although most of the youth were willing to deviate from their rules when necessary, the few youth who adhered to their self-imposed guidelines were coded as Rule-bound Searchers. Self-imposed rules fell into 10 categories (see Figure 47):

- Choose the first result,
- Don’t use Wikipedia,
- Go through results in order,
- No inappropriate sites,
- Results get worse,
- Search school databases first,
- Spelling,
- Domains,
- Use specific keywords, and
- Use Wikipedia

Figure 47. Self-imposed rules over time. Number of participants from each study reporting self-imposed rules.

A mapping of the 10 rules arising during this research to search processes shows that rules mainly pertain to sources for information and to a lesser extent, result selection and query formulation. The five rules regarding sources are: search school databases first, no inappropriate sites, don't use Wikipedia, domain rules, and use Wikipedia. Three rules pertain to result selection: choose the first result, go through results in order, results get worse. The remaining two rules relating to query formulation are those about spelling and use specific keywords. This distribution identifies three major areas of difficulty for youth, with rules substituted as solutions.

Longitudinal study participants did not mention the rule no inappropriate websites present in the child study but did discuss the other rules. During the child study, 44% of youth reported rules on how they searched or how others should search. Rules were more common for the longitudinal study participants; 78% of the longitudinal youth discussed rules. The longitudinal participants who discussed rules repeated those rules at different

points during the interview more frequently than child study participants; 36% of longitudinal participants repeated rule more than once, compared to only 14% of child study participants repeating their rules more than once during the interview.

The most frequently mentioned rule during the child study was to use Wikipedia, discussed by 20% child study participants and 18% of longitudinal study participants. This was sometimes described as a personal habit, and at other times was described as good practice for all searchers. A child study searcher described using Wikipedia as good practice:

9-year-old boy:

> Because if you want to find something about or if you want to read about them and find facts about them then Wikipedia is pretty good to go to.

Sixteen percent of child study participants mentioned the rule choose the first result, as did 32% of longitudinal participants. Choosing the first result was generally discussed as a personal habit by the participating youth. As explained by a child study participant:

11-year-old girl:

> I usually click the first thing to see if it's good.

Don't use Wikipedia was mentioned by 32% of longitudinal study participants and only 6% of child study participants. Use specific keywords was a common longitudinal rule, reported by 22% of participants during the longitudinal study, and only 6% of participants during the child study. As longitudinal searchers explained their views of keyword order:

12-year-old boy:

> …when you type something in, since it gets it in any order, you have to be very specific about the order or else it just finds stuff that's just completely irrelevant to what you're trying to find.

13-year-old girl:

> Interviewee: Like the more specific you are with what you're looking for, the faster you'll find what you're looking for.
>
> Interviewer: So, what do you mean?
>
> Interviewee: So if I was looking for baby pandas, instead of putting in just pandas and looking through all the pictures and trying to find what you need, you put in baby pandas instead.

Results get worse and rules about the domain were also fairly commonly reported rules, by 16% and 14% of longitudinal participants respectively. Only 6% of child study participants reported results get worse and 8% had rules regarding the domain of websites. Rules about domain were rules that described, for example, choosing websites with specific domain names:

15-year-old girl:

> You're supposed to use, like the .gov or .edu or whatever.

Examining self-imposed rules by role reveals varied changes by role between the studies. Figure 48 illustrates the percentages of participants by role who reported at least one self-imposed search rule. Distracted Searchers displayed no change in verbally mentioning rules while Power Searchers showed a decrease. The remaining roles increased in discussing their self-imposed rules, most dramatically for Visual Searchers,

but also for Non-motivated Searchers as well. The roles of Visual and Non-motivated were the lowest ranked in skill during the child study. For youth in these two roles, rules may provide structure surrounding an otherwise overwhelmingly confusing search processes.

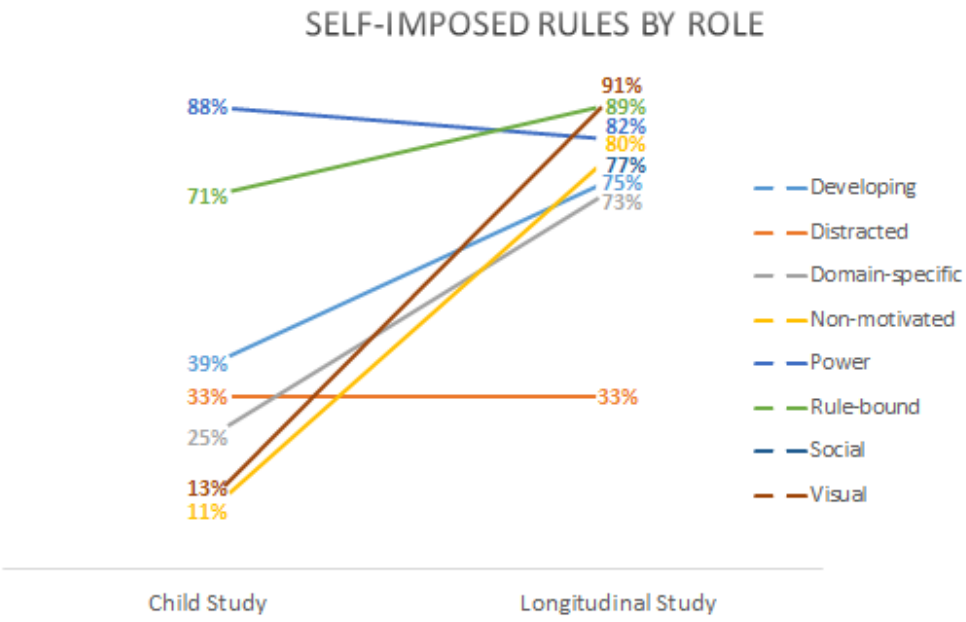

Figure 48. Self-imposed rules by role. Percentage of participants by role reporting at least one self-imposed rule.

By age, self-imposed rules seem to be most important to youth between the ages of 10 to 13; the youngest child study participants had few rules while the 11-year-old child study participants reported rules frequently. During the longitudinal study, the youngest participants at age 10 or 11 reported frequent rules, but the oldest participants who had formerly reported many rules decreased over time. As many factors examined during this research have shown, computer knowledge rapidly increases around ages 10 to 13; perhaps rules develop to aid youth in organizing the flood of computer and search related information they learn at this age. Once youth begin to gain real proficiency

however, the rules are less and less necessary, and so drop off in frequency as youth age. The trends for the child and longitudinal study age groupings are presented in Figure 49.

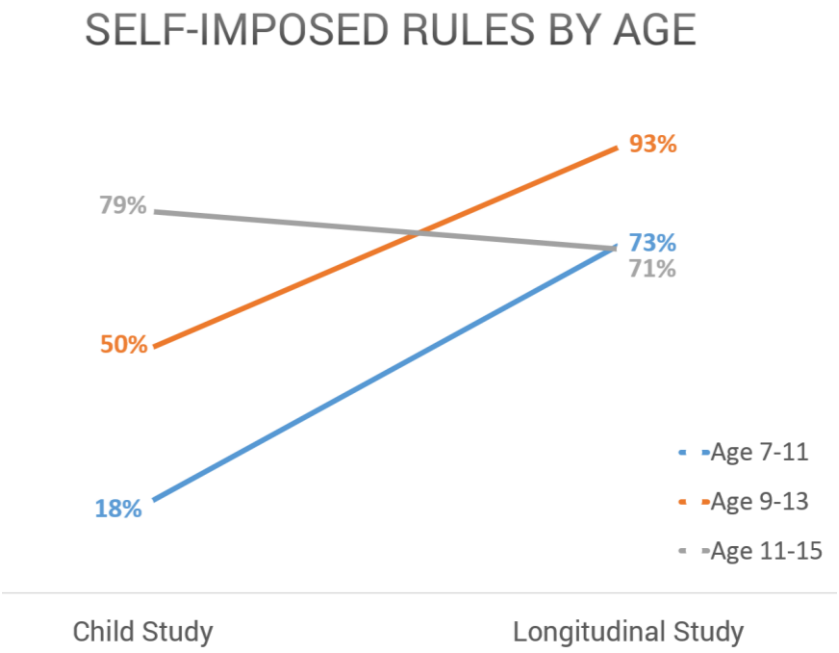

Figure 49. Self-imposed rules by age. Percentage of child and longitudinal study participants by age reporting at least one self-imposed rule.

Support Behaviors

The behaviors presented within this section do not necessarily relate directly to searching. However, they do affect search behaviors, experiences, and knowledge in youth, and are important to consider when attempting to understand the whole searcher. Use of mobile devices, discussions of visual content online, people influencing search, the social landscape surrounding youth, expressing uncertainty, and distraction are all addressed below.

Device Use

Youth in this study increasingly use or own devices. Unfortunately, device use can hamper search ability, as smaller screens and the lack of traditional input tools force youth to relearn basic computer and search skills. Tabbed browsing for example is difficult on smartphones, and tablets do not lend themselves to traditional search processes, requiring learning new typing and selection methods. However, youth during the search studies demonstrated while using tablet devices that many websites are adapting to the growing use of tablet computers by providing tailored ways to navigate content. For example, the Google search interface takes advantage of touchscreen capabilities by allowing users to swipe through related topics laterally, bypassing the awkward typing required by traditional search.

For both studies, researchers asked the participants to conduct the interview searching tasks using the computer or device with which they were most familiar. For the child study, all of the participants chose to use a laptop or desktop computer. However, during the longitudinal study, eight interviews were conducted with the youth participant using a more lightweight mobile device (iPad, iPhone, Windows phone, Samsung tablet) rather than a laptop or desktop computer, and numerous other participants had their devices within reach during the interview and would receive messages and check notifications while talking with the researcher. There were no specific interview questions pertaining to ownership or use of devices or other technology for the child participants, but despite not being specifically addressed, devices were prominent during the longitudinal interviews. As there were no scripted interview questions about devices,

all discussions of device use arose naturally during the course of the interviews. For example, one longitudinal searcher reported her smartphone use:

11-year-old girl:

> I use the computer to do homework and my phone for Instagram [http://www.instagram.com].

During the longitudinal study, 48% of youth reported use or ownership of 37 devices. In contrast, only four child study participants (8%) reported owning or using mobile devices and other technology.

The longitudinal participants reported ownership or use of varied types of devices: E-readers, gaming systems, iPod Touches, smart boards, touchscreen monitors, smartphones, and tablets and iPads. The most common of these types was the tablet computer, discussed by 22% of longitudinal youth; 18% of these youth specifically discussed the iPad. The second-most common type of device was the iPod Touch, owned or used by 20% of longitudinal youth. Sixteen percent of youth discussed their smartphone.

During the child study, all roles reported device ownership or use at similar low percentages. During 2013, Social Searchers were most likely to report device use or ownership, with 77% of Social Searchers doing so. Social Searchers were also much more likely to report use or ownership of devices than participants in the other longitudinal roles; what was not clear was whether these youth used devices that enabled their already-present sociability, or whether owning and using devices with easily accessible social applications aided in the creation of Social Searchers. For Social Searchers, device use and ownership is potentially a defining characteristic. Longitudinal

Non-motivated Searchers also discussed device use or ownership at a high rate, at 60% and Distracted Searchers did not report device use at all during the longitudinal study, but were more likely than youth in other roles to discuss devices as child study participants (see Figure 50).

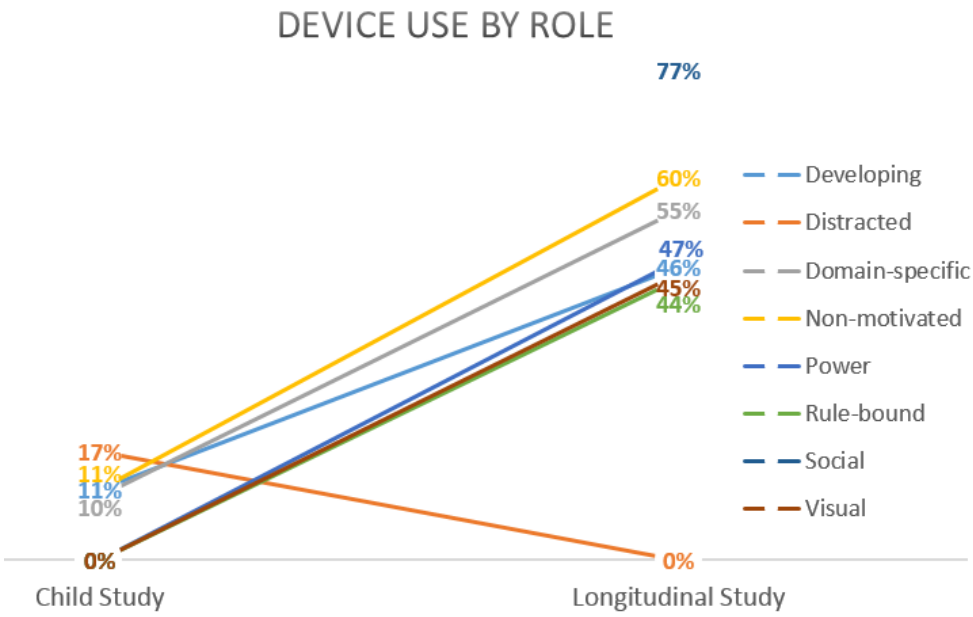

Figure 50. Device use by role. Percentage of child and longitudinal study participants by role reporting use or ownership of at least one device.

Device use and ownership increased for all three age brackets during the longitudinal study. The participants in the middle and oldest age groups showed identical percentages of device ownership and use during both studies; both moved from 14% during the child study to 57% during the longitudinal study. As the middle and oldest age brackets reported device use and ownership at the same percentages during both studies, youth seem to begin to own and use devices at varying ages, anywhere between ages 12 to 15. The youngest participants showed the largest amount of increase among the age groups from the child to the longitudinal study in owning or using devices, but reported

less device use than those in the middle and oldest age brackets. The trends by age in relation to device use are observable in Figure 51.

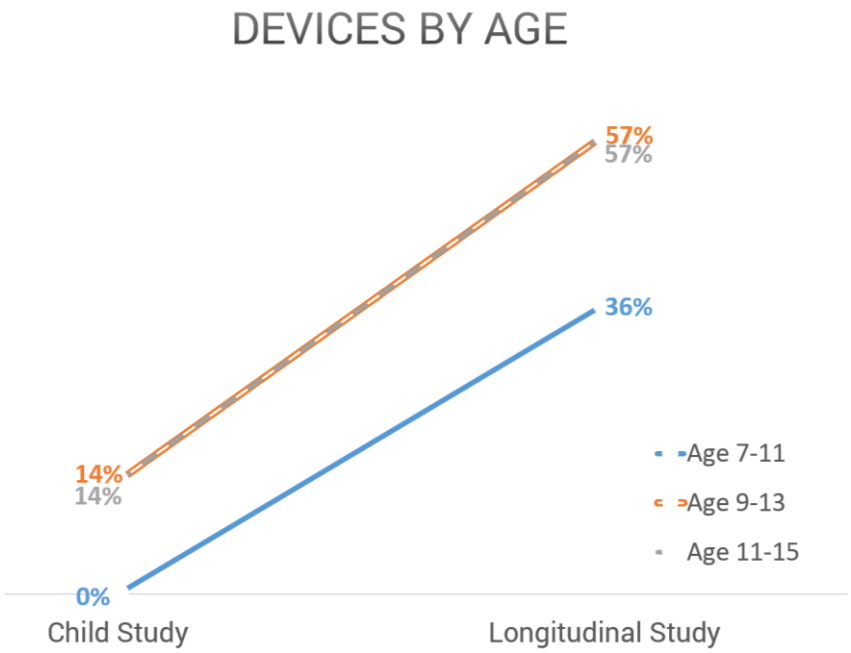

Figure 51. Device use by age. Percentage of child and longitudinal study participants by age discussing use or ownership of at least one device.

The Visual Context

To explore how youth encountered and used image and video content available on the Internet, during both the child and longitudinal studies I analyzed the number of verbal mentions of images or videos. Participants discussed visual content from websites or search results pages including image results, images on websites, video results, or videos within websites. Researchers did not prompt the participants to explain visual Internet content; all of the mentions of images or video arose naturally during the course of the interviews. Figure 52 displays the number of participants discussing each type of visual content and the stable participants discussing image and video content during both studies.

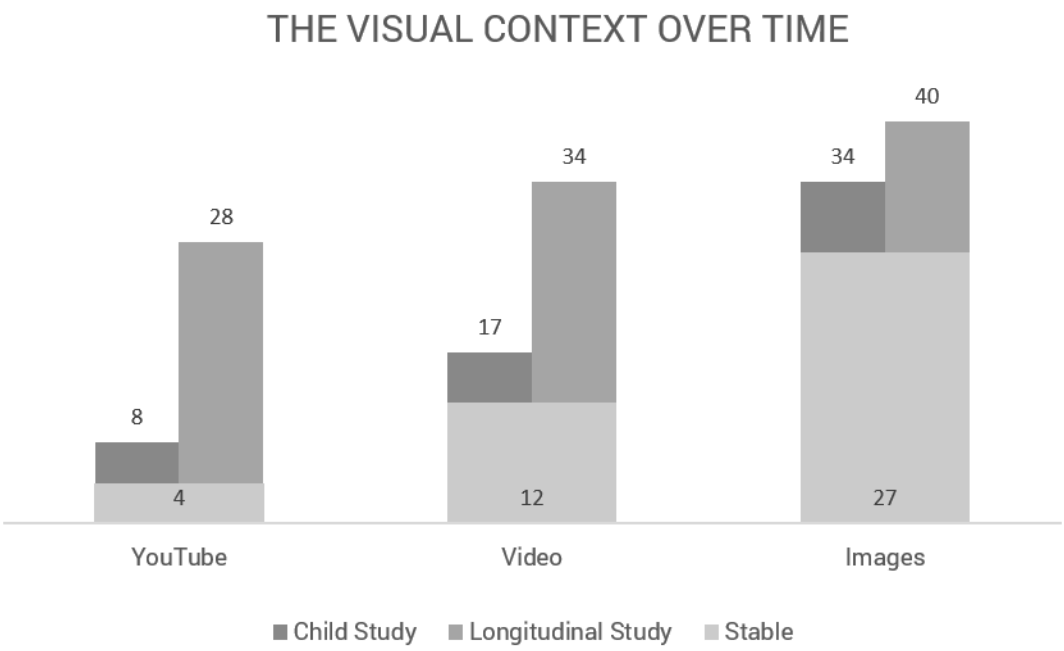

Figure 52. The visual context over time. Number of participants in each study mentioning image content, video content, or YouTube.

Sixty-eight percent of child study participants discussed image Internet content and 80% of the longitudinal study participants verbally discussed image content. Discussing images alone was more common than discussing video content alone; only 35% of child study participants referred to videos and 68% of longitudinal youth referred to video. Many of the child study participants repeatedly discussed images or videos throughout the interview. Per child study participant, there were 2.74 mentions of images and 0.72 mentions of video. For the longitudinal participants, these rates were increased, and in particular in reference to video content; there were 3.0 image mentions and 2.26 video mentions per longitudinal participant.

Sixteen percent of child study participants specifically mentioned the website YouTube, discussing that they use the website to watch "funny videos" (9-year-old boy) or to "watch horses" (7-year-old girl). YouTube was more prominent for the longitudinal

study participants, with 56% of longitudinal study participants discussing watching videos on the website. Per participant, child study participants mentioned YouTube 0.46 times each, compared to the longitudinal participants, discussing the website 1.80 times each. The longitudinal study youth revealed using YouTube in varying ways. One searcher described listening to music available on YouTube as a favorite activity:

14-year-old boy:

Interviewer: Ok. Uh, what's your favorite thing to do on the computer?

Interviewee: I don't know, sometimes I listen to music, or, play a game.

Interviewer: Ok. How do you listen to music on the computer?

Interviewee: I go to YouTube.

Other longitudinal participants discussed using YouTube to watch episodes of television shows or discussed YouTube when explaining how the search engine worked. Some participants used YouTube socially, relaying stories about watching videos on YouTube with friends, based on friends' recommendations, or subscribing to specific people within the YouTube site.

The visual context, measured by frequency counts of verbal mentions of images, video, or YouTube, represents awareness of and amount of engagement with visual information. Image awareness was very stable by participant, but when examining the number of mentions per participant, engagement with images grew steeply since 2008 and 2009. For discussions of video content, not only were there more participants discussing video in 2013, there were also more mentions of videos per participant. Finally, for YouTube in specific, the number of participants discussing the website and mentions per participant both grew as well. These measures of the impact of information

in visual forms shows that youth discover visual information, find visual information to be useful, and seek out visual information at higher rates as they age, and that the visual context is more prominent in the current technology landscape.

Examining percentages of participants in each role discussing images, the findings do not show large amounts of growth between the two studies. Visual Searchers predictably discussed images at higher rates than youth in other roles during both the child and longitudinal study. The remaining roles are fairly consistent in percentages of youth in each role talking about images, with the exception of the roles of Distracted. The shift in Distracted Searchers from talking about images at high percentages to lower longitudinal percentages may be reflective of the low skill levels present in the role.

For discussions of video content and YouTube in specific, the roles are relatively closely grouped during the child study, but fan out to broadly different and higher percentage rates longitudinally. The longitudinal increases for percentages of participants discussing of YouTube correlate with the placement of YouTube as a link in the highly-noticed AppBar. Additionally, the wide spread of the percentages of youth discussing video and YouTube indicates that information in video form is highly dependent on preferences within the roles. Figure 53 contains the complete results by role for referring to images or video as well as for discussing YouTube.

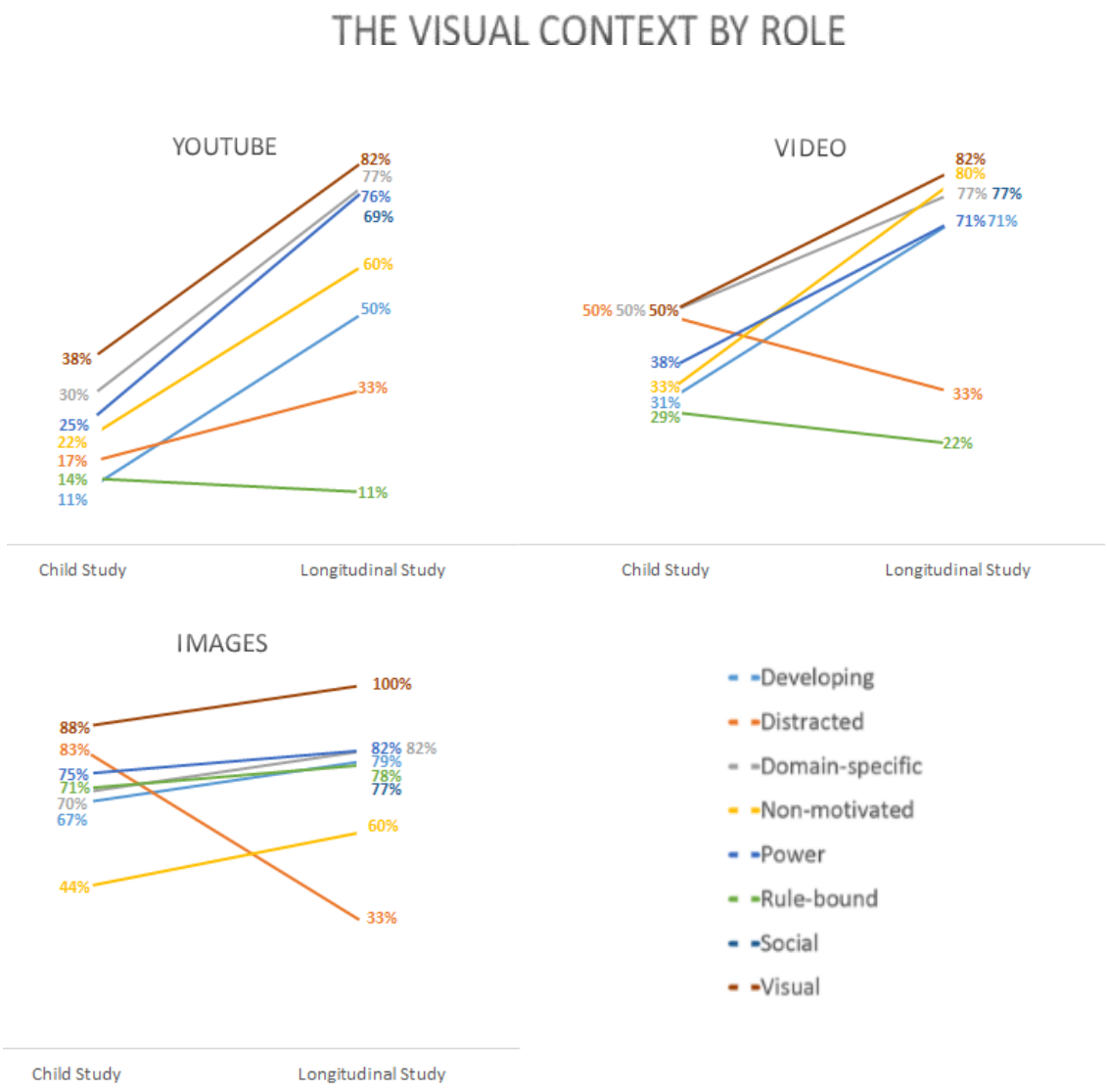

Figure 53. The visual context by role. Percentages of child and longitudinal study participants by role discussing YouTube, video, or image content.

Between the 2008 and 2013 studies, the three age groups showed an increase in verbally discussing images, video, or YouTube. This increase was most notable for discussions of YouTube and less steep for discussions of images. The oldest participants were outranked over time when examining mentions of video or image content by their younger peers. See Figure 54 for the changes over time for all three age groups.

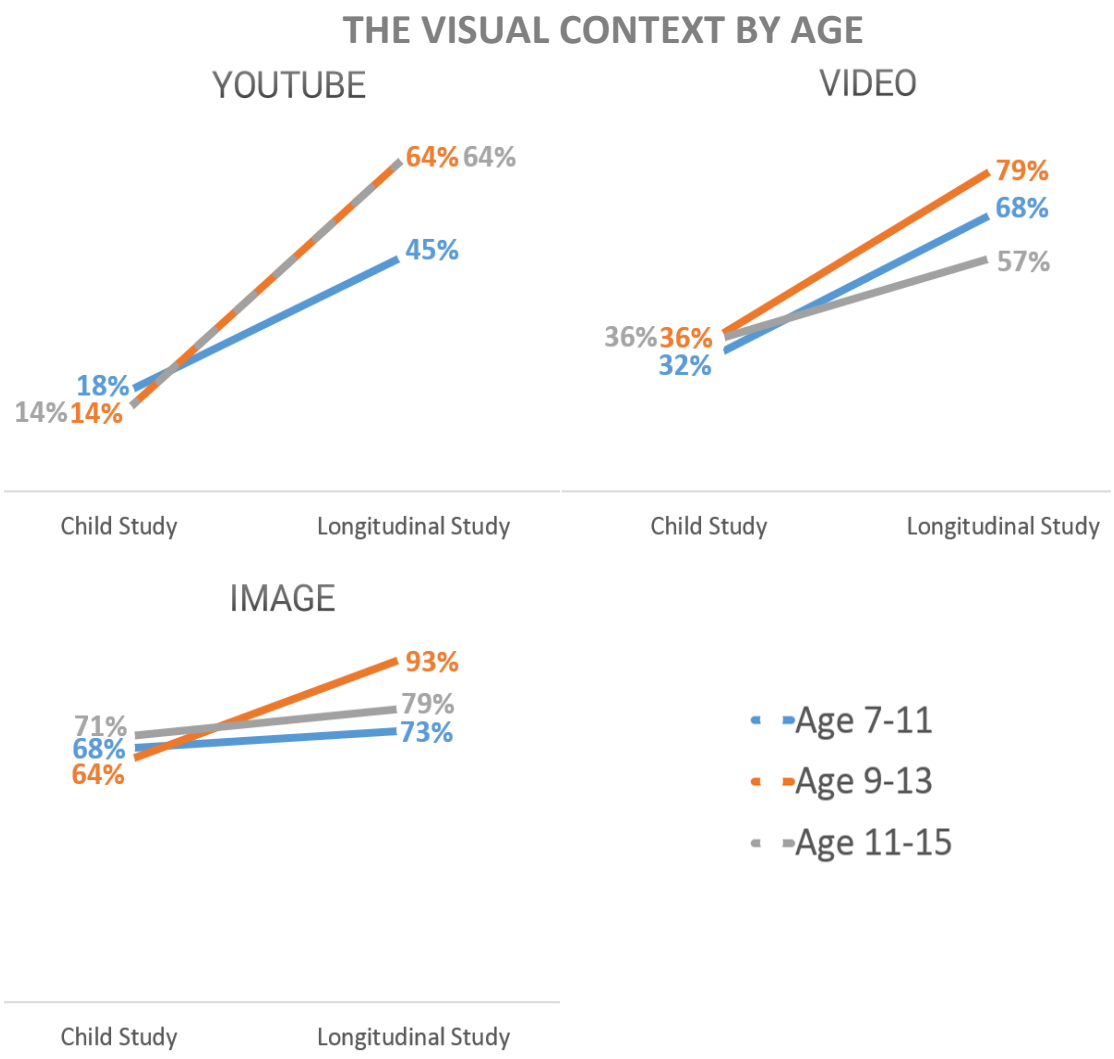

Figure 54. The visual context by age. Percentages of participants by age discussing visual content online.

Influencers

During the child and longitudinal study interviews, participants frequently mentioned other people. In many instances, participants included enough context surrounding their discussions of others to enable the categorization of how other people impacted their Internet searching. Researchers also directly asked participants during both studies, "Who else uses this computer?", referring to the computer or device used in the interview. To examine the role of others in youth search, all the people, or

influencers, mentioned by the participants were collected into groups. Whenever possible from the context, the method of influence was linked to the influencer. Additionally, many of the participants in both studies shared their home technology with other members of the household.

The child study participants mentioned other people often. Ninety-two percent of the child study participants discussed other people, with a total of 214 mentions of others during the interviews (some youth repeatedly mentioned the same person throughout the interview but in different contexts); there were 4.65 mentions of influencers per child study participant discussing others. Influencers fell into five categories: extended family, friends, parents (including specific mentions of mother or father), school (including all teachers, librarians, etc.), and siblings. Child study participants also referred to others in non-specific ways, such as a participant describing how he would proceed with his stymied search:

11-year-old boy:

I might go find somebody to ask.

Unspecified others are included in the analysis of influencers. The child study participants most commonly discussed mothers as influencers, with 78% of child study participants referring to mothers. Fathers were the second-most common influencer, discussed by 58% of child study participants. Forty-six percent of child study participants discussed siblings and 32% children mentioned teachers, librarians, technology teachers, media specialists, or other adults at school. Less frequently mentioned influencers for the child study participants were friends, by 20%, and extended family, by 6% of

participants. Non-specific references to others (e.g. “somebody”) were made by 6% of the child study participants. See Figure 55 for complete findings.

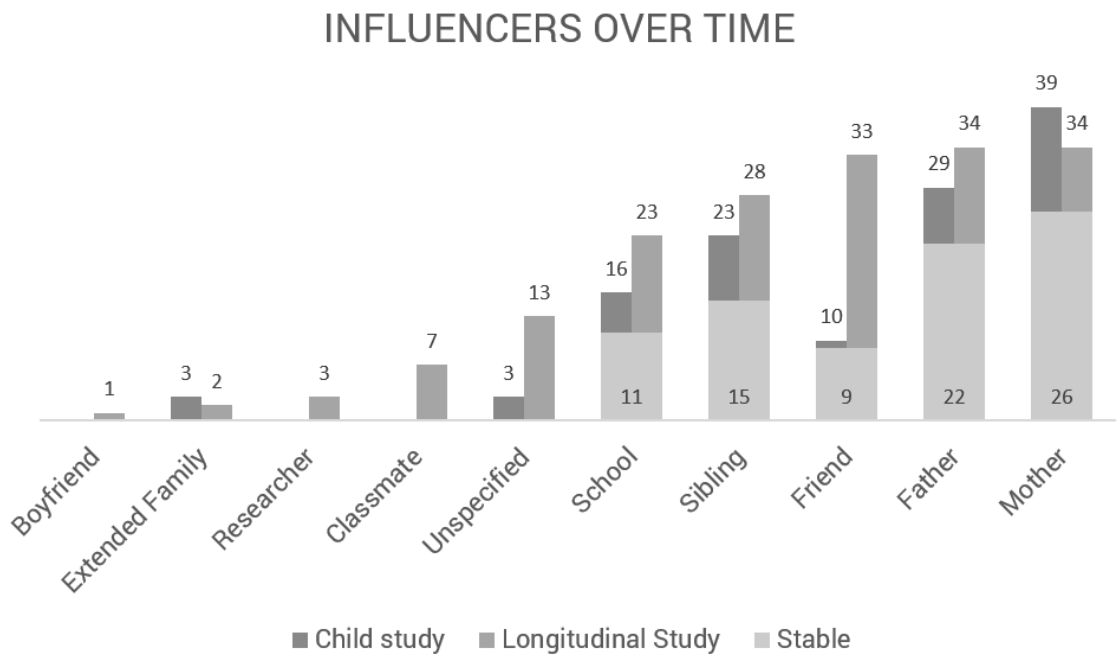

Figure 55. Influencers over time. Number of participants in each study discussing each type of influencer.

During the longitudinal study, 98% of youth reported influencers, mentioning others a total of 397 times; for each participant discussing others, there were 8.10 mentions of other people during the interview. Researchers asked the longitudinal participants about other people in several interview questions: “How did you learn how to search on the computer?”, “If you needed help when searching, who would you want to help you?” and “Do you ever search with other people?” People having an impact on search behaviors of the longitudinal youth included boyfriends, classmates, extended family, friends, fathers, mothers, the researchers conducting the study, school (teachers, librarians, etc.), siblings, and unspecified others. Of these groups, fathers, mothers, and friends were discussed by nearly equal numbers of longitudinal youth; 68% of 2013 study

youth mentioned fathers and mothers, and 66% discussed friends. Other frequently discussed people were siblings, by 56%, and teachers or other adults at school, by 46% of youth in 2013. References to unspecified others were made by 26% of youth in 2013.

The 2013 youth reported influencers who were not mentioned during 2008. These were a boyfriend, classmates, and the search study researchers. The boyfriend was not discussed beyond this mention:

15-year-old girl:

> I don't know what you can call him, boyfriend [name elided], I can't call him that.

Classmates, from 14% of longitudinal participants, were generally discussed in relation to completing school projects. For example, a searcher described:

13-year-old boy:

> Uh, usually what happens is the person sitting next to me will ask me a question about their program and why it's not working, and I finished my program thirty minutes earlier, and so, “Will you email me a copy of your program?”

When researchers interviewed youth new to searching, the script diverted to an explanation of how to use Google to search. In response to the question, “How did you learn to search on the computer?” two searchers responded:

10-year old girl:

> Um, well, you actually taught me.

12-year-old girl:

> Well, you guys did the last time you were here.

Another searcher discussed the study researchers in response to the question, "If you needed help when you were searching, who would you want to help you?"

11-year-old boy:

I'd probably pick some instructor, like, you.

Although only three children referred to the study researchers, it is interesting that a brief interview occurring years prior made a lasting impact.

Researchers added three questions to the interview script specifically devoted to exploring social aspects of searching prior to beginning the longitudinal study (See Table 2). In some ways, this provides a skewed picture of how youth have changed in relation to other people over time, as priming the longitudinal participants to think of other people likely led to increases in discussions of others. However, much of the evidence collected from the interviews pertaining to influencers occurred outside of specific researcher questioning, prior to the new interview questions regarding other people, or was mentioned off-handedly by the participant and not pursued with follow-up questions by the researcher.

By role, Social Searchers showed fairly high percentages of influence by all of the five most common types of influencers, especially for friends. Rule-bound Searchers were much more likely than searchers in other roles to be influenced by adults at school. Visual Searchers discussed siblings more often than participants in other roles, although Visual Searchers were also highly influenced by mothers. Non-motivated Searchers were the only role to show a decrease in influence from fathers and Distracted Searchers were the only role to show a decrease in influence from friends and siblings. Figure 56 shows the percentage of participants by role discussing the most frequent types of influencer.

Figure 56. Influencers by role. Percentages of child and longitudinal study participants by role reporting the most frequent types of influencers.

For the most frequently mentioned influencers, the youngest participant group increased over time in mentioning influencers. The middle age bracket of participants displayed a decrease over time in discussing fathers, mothers, and siblings. For friends, the participants in the middle age bracket showed an increase over time and for siblings, they remained stable. For the oldest participant group, mentions of friends and siblings increased during 2013, mentions of mothers decreased, and fathers and school remained stable. Figure 57 shows the percentages of participants in the three age groups for each study discussing the most frequent influencers.

Method of influence. Methods of influence fell into nine categories: answering questions, encouraging to use, fixing technology problems, general helping, learning/teaching by observation, making rules, searching together, showing new sources, and spelling/typing/keywords. The most frequent method of influence for the 2008 participants was the influencer making rules to follow, as was the case for 28% of 2008 participants. Mothers, fathers, and teachers were the only influencers connected to rule-making, with mothers making rules for 14%, teachers making rules for 16% and fathers making rules for 6% of 2008 participants. The second-frequent method of influence was for 2008 searchers to learn search skills and habits by watching influencers, as was the case for 20% of the child study participants. Participants were most likely to learn search skills from watching siblings. For 16% of 2008 participants, influencers showed new sources for information and encouraged computer use. Only 14% of 2008 participants searched together with influencers using the same machine at the same time.

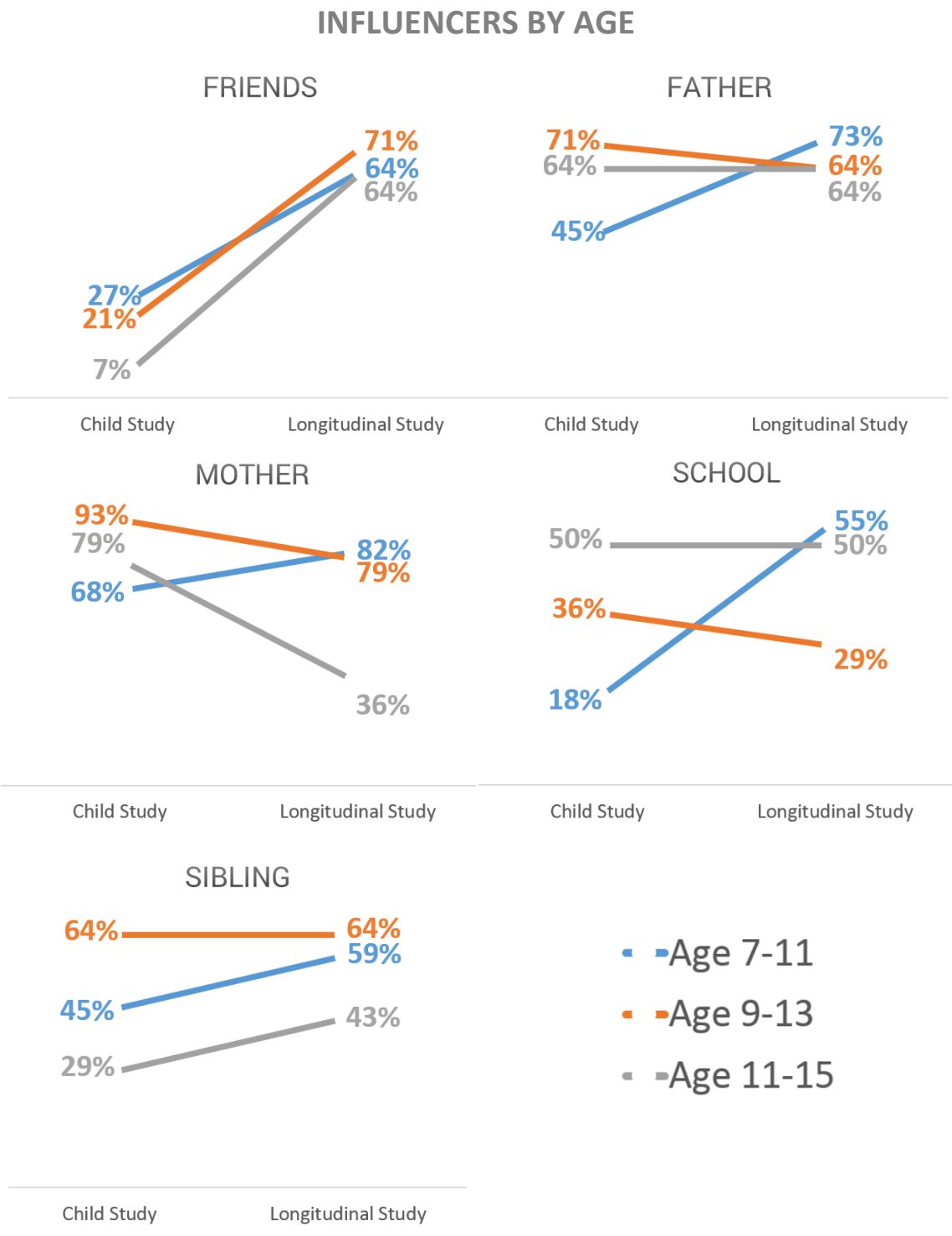

Figure 57. Influencers by age. Percentage of participants by age discussing the most frequent types of influencers.

The longitudinal study methods of influence reflect those from the child study with two additional categories (see Figure 58). Unique to the longitudinal participants, influencers helped with result selection and engaged socially online. The most common method of influence, for 52% of longitudinal study youth, was influencers searching with the youth on the same computer. For 48% of longitudinal study participants, influencers aided with spelling, typing, or keyword formulation. Forty-six percent of longitudinal youth learned search skills by watching influencers' computer use habits. Thirty-six percent of longitudinal youth had influencers who imposed rules: mothers for 22%, teachers for 20%, and fathers for 18%. Thirty-five percent of longitudinal participants reported influencers showing new websites. For the categories arising during the longitudinal study, 16% of longitudinal participants had influencers who aided with result selection, and 14% engaged socially online with influencers.

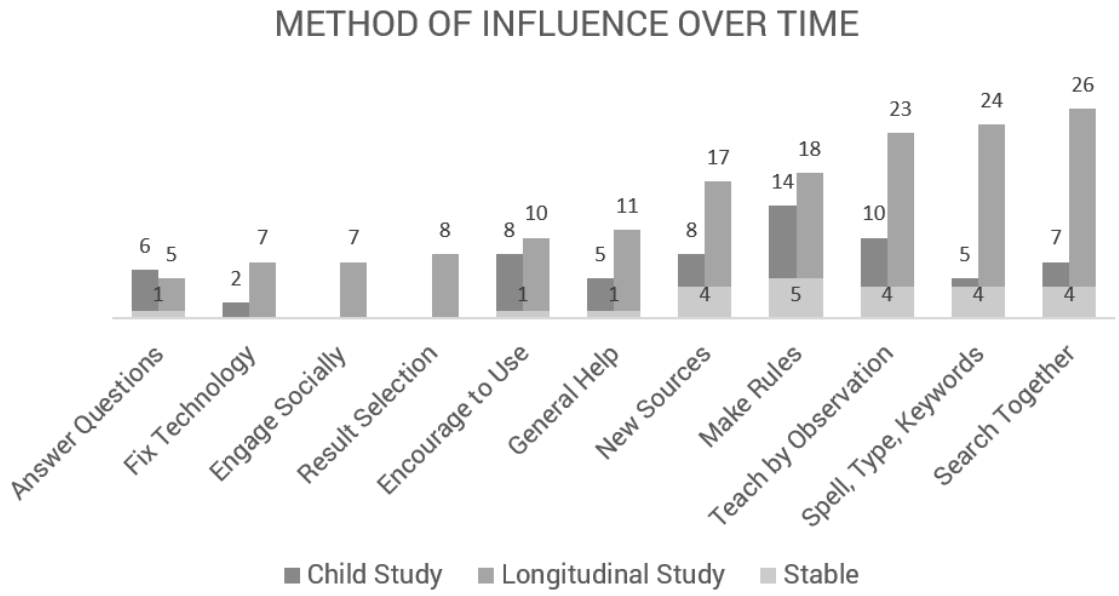

Figure 58. Method of influence over time. Number of participants in each study reporting each type of influence.

There were larger numbers of participants reporting almost every method of influence during the longitudinal study. This is largely attributable to the age of the participants; older youth are better able to verbalize their thoughts, and so connecting influencers to methods of influence was more common during the longitudinal study. There were only 33 youth discussing influencers fully enough to connect to methods of influence in the child study data, as compared to 49 youth in the longitudinal study data.

Child study participants most frequently discussed their influencers making rules regarding computer use. However, as the child study participants also commonly discussed being encouraged to use the computer and being shown websites, it seems that influencers were not making prohibitive rules, and instead established expectations of how youth should engage with the computer. The longitudinal study youth most frequently discussed searching with their influencers. This finding likely ties into the increase in types of influencers during the longitudinal study; with more different types of people available as search partners, the number of situations in which searching socially can occur also increases. Additionally for longitudinal participants, receiving help with spelling, typing, or keywords was prominent, despite their increased age. That the study youth, even into adolescence, reported needing aid from other people to overcome such basic problems underscores how the lack of basic skills can derail youth when searching.

For the most common methods of influence existing in both studies examined by role there are varied trends, as visible in Figure 59. Social Searchers are more likely than searchers in other roles to have influencers who make rules, search with them, show new websites, and help with spelling, typing, or keywords. As Social Searchers discussed

other people in general at high rates, it is not surprising that they often revealed how their influencers affected them. Overall, Domain-specific and Rule-bound Searchers reported few dramatic shifts in how influencers affect their searching across the studies; of all the roles, they show stability in method of influence. Power and Developing Searchers also do not show large changes between the studies regarding how influencers affect their searching. In contrast, Distracted and Non-motivated Searchers show largely different percentages across the studies in almost all the categories of method of influence.

For all age groups, the methods of influence of learning from watching, searching together, showing sources, and spelling, typing, and keywords all showed increases over time. For the oldest participant group, there were fewer reported incidents of influencers making rules. The trends in method of influence by the three participant age groups for each study are presented in Figure 60.

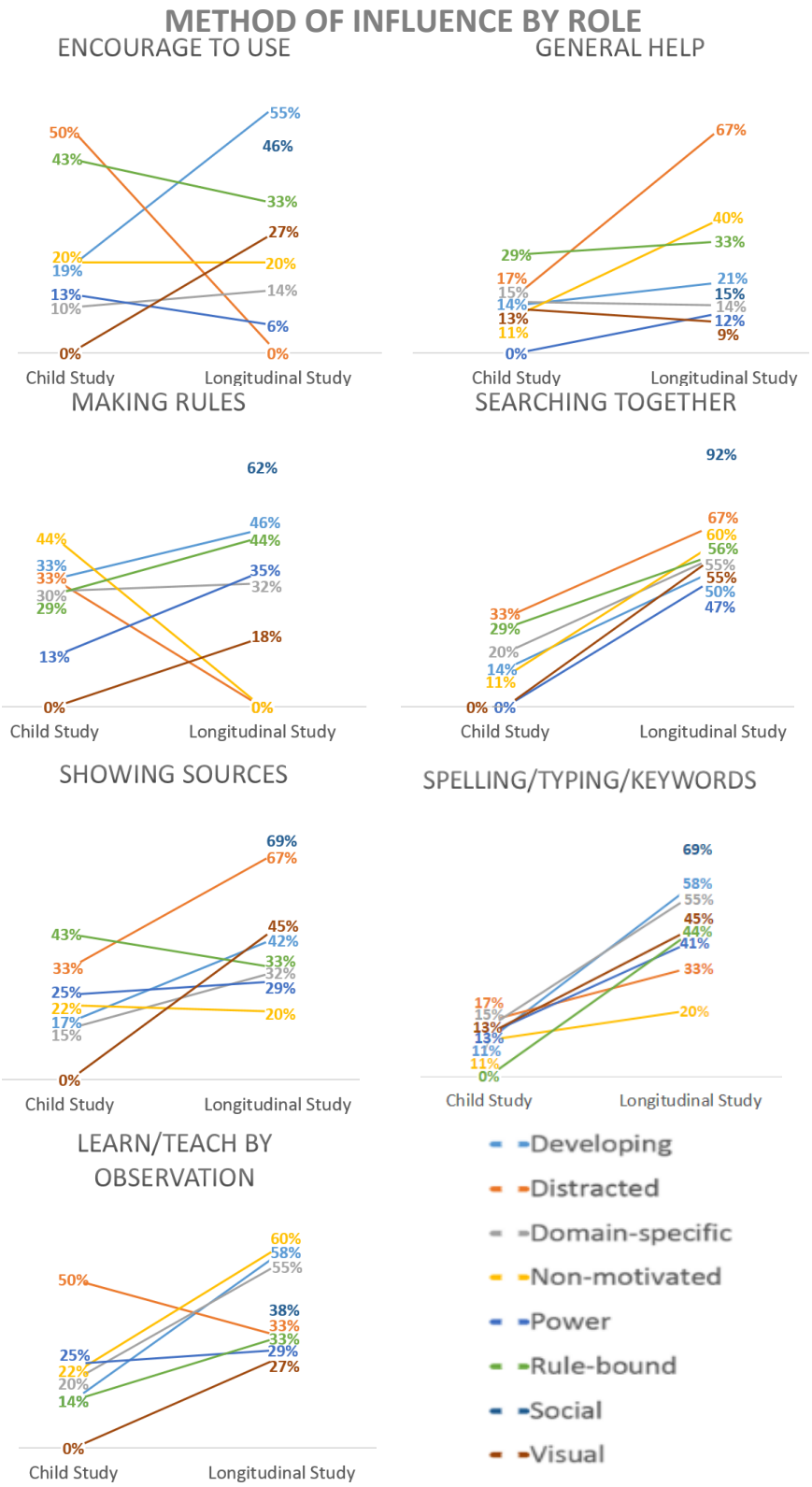

Figure 59. Method of influence by role. Percentage of child and longitudinal study participants in each role reporting different types of influence.

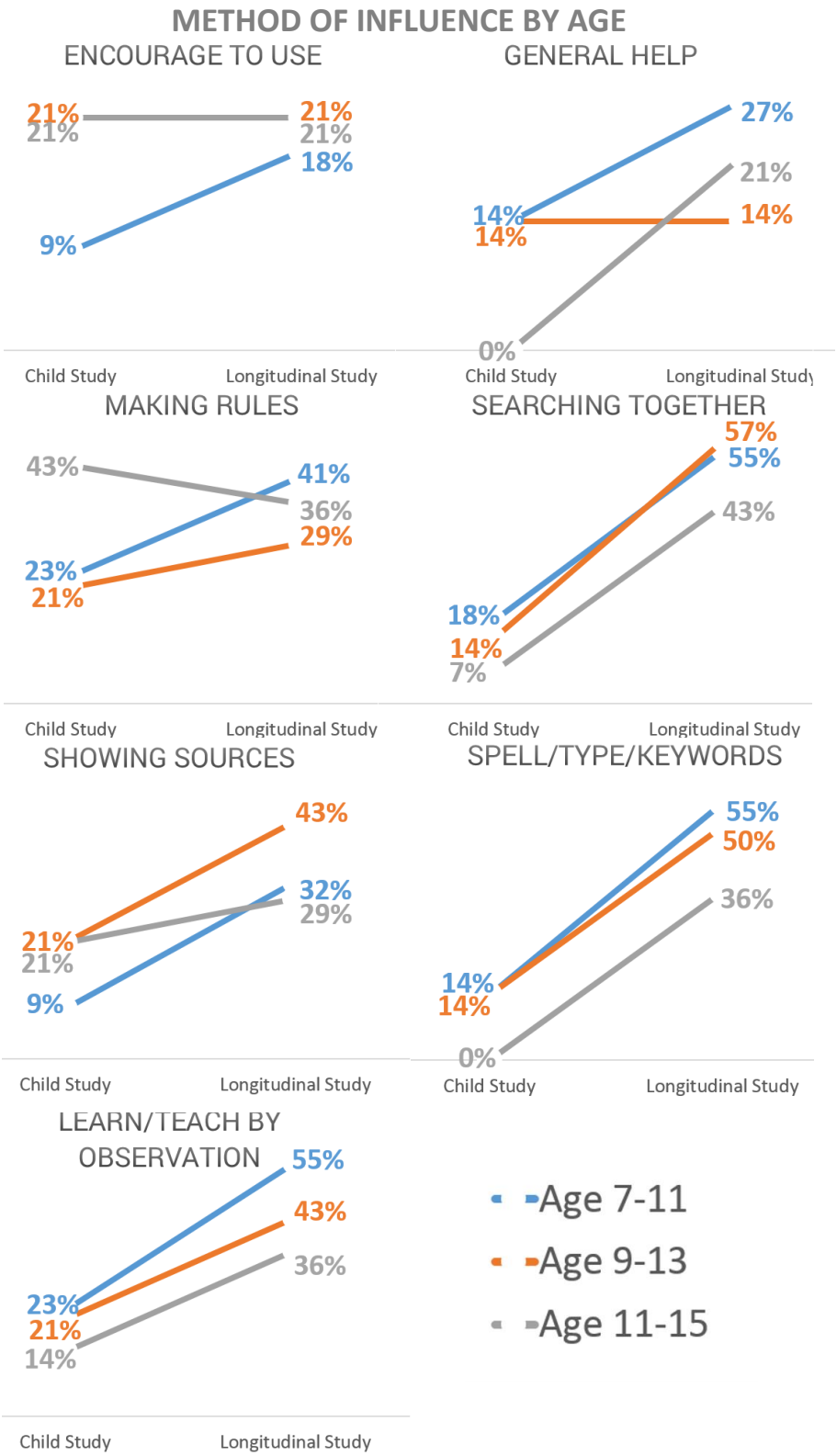

Figure 60. Method of influence by age. Percentage of child and longitudinal study participants by age reporting each type of influence.

Technology sharing. Almost every child study participant shared the computer they used during the interview with other members of their household; only two child study participants had their own computer. Twenty-eight percent of longitudinal study participants indicated that they were the only user of the computer or device used during the interview. During 2008, mothers were most commonly reported as shared users, by 76% of child study participants. Fathers and siblings shared the computer with the child study participants at almost the same rate: fathers were reported by 52% and siblings were reported by 50% of 2008 participants. The youth participating in 2013 reported sharing the computer or device used during the interview most frequently with their siblings (44% of participants). Mothers were reported as sharing the interview computer by 40% of 2013 participants, followed closely by sharing with fathers, reported by 38% of participants. One 2013 participant mentioned sharing the computer with a friend.

While fathers overall became more prominent as influencers during the longitudinal study, they were also reported by fewer participants as being a user of the same computer. The number of participants reporting sharing with mothers also showed a downward trend in sharing for all roles except Non-motivated. Concurrently, more participants discussed sharing their main computer with a sibling. The most likely explanation for these changes over time is that parents either passed down one of their own computers or purchased a new computer or device for any youth in the home to use. As Non-motivated Searchers reported sharing the computer with mothers at a higher rate than youth in other roles, and as they are less skilled than youth in other roles, it is possible that ownership of computers or devices independent of parents is important to developing search skills.

By role, Visual Searchers reported an increase in sharing computer with siblings, fathers, and mothers during the longitudinal study. Non-motivated Searchers also showed increased in sharing the computer with mothers and siblings, and were also likely to share the computer with fathers when compared to searchers in other roles. For all roles except Visual, there was a shift away from sharing computers with fathers during the longitudinal study (See Figure 61).

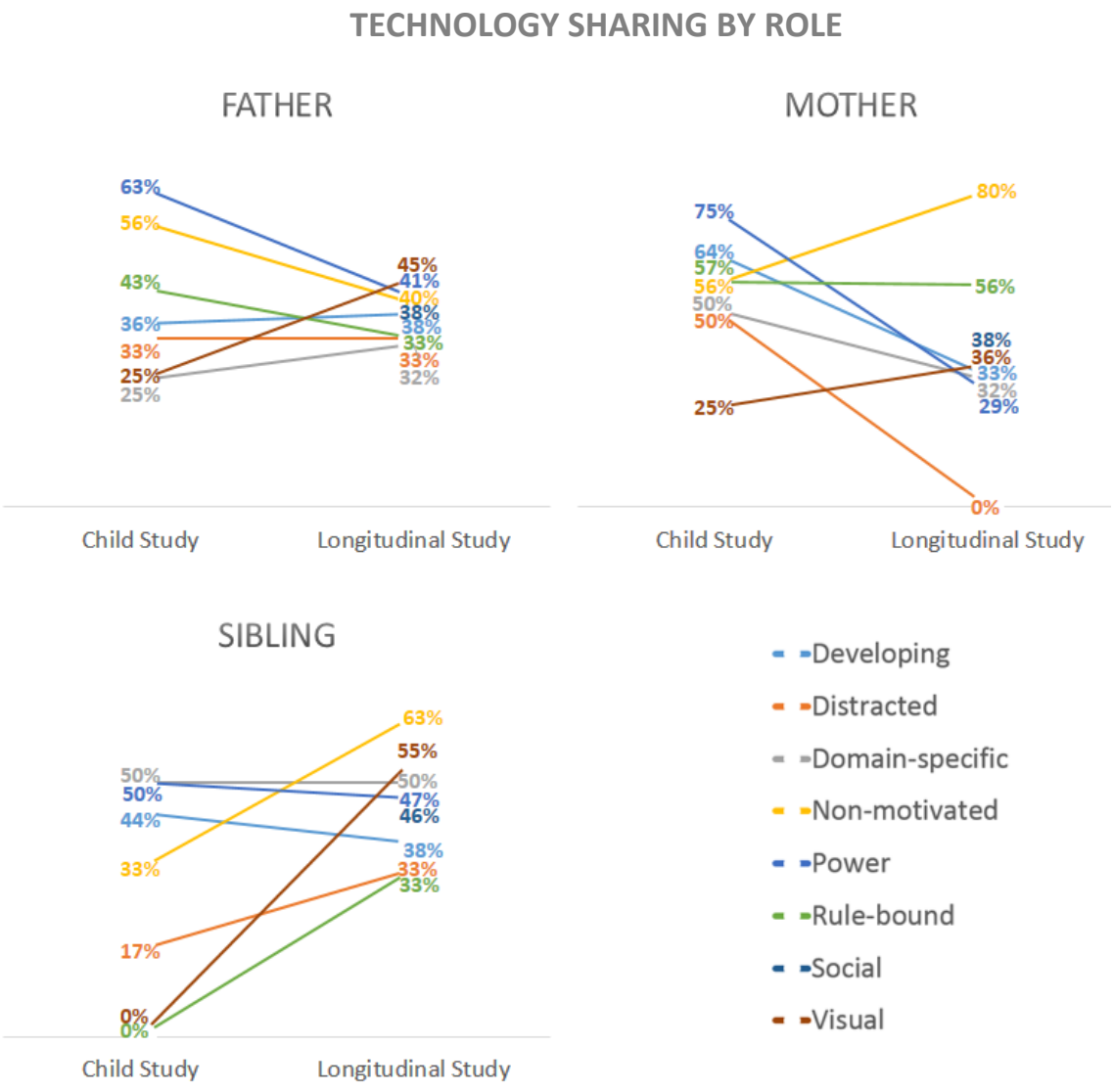

Figure 61. Technology sharing by role. Percentage of child and longitudinal study participants reporting sharing the computer with different family members.

The oldest participants displayed decreases over time in sharing computers or devices with others. The participants in the middle age group moved away from sharing with parents as 9-year-olds and into sharing computers or devices with siblings as 12- or 13-year-olds. The youngest participants were most likely to share with mothers during the longitudinal study, and shared with siblings and fathers at the same percentage. The trends by age in sharing technology are visible in Figure 62.

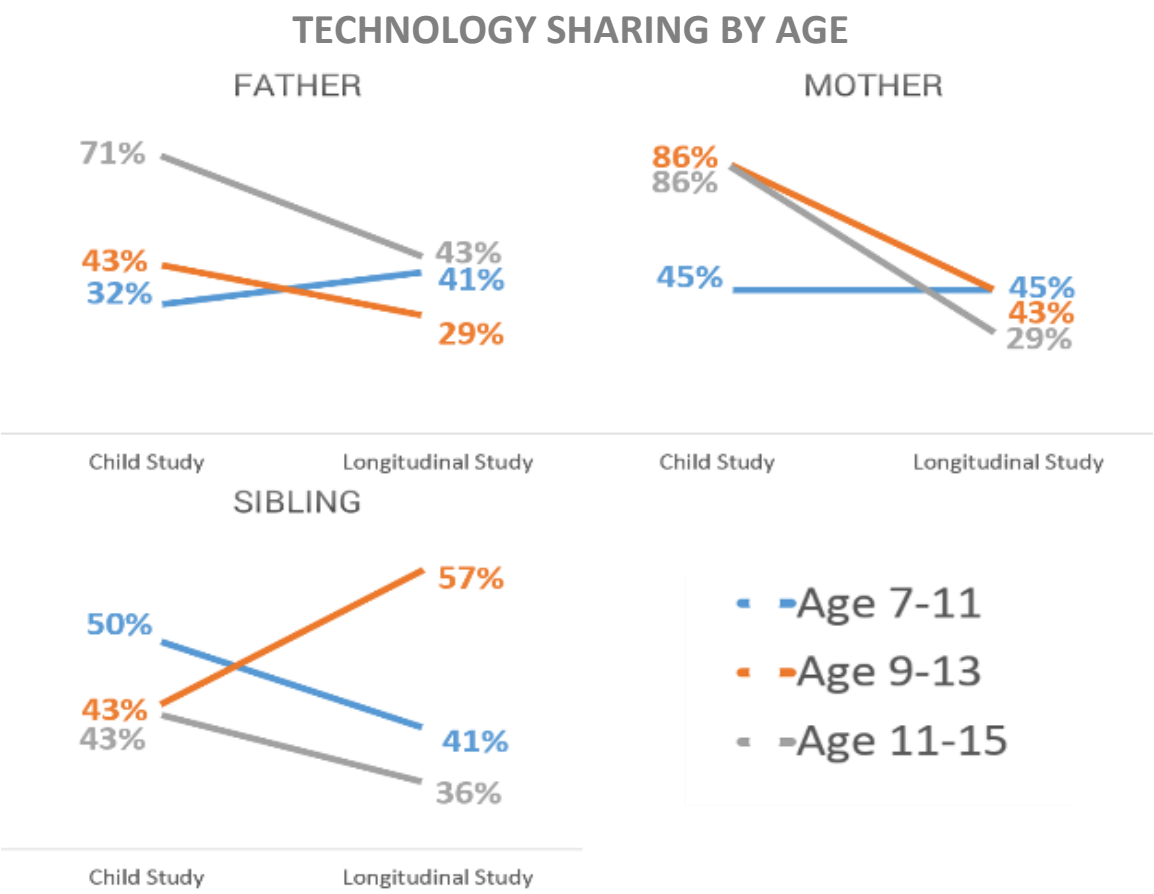

Figure 62. Technology sharing by age. Percentage of child and longitudinal study participants by age reporting sharing with different family members.

The Social Landscape

The participating youth in both studies discussed social Internet activities, such as online gaming or visiting social media sites. Occasionally, participants discussed online

activities that were inherently social without mentioning other people specifically, for example, using email or chatting. Activities that were social in nature or that included others were examined, even when the other people were not directly discussed (See Figure 63).

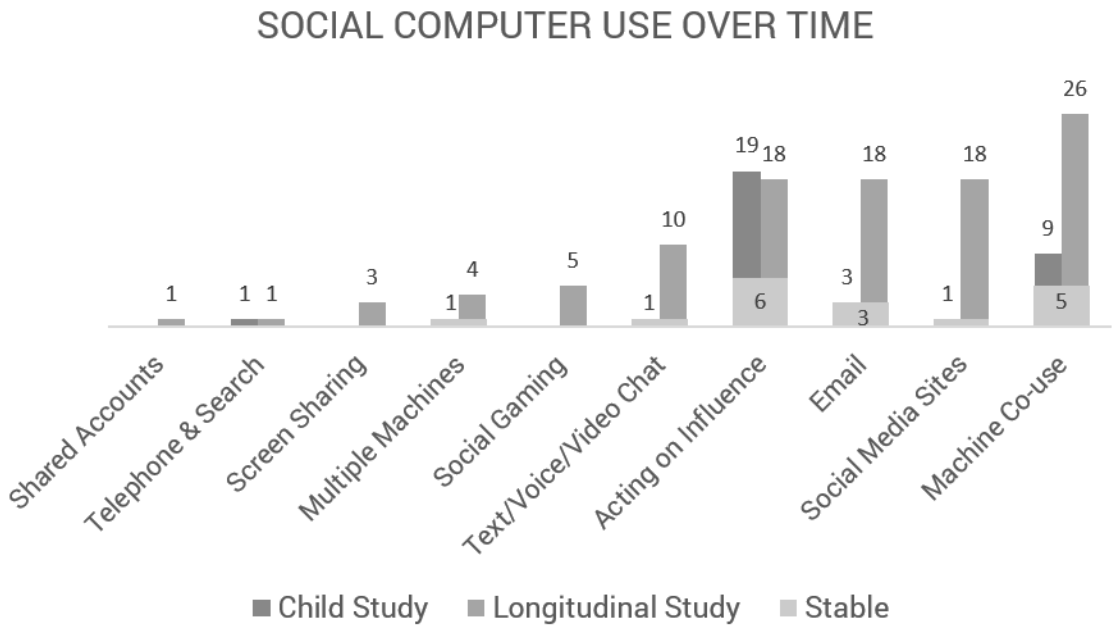

Figure 63. Social computer use over time. Numbers of child and longitudinal study participants discussing different types of social computer use.

The child study interviews contained very little data regarding social computer use or social computer search behaviors. Researchers did not directly question the child study participants about the role of others, or about their use of socially-based sites, applications, or activities on the computer. However, the child study participants did conduct actions during the interviews that, per self-report, originated from social interactions. Taking action or following through on the recommendation of another person indicated a higher level of influence and that the participant had a desire to engage in the recommended activity. In contrast, influencers and methods of influence are

sometimes present out of imposition (e.g. making rules) or necessity (e.g. spelling/typing keywords). Examples of child study participants acting based on the influence of others include:

7-year-old girl:

> Like my mom showed me how to use YouTube, so I look for YouTube videos.

9-year-old boy:

> I've just always used Google. It's mom's choice.

9-year-old boy:

> Interviewer: Why do you use Google and Google Chrome?
>
> Interviewee: First, my dad usually wants me to.

9-year old boy:

> Interviewer: So it's kind of what you usually do?
>
> Interviewee: Yes. I just did research for like songs that my, um, friends tell me to.

11-year-old boy:

> Interviewer: If you were searching on Google for your own interest, what would you search for?
>
> Interviewee: Usually I search for like, like my friend tells me about a video, I'd go to YouTube and search it, if he tells me about a site I'd search it on Google. If he tells me about a game.

Thirty-eight percent of child study participants reported acting on the recommendations from others. Other social aspects for child study participants included co-use of one

computer, reported by 18%, and use of email, which was discussed by 6% of child study participants. Using social media sites, using the telephone simultaneously with the Internet, using text chat, and using two computers in the same space were each reported by one child study participant. No child study participants discussed online gaming with others, screen sharing, or sharing accounts with others.

For the longitudinal youth, there were many ways the participants discussed the computer as a social tool during searching. Co-use of the same machine was the most prominent method for social search use, reported by 52% of longitudinal study participants. Discussed at equal rates were the use of email and social media sites, both reported by 36% of longitudinal study participants, although these mentions did not always pertain directly to search behaviors. Use of email was generally not discussed in-depth, but discussions of using social media sites were somewhat more revealing into youth online social behavior. The longitudinal participants discussed using social media sites to share photos, verify homework answers, expand their network of real-world friends, and to keep updated with others:

15-year-old girl

> Interviewer: Ok, what is your favorite thing to do on the computer?
>
> Interviewee: Um, my friends and I do a lot of photo shoots, and we'll use the photos and we'll run with those, and you know?
>
> […]
>
> Interviewer: What do you do with them?
>
> Interviewee: Some of them go on Facebook, and some of them I just keep. Some of them go on deviantART [(http://www.deviantart.com)]…

14-year-old girl:

Interviewer: And why did you click the Yahoo! Answers [(http://www.answers.yahoo.com)] one?

Interviewee: I was just scrolling just to see what was there and I usually go on Yahoo! Answers just to see what people write.

Interviewer: Ok, so you go to see what people write cause why?

Interviewee: Oh, cause I just want to see if they're right or wrong and I want to like, um, what's the word, debate about it in my mind.

Use of online text, voice, or video chat was reported by 18% of longitudinal study participants. Ten percent of longitudinal youth discussed playing online games with either friends or strangers, and in-person or via the Internet. Youth also reported social technology use by using two computers or devices in the same space (8% of longitudinal study participants), using screen sharing or remote desktop (6% of longitudinal study participants), sharing accounts (one participant), and using the telephone to talk while simultaneously using the Internet (one participant). Given that the discussions surrounding social computer and searching behaviors happened spontaneously during the interviews, more concentrated research is needed into how social media, device usage, and online and real-world interactions affect search behaviors.

2008 participants were largely unsocial in their use of the computer and search behaviors, displaying social behaviors in two main areas: acting on influence from others and using computers simultaneously with others. 2013 youth showed only a few areas of social behavior with high numbers of participants, but were social in more ways. The finding of social computer use occurring through numerous paths indicates youth are

diverse in their interests and skills, and they align their social computer activities with their areas of preference and according to their individual abilities. Youth during the longitudinal study also discussed owning or using mobile devices at much higher rates than did child study participants. The interface present on mobile devices is largely geared towards social applications, making communication with others accessible. Additionally, many social media sites have come into prominence since the child study in 2008. There are numerous photo sharing applications new to the technology landscape since 2008 (e.g. Instagram), as well as new ways to communicate via video chat (e.g. Google Hangouts (http://www.google.com/hangouts)).

By role for the most common social computer use activities, all the longitudinal Distracted Searchers used email. Social Searchers were highly likely to use chat, act on the influence of others, use social media sites, or use the same computer or device with others, but were less likely than most other roles to use email. Non-motivated Searchers showed longitudinal decreases in chatting, acting on influence, and machine co-use. Rule-bound, Developing, and Domain-specific Searchers showed similar patterns for social computer use. Figure 64 provides the complete reporting of social computer use activities by role.

The older two groups of participants increased over time in their reporting use of social media sites, and the youngest participants, while increasing in reported use, did so at a much lower rate. Social media website use seems to begin around age 12 to 13, perhaps due to parental prohibition at younger ages, and also possibly due to a lack of interest until youth reach age 12 to 13. See Figure 65 for complete trends by age.

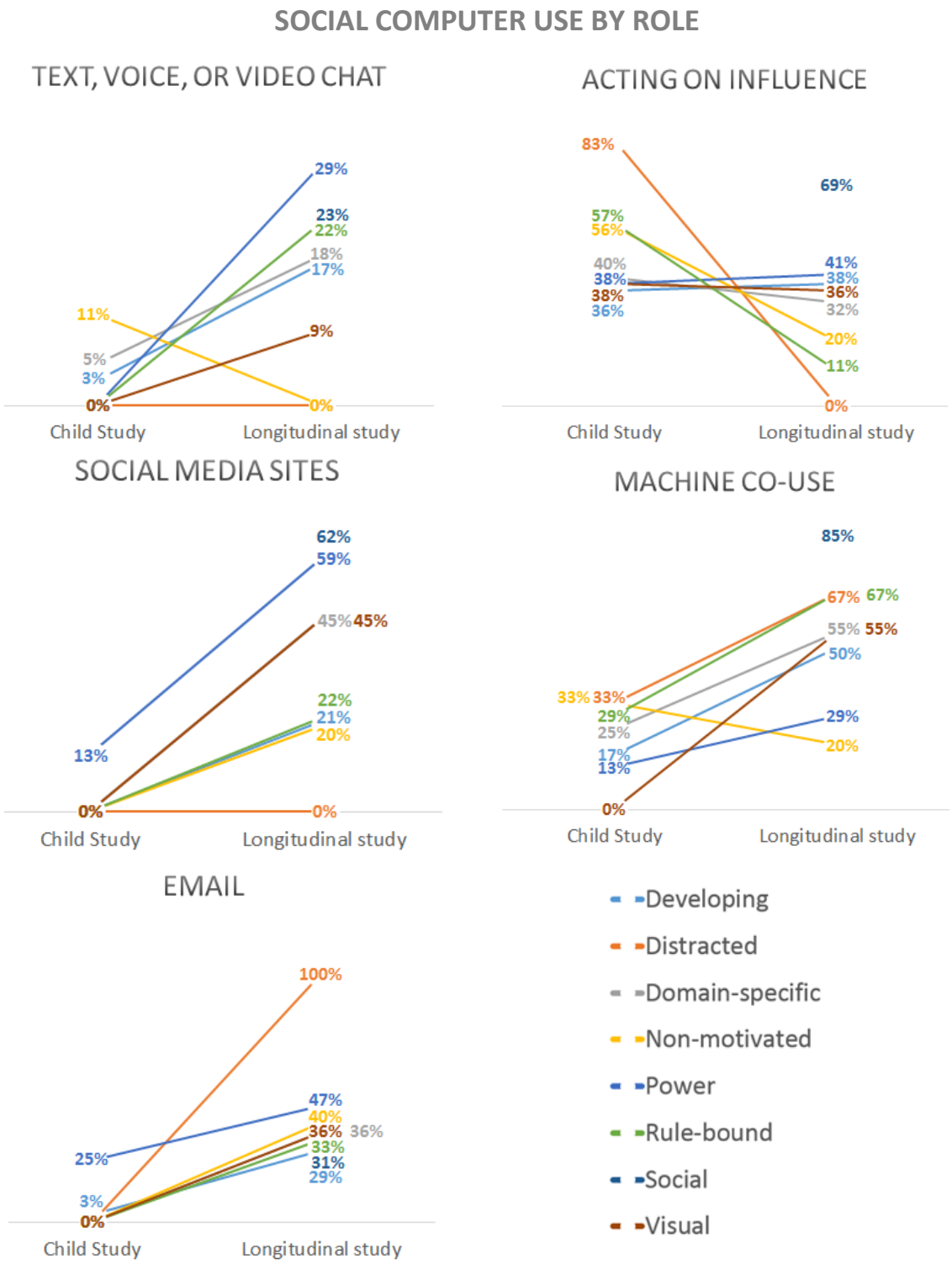

Figure 64. Social computer use by role. Percentages of child and longitudinal study participants by role reporting different types of social computer use.

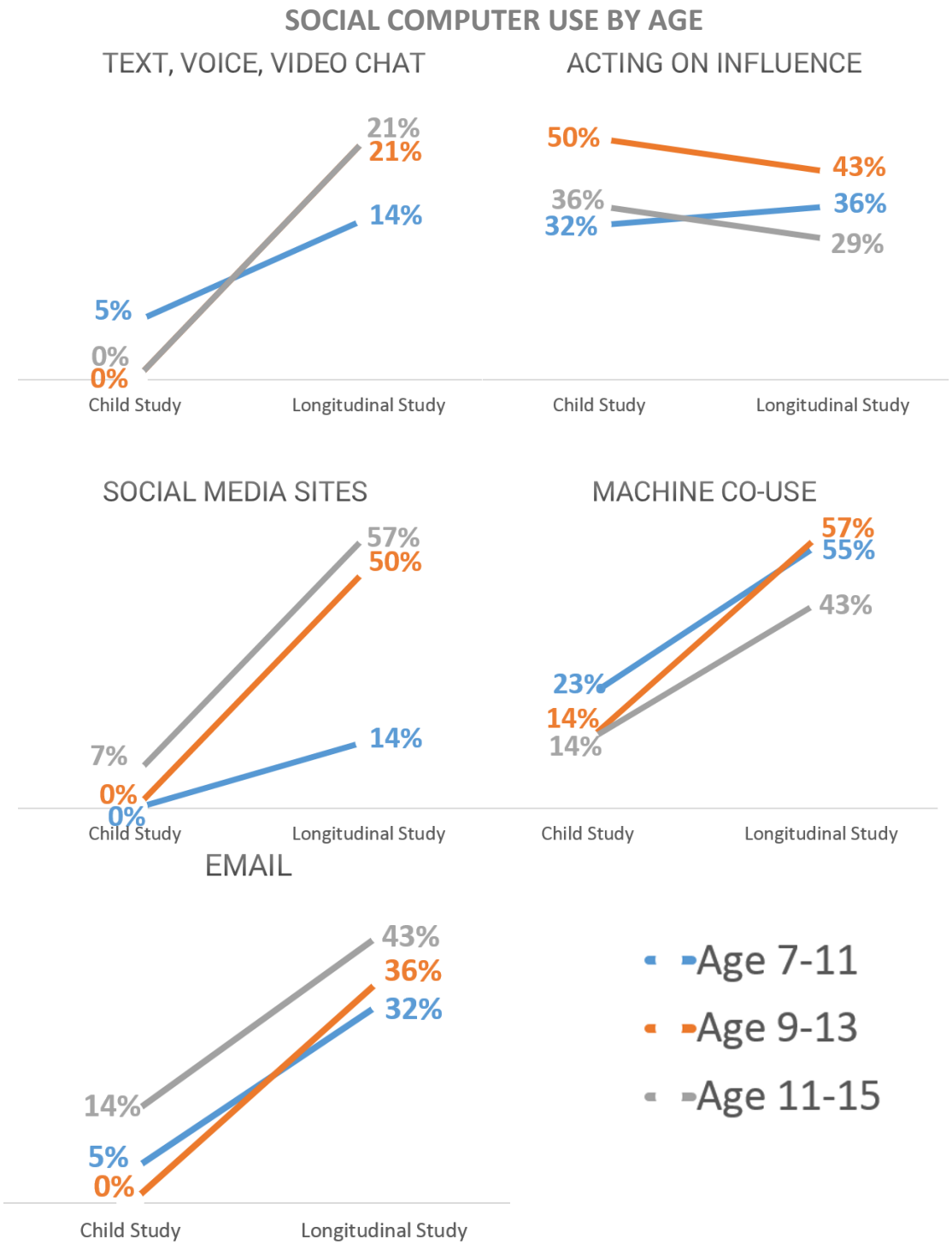

Figure 65. Social computer use by age. Percentage of child and longitudinal study participants by age discussing different social computer use activities.

Social computer use stability. All three of the child study participants who reported using email also used email during the longitudinal study. Of the nine child study participants reporting co-use of one computer with another person, five reported co-use during the longitudinal study. One child study participant discussed social media sites, and this remained consistent during the longitudinal study; this participant is a 15-year-old boy falling into the Power Searcher role. For use of text, voice, or video chat, only one participant, a female 11-year-old Rule-bound, Developing, and Social Searcher, discussed this type of social use during the child study. She was consistent in her use of text chatting, reporting it during the longitudinal study as well. Only one participant reported using multiple computers or devices in the same space during the child study. This participant, an 11-year-old female Developing, Visual, and Distracted Searcher, again reported using two computers in the same room during the longitudinal study. Although it is difficult to draw conclusions based on so few child study participants describing social search and computer use, the existing data seems to show that social behaviors are relatively stable over time in individuals.

Uncertainty

Statements such as, “I don’t know,” “I’m not sure,” “I can’t,” or “I have no idea” served as alerts to when a participant was feeling uncertainty or similar emotions surrounding the interview context or search tasks. During the child study, 68% of participants made these types of statements. Many of the child study participants had multiple instances of uncertainty statements; there were a total of 156 occurrences of statements such as “I don’t know” during the child study. The longitudinal participants made statement indicating uncertainty in the same language as the child study

participants; “I don’t know” or “I’m not sure” were common phrases. Sixty-six percent of longitudinal study participants verbalized uncertainty during the interviews. As some participants made such statements multiple times throughout the course of the interview, there are 80 total uncertainty statements for the longitudinal study youth. On average, uncertainty statements were nearly twice as common during the child study as for the longitudinal study; when averaging uncertainty statement frequency across all 50 participants, child study participants made 3.12 statements per participant and longitudinal youth made 1.60 statements per participant. Expressing uncertainty was also fairly stable across time; of the 34 child study participants who expressed uncertainty, 25 expressed uncertainty again during the longitudinal study.

Examining uncertainty by role, as in Figure 66, reveals varied patterns of uncertainty statements between the studies. Distracted, Non-motivated, and Domain-specific Searchers all showed a decrease in uncertainty statements from the child to the longitudinal study. Developing and Rule-bound Searchers showed relatively stable percentages of participants expressing uncertainty, while more Power and Visual Searchers made uncertainty statements during the longitudinal study.

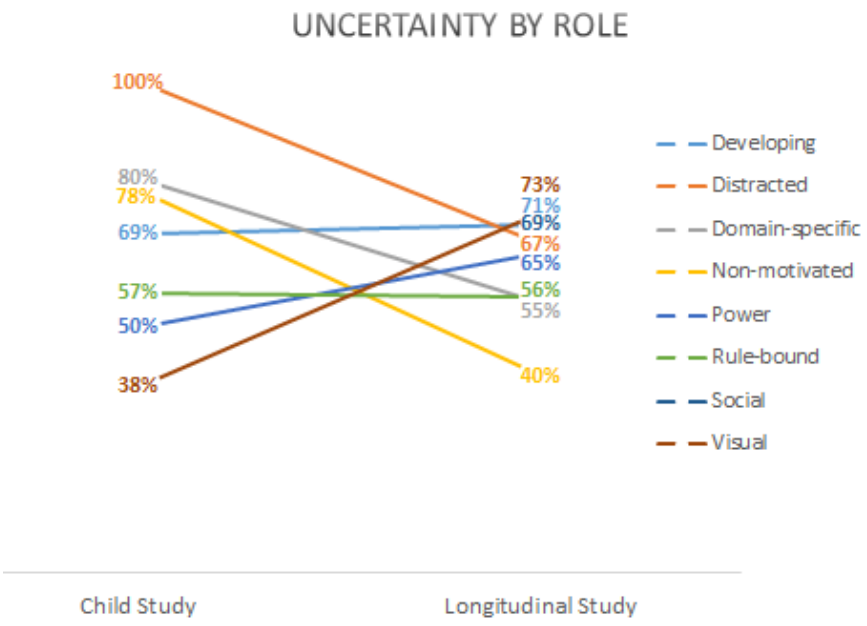

Figure 66. Uncertainty by role. Percentage of child and longitudinal study participants by role making uncertainty statements.

By age, the youngest participants expressed more uncertainty than participants in other age groups during both studies, however, uncertainty decreased for the youngest participants over time. The participants in the middle age group remained stable in expressions of uncertainty between the studies, and the oldest participants expressed more uncertainty during th e longitudinal study. Figure 67 illustrates the changes between the studies by age.

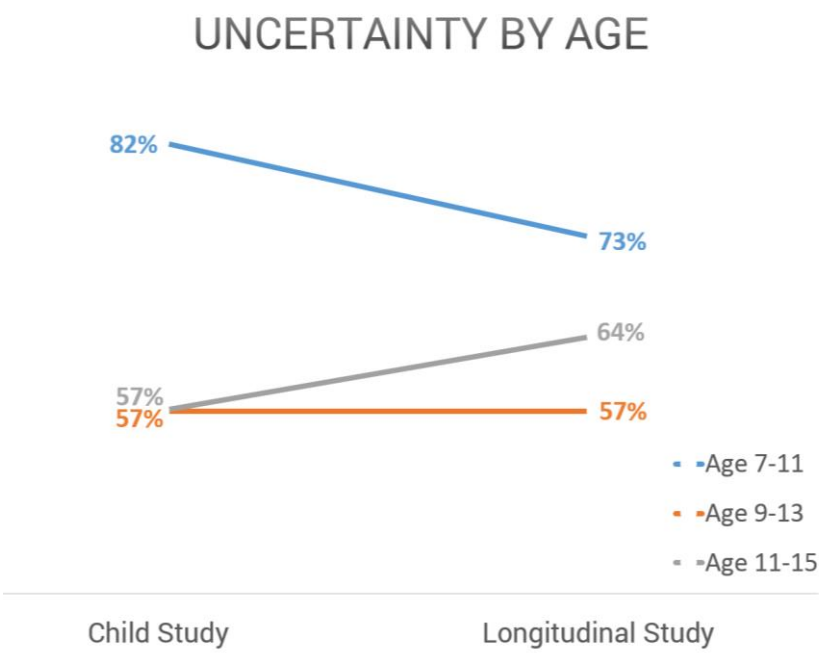

Figure 67. Uncertainty by age. Percentage of child and longitudinal study participants by age making uncertainty statements.

Distraction

Participants in the child and longitudinal studies had instances of becoming distracted to the point of needing researcher prompting or reminders to return to the interview. The causes of distraction fell into six categories (see Figure 68): ads on webpages, using the bathroom, games, the physical environment of the interview, videos, and websites. Twenty-four percent of child and 26% of longitudinal study participants became distracted at some point during the interview. The most common causes of distraction were websites and online games, which caused distraction for 8% of child study participants. The longitudinal reasons for distraction fell into five categories: using the bathroom, playing online games, the physical environment of the interview, videos, and websites. For the longitudinal youth, the most common reason for becoming distracted was exploring a website. The second-most common cause of distraction was

the physical environment, such as pets entering or leaving the room, siblings becoming noisy, or conversations with parents during the interview.

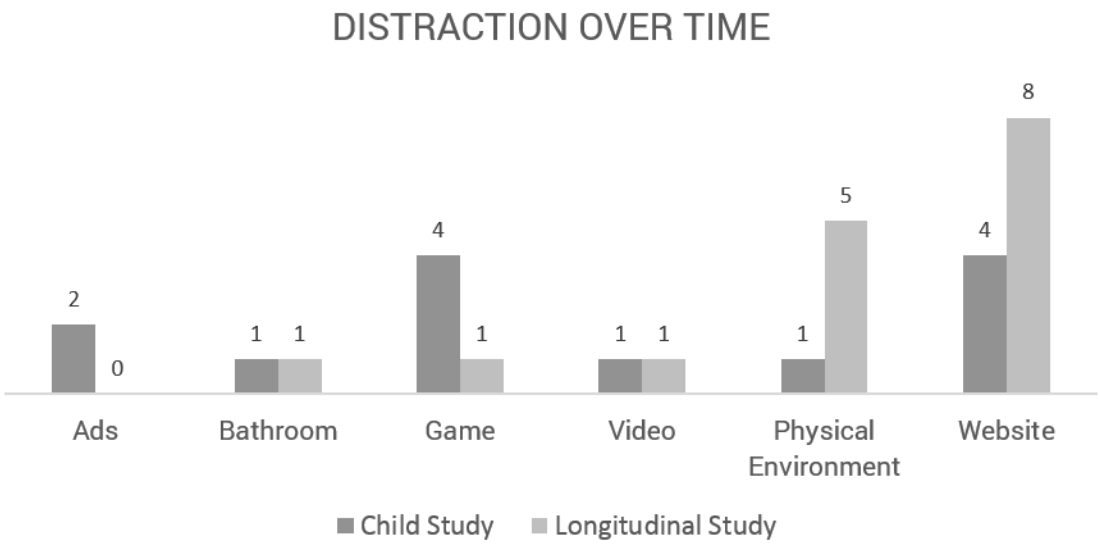

Figure 68. Distraction over time. Number of participants becoming distracted by different factors.

Participants did become distracted during their interviews, but it is important to note that researchers did not attempt to force participants to strictly adhere to either the interview script or to a set of expected behaviors. Rather, participants had the freedom to explore the Internet, and researchers frequently asked or answered questions outside of the scripted interview, as is expected in a semi-structured interview protocol. Overall rates of distraction causing impediment to the interviews were relatively low, especially factoring in the chaotic home environments in which the interviews took place. Additionally, as only four participants became distracted as child study participants and again as longitudinal study participants, distraction is not a stable behavior.

For Non-motivated Searchers, the percentage of participants becoming distracted decreased during the longitudinal study (see Figure 69). Distracted, Domain-specific, Developing, and Rule-bound Searchers showed similar rates of distraction across the two

studies, while for Power and Visual Searchers, distraction increased during the longitudinal study. Social Searchers had low rates of distraction during the longitudinal study by comparison to other roles.

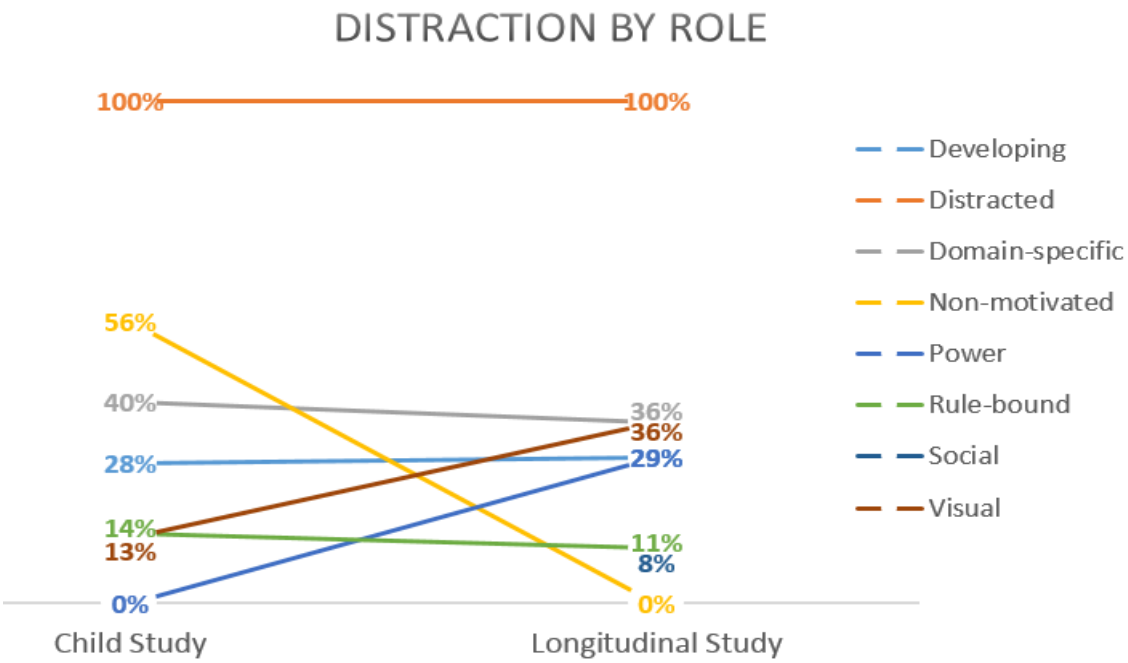

Figure 69. Distraction by role. Percentage of child and longitudinal study participants by role becoming distracted during the interview.

Unsurprisingly, Distracted Searchers all showed a large amount of distraction; the percentages of Distracted Searchers needing prompting to return to the interview are well above the percentages for the other roles during both studies and Distracted Searchers are more distracted than participants in other roles. Given this, distraction can be used as a reliable indicator as to belonging to the role of Distracted. Notably, some Distracted Searchers were most identifiable not from the transcripts of their interviews, but by observing their behavior during the interviews; some of these youth were able to carry on

conversation with the researchers while playing online games, looking around the room, or engaged in other activities in the physical environment.

In examining distraction by age, there are varied results for the three age groups (see Figure 70). The youngest participants remained stable in distraction during the longitudinal study. The participants in the middle age group decreased greatly in distraction during the longitudinal study. Older participants displayed a large amount of growth during the longitudinal study in becoming distracted. Possibly, they were aware of more websites to visit that captured their attention, or perhaps older participants were less engaged in the interview, and more willing to allow their focus to waver.

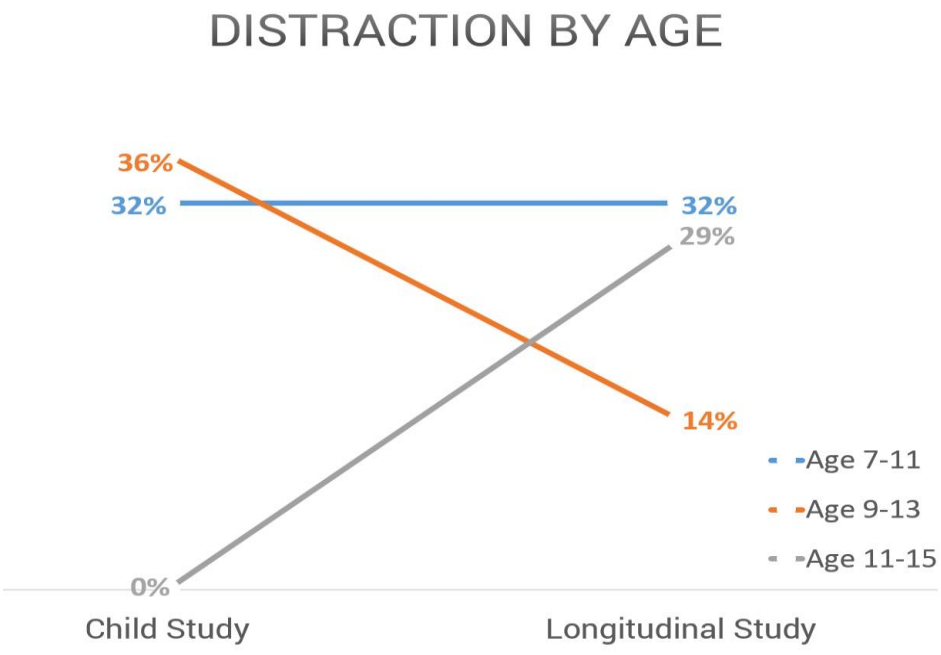

Figure 70. Distraction by age. Percentage of child and longitudinal study participants by age becoming distracted during the interview.

Responses to Interview Questions

The results contained within this section are participant responses to scripted interview questions. These results are presented separately from other results as they do not represent searching skills, alternate searching strategies, or support behaviors displayed during the interview as observable phenomenon, but rather verbal historical references to usual behaviors and reactions.

Triggers

Triggers are search initiators or motivators. In the youth interviews, researchers attempted to gain more of an understanding of the triggers for beginning searches by asking, "What makes you look for information?" Eighty-eight percent of child study participants provided responses to the interview question, "What makes you look for information?" The remaining children did not provide answers to the question or researchers did not ask about triggers in accidental oversights. The 50 child study participants provided 80 reasons to begin a search, and these reasons are grouped into five distinct categories: because of a real-world activity, to play or find an online game, based on the influence of another person, for information pertaining to general personal interests, or due to school. Six child study participants misinterpreted the question posed to them and responded that a browser or search engine made them look for information. In the longitudinal data, there are 90 triggers from the 49 responding participants, falling into the same groupings as the data from the child study. Almost every longitudinal study participant provided a response for why they began searches; only one participant declined to answer the question, as demonstrated in the following exchange:

10-year-old girl:

Interviewer: So what makes you search for information?

Interviewee: Um, hmm. Not sure.

Interviewer: Not sure? Um. Maybe if you thought of like the last time you did a search, can you think of what made you do that search?

Interviewee: Um, well, I'm not exactly what I last searched.

The most common reason reported by child study participants for beginning a search was for information regarding specific personal interests, with 50% of the participants reporting this as a trigger. Personal interest was again the most common reason reported for beginning a search during the longitudinal study, with 70% of the participants reporting this as a trigger. Personal interests ranged widely:

7-year-old girl:

I look for YouTube videos.

9-year-old boy:

Because I'm interested in the subject.

The second-most common reason for beginning a search was school, reported by 36% of participants. Again reflecting the findings from the child study, school is the next most commonly reported trigger for the longitudinal study, with 56% of longitudinal participants reporting school. Only 8% of child study participants reported searching due to influence from another person. In contrast, 24% of longitudinal participants discussed beginning searches due to the influence of others. As one participant described this type of trigger:

10-year-old boy:

> …Whenever, like, um, my mom tells me about something, we usually look it up.

The categories of school, personal interest, and influencer showed growth between the two studies, as visible in Figure 71. Beginning searches due to personal interests showed a high level of stability, as many youth reported this during both studies. The category of influencers as search triggers was notable as an area of change during the longitudinal study; a low percentage of child study participants reported other people triggering searches. When examining games and activities as triggers, fewer participants reported these during the longitudinal study than during the child study.

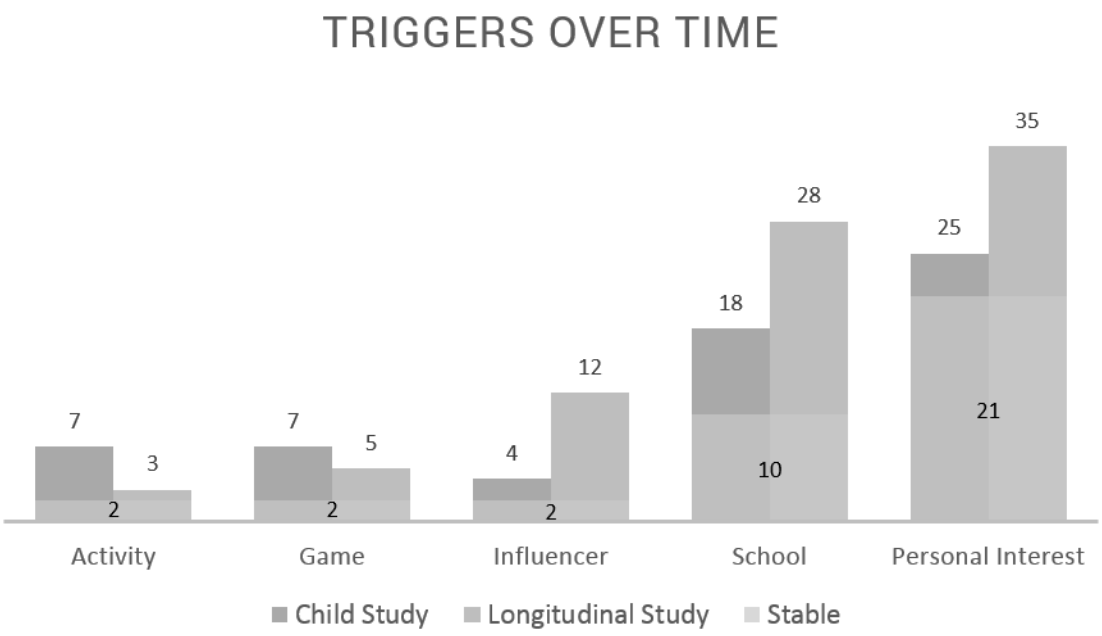

Figure 71. Triggers over time. Number of participants in the child and longitudinal study reporting different types of triggers.

When examining triggers for participants in each role, Rule-bound Searchers during both studies were the most likely to report that they were triggered to search by

school. Rule-bound and Non-motivated Searchers were the only roles to report being most triggered by a reason other than personal interest; both roles had higher rates of search initiation for school. Non-motivated Searchers during both studies reported triggers in the fewest categories, only triggered by influencers, personal interests, or school. 2008 Developing Searchers reported initiating searches for the broadest number of reasons, but the 2013 Developing Searchers reported triggers in only four categories. Distracted Searchers showed opposite patterns of triggers than other roles between the studies, as they were longitudinally more triggered by outside activities and games, stable in triggering from school and personal interest, and less triggered longitudinally by influencers. Figure 72 shows the different triggers by role.

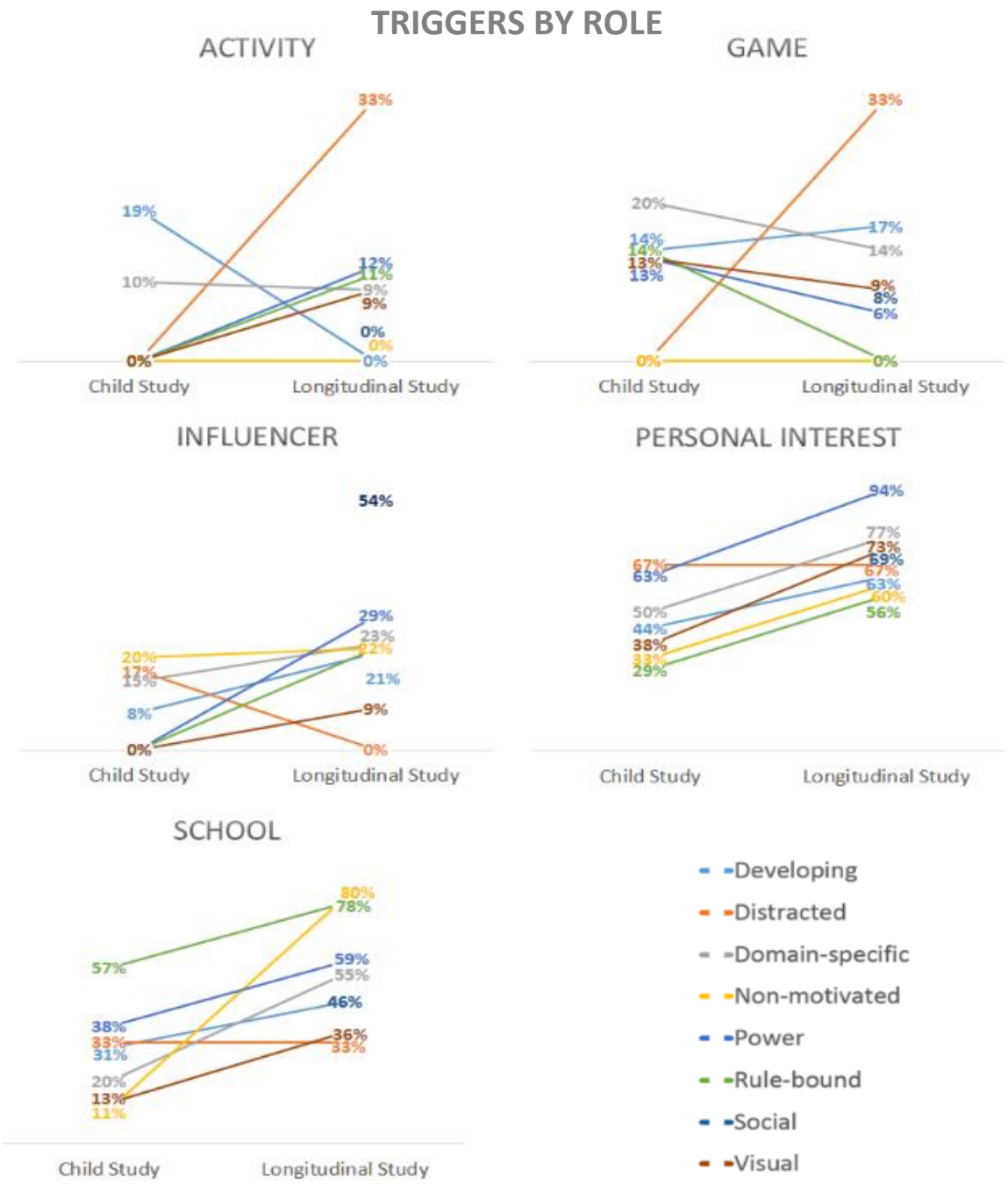

Figure 72. Triggers by role. Percentages of participants by role reporting different types of search motivators.

Non-motivated Searchers were heavily triggered by school during 2013. This illuminates the Non-motivated role-specific traits of using short search paths and disinterest in the computer, as these youth are frequently required to search for imposed topics to complete homework assignments. In contrast, Power Searchers were more frequently triggered by personal interest during both studies. Power Searchers possibly explore search engine capabilities due to internal motivation for information, and possibly gain search skill through this avenue. Rule-bound and Non-motivated Searchers discussed triggering by school at near-equal rates. In seeking specific information to fulfill school assignments, Rule-bound Searchers were likely employ their search rules, or perhaps developed their search rules in response to requirements imposed by the school. Distracted Searchers stood apart from the other roles when examining the change in triggers over time, and were the only role to report an increase during 2013 in being triggered by online games or daily life events or activities.

Visible in Figure 73, the oldest and youngest study participants appeared similar, becoming more triggered by school, influencers, and personal interest during 2013. Participants in the middle age group became more triggered by influencers and school, and less triggered by activities relevant to their personal lives such as holidays or online games. The youngest participants showed only a slight decrease in triggering due to online games during 2013, indicating that interest in playing games on the computer does not begin to dissipate until around age 10 to 11. Although all three age groups discussed school as an influencer elsewhere in the interviews, beginning searches due to school as a specific task does not seem to be prominent for youth until after age 11, when youth enter grade 6.

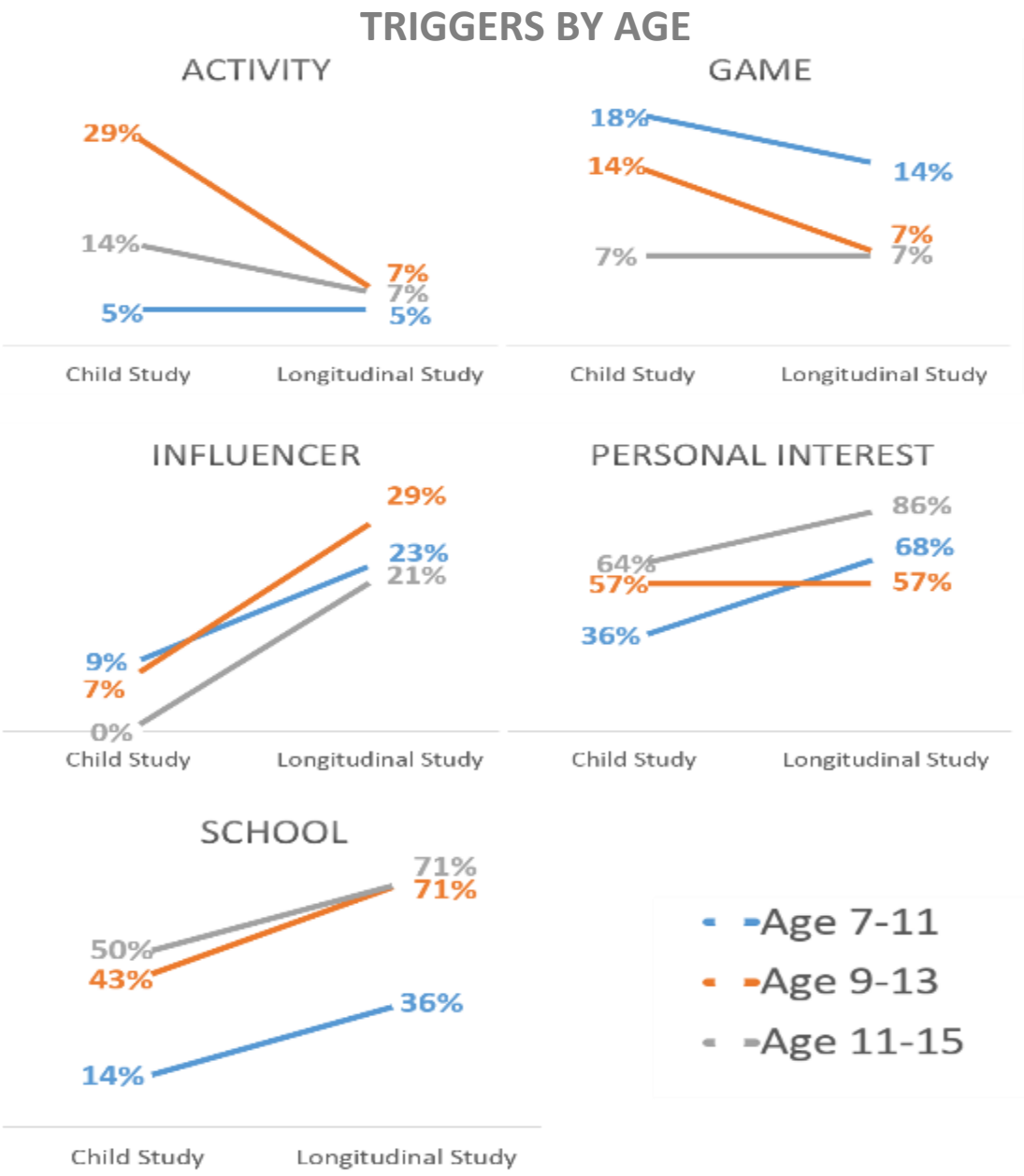

Figure 73. Triggers by age. Percentages of participants by age reporting different types of search motivators.

Search Stoppers

During both the child and longitudinal studies, researchers asked participants, "When do you stop looking for information?" The intention behind this question was to uncover reasons for the cessation of searches, as these could provide insight into areas for search interface improvement or youth education. However, some youth had not used the computer to search prior to the interview, or could not search without researcher direction. When interviewing new searchers, researchers explained how searching on Google worked using the search query [dogs] and then skipped interview questions pertaining to the child's usual search habits, including why the participant stopped searching.

As a result of researchers following the interview protocol to skip questions for new searchers, 20% of child study participants did not respond or were not asked the interview question about why they stopped searching. For the remaining 80% of child study participants, there were 66 reasons for stopping searches, falling into six distinct categories: stopping searches due to engaging in an activity off the computer, boredom, finding the sought information, gathering enough information, stopping due to the direction of a parent or other adult, or due to encountering wrong or no information (see Figure 74). For the longitudinal study participants, all of the youth responded to the interview question regarding their reasons for stopping searches; none of the longitudinal youth were new to searching. There were 95 reasons given for stopping searches, falling into the same categories as those in the child study.

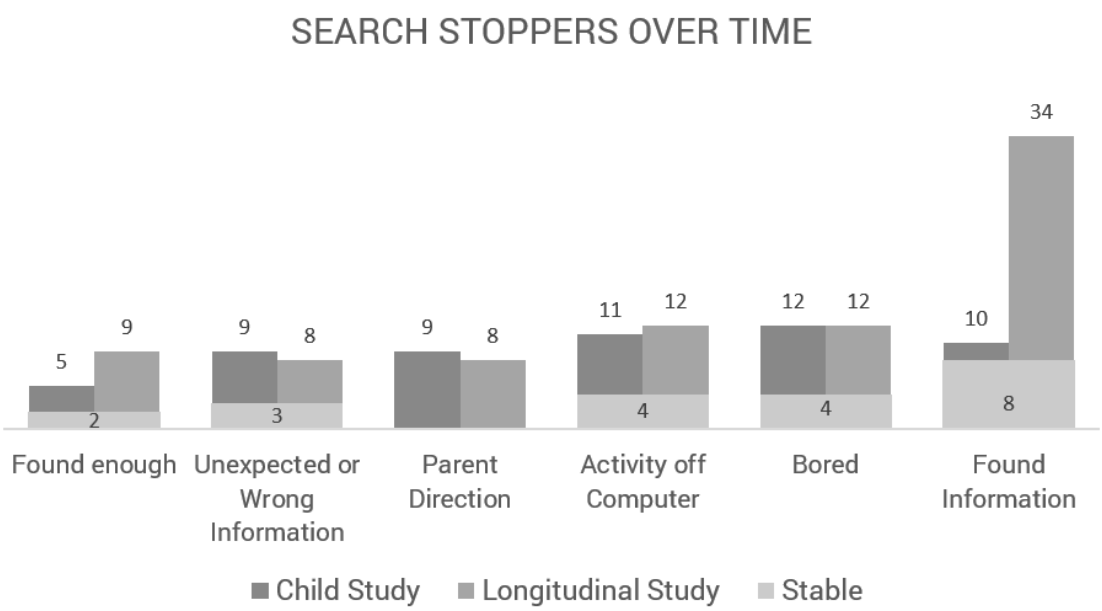

Figure 74. Search stoppers over time. Number of child and longitudinal study participants reporting different reasons for stopping a search.

Stopping due to boredom was reported by 24% of child study participants and 24% of longitudinal study participants. Boredom was discussed in the same language during both studies. Stopping to switch to an off-computer activity was reported by 22% of child study participants and 22% of longitudinal participants. Explained by a searcher:

9-year-old boy:

> …unless I have to go somewhere. If it's my friend's birthday and I have to go to their birthday party.

Successfully finding information leading to stopping a search was reported by 20% of child study participants. In contrast to the child study participants, 68% of longitudinal study youth reported stopping when they were able to find the information they sought. As described by a searcher:

11-year-old girl:

> I stop searching when I find something that I like and that I found on Google and you know, like, that I like to, that I'm interested in and has what I want and not something else.

Eighteen percent of participants stated they stopped due to parent directions compared to 14% of longitudinal youth who reported stopping their searches due to direction from a parent. Sixteen percent of child study participants discussed stopping when encountering unexpected information or not being able to find information. Unexpected or no information was discussed as confusion over next steps or simply not finding any results. Sixteen percent of longitudinal youth discussed unexpected or no information as search stoppers. The longitudinal youth explained in detail some of the unexpected information they encountered while searching:

11 year-old boy:

> Because if I eventually find something that's not appropriate, I would probably get off then. If I'm looking up, if I type in something that's general enough, it would probably pop up a weird video.

The least frequent reason for stopping searches given by child study participants was due to finding enough information, reported by 8% of child study participants. For these youth, the quantity of the acquired information was a factor. Eighteen percent of longitudinal youth discussed gathering enough information on their search. As one searcher describes this search stopper:

11-year-old boy:

> When I think that I have enough information to, um, complete the project and give a thorough, like, explanation on what you're doing and when that happens, so I'd say probably once I know at least 96, 95 percent of the topic.

Examining search stoppers by role (see Figure 75) reveals that boredom was reported by youth in all roles during both studies, with the exception of child study Visual Searchers. All longitudinal Non-motivated Searchers report stopping due to finding the information and were most likely to discuss gathering enough information during the longitudinal study, although they did not mention this during the child study. As Non-motivated Searchers are unskilled in relation to searchers in other roles, this change likely represents a complete shift in perception of success rather than a gain in skill. For child study Power Searchers, the most common search stoppers were to move to an activity off-computer or due to finding information. Longitudinally, Power Searchers most frequently discussed stopping due to finding information. All Distracted Searchers in the longitudinal study discussed stopping due to boredom; for other roles, this was a much less frequent response.

The oldest participants were more frequently directed to stop searching by a parent than were participants in the younger two groups during 2013. This suggests that at age 14 to 15, youth are using the computer for long enough time periods and for non-essential tasks as to require intervention for time management. All three age groups showed a 2013 study increase in finding the sought information as a search stopper (See Figure 76), with the youngest participant group reporting the largest increase over time.

Older participants were more likely to discuss having no frustrations during 2013, as the middle and oldest age groups increased in percentages of participants giving this response. At the same time, the youngest group of participants seemed more aware of their frustrations as 2013 participants than as child study participants. Based on these findings, youth seem to be largely unaware of the sources of their problems around age 7, but are able to more accurately describe their problems by age 11. After age 11, youth begin the processes to overcome their specific difficulties, allowing them to search with fewer frustrations.

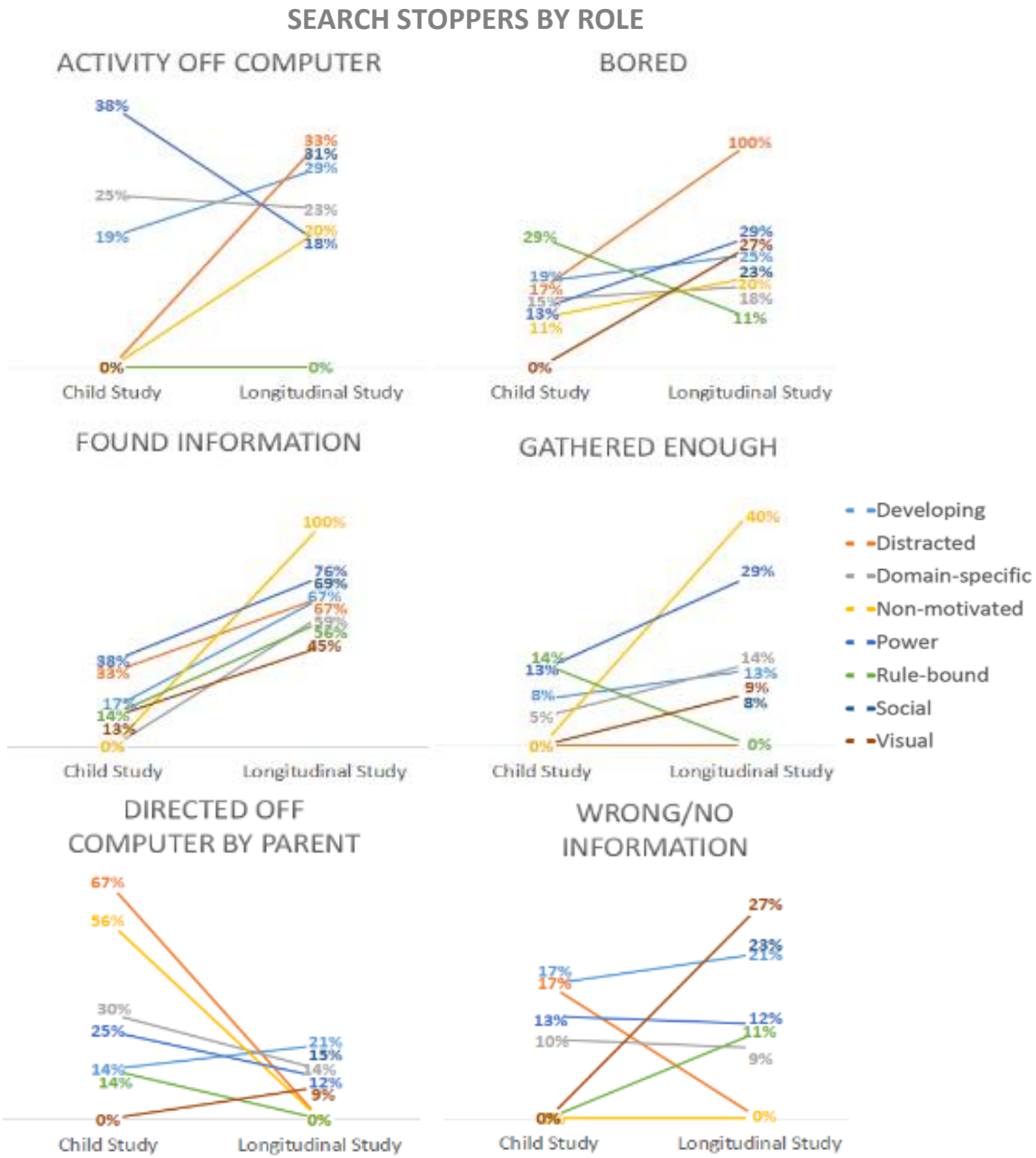

Figure 75. Search stoppers by role. Percentage of child and longitudinal study participants by role reporting reasons for stopping searches.

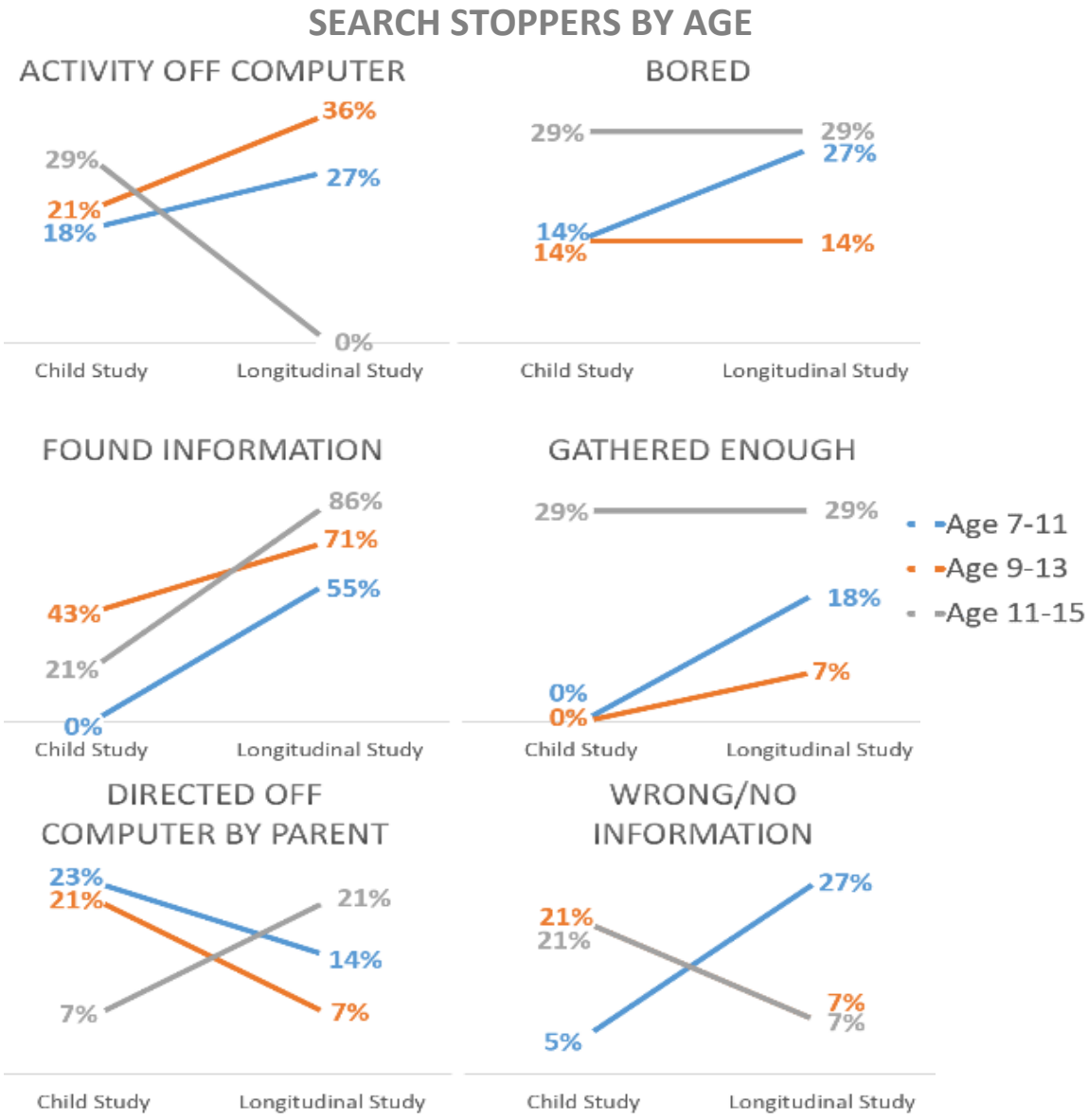

Figure 76. Search stoppers by age. Percentage of child and longitudinal study participants by age reporting reasons for stopping searches.

Explicit Frustrations

Researchers asked the child study participants to discuss their frustrations by posing a series of related questions, "Is there anything frustrating about finding information on the computer? Is there anything annoying about finding information? Is there anything hard about finding information?" Each of these questions generally elicited a different response. Explicitly stated frustrations, annoyances, or difficulties were coded together and aligned into 10 separate categories. These were: ads, not finding the sought information, not finding enough information, query formulation, finding incorrect information, software errors, speed, spelling and typing, being presented with too many results, and retrieving unrelated results. Researchers asked the longitudinal study participants if anything was frustrating about searching by phrasing the question, "Is there anything frustrating, annoying, or hard about finding information on the computer?" This change in the interview protocol was based in experiences during the adolescent study, when the adolescents did not distinguish between frustrating, annoying, and hard. The longitudinal participants gave responses of their explicit frustrations, annoyances, and challenges in nine categories, coinciding with the child study categories, except longitudinal participants did not report too many results as a frustration. Fourteen percent of longitudinal participants did not report any frustrations, as did 12% of child study participants. The changes in frustrations over time are visible in Figure 77.

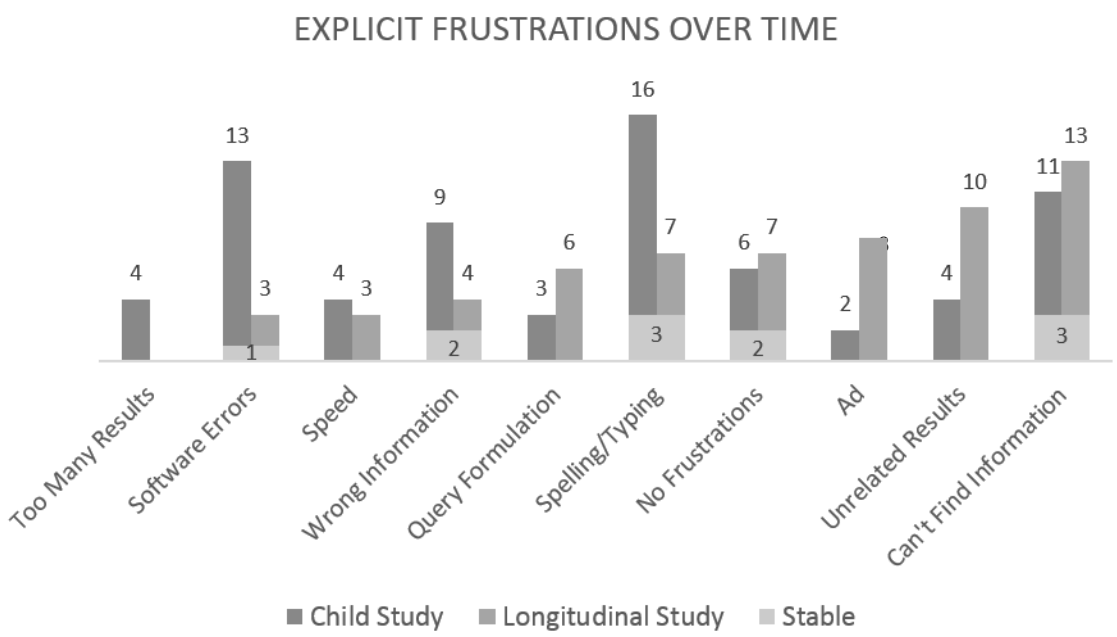

Figure 77. Explicit frustrations over time. Number of participants during the child and longitudinal study reporting causes for frustration.

For the child study participants, spelling and typing was the most common frustration, reported by 32% of participants, but was only reported by 14% of longitudinal youth, An example of this frustration:

9-year old boy:

> Like sometimes, you'll write something and then it doesn't know what I'm searching and you need to have the correct spelling first.

Twenty-six percent of child study participants and only 6% of longitudinal participants discussed software or browser errors as causing frustration. A searcher explained this type of error as:

7-year-old girl:

> When you click on it but it absolutely doesn't work.

Not finding the sought information frustrated 22% of child study participants. This was most common longitudinal study response, given by 26% longitudinal study participants. As described by a searcher:

10-year old boy:

> Well, you know it's frustrating when you don't find what you want after a lot of searches.

Figure 89 reveals that for all the roles, the most common frustrations generally shifted over time. Distracted Searchers were consistently frustrated by spelling and typing and by unrelated results. Power Searchers reported frustration with ads, finding incorrect information, and spelling and typing during both studies at similar rates.

By role, explicitly stated frustrations were not consistent over time; for most reported frustrations, the percentage of participants by role reporting each frustration changed between the studies (See Figure 78). This is an encouraging finding, as it suggests that youth do not become stymied by the same challenges through adolescence. Power Searchers were the most likely child study role to report frustration with not finding the sought information, but this decreased during the longitudinal study; possibly Power Searchers were more aware than other roles during the child study that retrieved information did not meet their needs, and as longitudinal participants, they had a high enough skill level to retrieve relevant results. Non-motivated Searchers during the longitudinal study were highly likely to report that they had no frustrations when compared to other roles. As Non-motivated Searchers are uninterested to use the computer and also possess a lower skill level when searching, it is surprising that they would report no frustrations at percentages higher than youth in other roles. As the

question regarding search frustrations was posed near the end of the interview, possibly Non-motivated Searchers responded by saying they had no frustrations to end the interview more rapidly.

The three age groups decreased in frustration over time in the categories of incorrect information, software/browser errors, and spelling/typing. The youngest child study participants were most frustrated by spelling and perceived software errors. For the middle age group, the highest reported frustration was with incorrect information during the child study and during the longitudinal study, not being able to find the information was most frustrating. The oldest participants had lower percentages of reported frustrations overall during both studies. See Figure 79 for these trends.

Figure 78. Search frustrations by role. Percentage of child and longitudinal study participants in each role reporting different causes for frustration when searching.

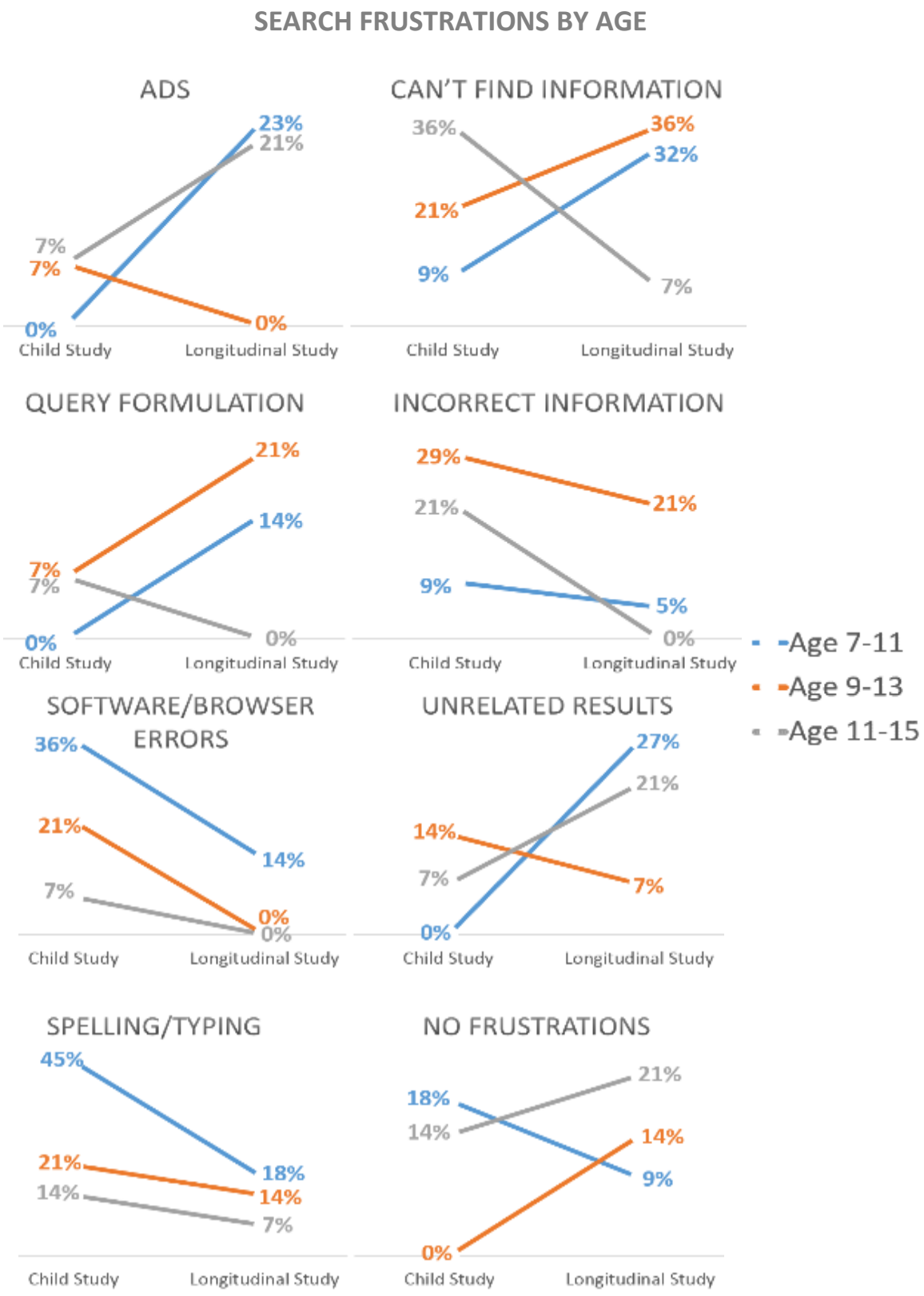

Figure 79. Search frustrations by age. Percentage of child and longitudinal study participants by age reporting the causes for their frustrations when searching.

Summary of Results

In this chapter, I described the changes in the search roles displayed by participants in terms of the role relationships within each study, the strongest relationships between roles over time, youth child study role dispersion into longitudinal study roles, and how participants in different age brackets dispersed into roles over time. The role results addressed the first research question of this study, "What are the transitions in search role occupancy over time in youth?"

After discussing the results relating directly to the roles, I moved into comprehensive descriptions of observable search behaviors and factors affecting search in the categories of skill-based search behaviors, alternate searching strategies, support behaviors, and participant responses to interview questions. I focused on changes within each of the search behaviors from the child study to the longitudinal study by role and by age. The results regarding search behaviors addressed the second research question of this study, "What are the changes in search behaviors over time by role and by age?"

The following chapter will present case studies of selected youth to aid in understanding how youth search in a comprehensive way. The next chapter will address the third research question relating to how changes in search roles and search behaviors occur over time in individual youth.

Chapter 6: Case Studies

In this chapter:

- Case study selection
- Selected cases
  - Increase in skill
  - Unusual role shifts
  - Device use
  - Broad roles
- Summary of case studies

This chapter describes the reasoning and process for selecting individual participants as case studies to provide a closer examination of factors contributing to role shifting and stability over time. Each of the three cases presents a different facet of the observed changes in youth occurring between the 2008 and 2013 studies. This chapter addresses the third question of the research, "How do changes occur over time for individual youth searchers?"

Case Study Selection

I selected three cases of individual youth in order to more closely examine trends in role shifts over time as well as changes in individual's search behaviors. These three cases serve to further explore the findings presented in Chapter 5 by providing a comprehensive snapshot of possible causes for search behavior and search role changes. I included a searchers displaying 1) an increase in skill, 2) an unusual role shift and 3) use of a mobile device.

To identify the first case study candidate, I examined predominant roles and the strongest role relationships for each study. The highest percentage of participants during 2008 displayed the roles of Developing or Domain-specific. These child study two roles

were also more strongly co-occupied than the other roles. During 2013, the most predominant roles were again Developing and Domain-specific, closely followed by the role of Power; however, the strongest relationship for role co-occupancy was between the roles of Domain-specific and Power. In the data, there were four child study Developing and Domain-specific Searchers who shifted into the roles of Power and Domain-specific; although many participants displayed these common role pairs in either study, only four showed the role pairs during both studies. Of these youth, only one displayed only the roles discussed with no other roles displayed in either study, reducing confounding effects from behaviors associated with other roles. I selected this searcher, a 9-year-old boy at the time of the child study, as the first case study.

To identify atypical cases in role shifting between the studies, I used NodeXL to create a graph of uncommon role shifts. In Figure 80, the child study roles are displayed in green, while the longitudinal study roles are displayed in black. Vertex size is proportional to the total number of participants displaying each role, and the placement of the vertices is to reduce edge crossings. The graph is filtered to display only roles and connections between roles where 10% of fewer participants from the child study role displayed each shift into the 2013 role. Of the participants remaining after this filtering, the most intriguing shift is for the participant who was able to shift from the lowest-skilled role of Non-motivated into the Power Searcher role. This participant, and 11-year-old female, and was selected as the second case.

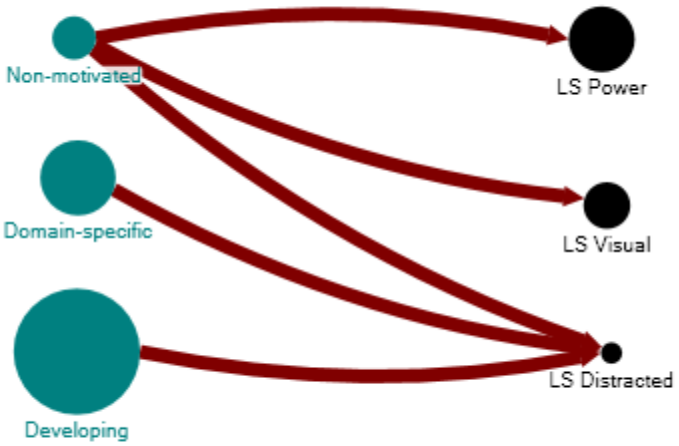

Figure 80. Participants displaying atypical role shifts. Child study vertices are green, and longitudinal study vertices are black. Edges represent participants who displayed unique role shifts; only 10% or fewer of 2008 participants displayed these shifts into 2013 roles.

Selecting a case where a participant chose to use a device was of interest due to the large increase during the longitudinal study in youth reporting ownership or use of devices. Eight participants used devices to complete the search tasks during their longitudinal interviews. The 11-year-old female participant included as the third case study provides contrast to the second case study, who is also an 11-year-old female participant, as well as shows diversity of roles over time, which is an area for exploration in relation to the use of a device. The third case study participant displayed the child study role of Rule-bound, shifting into the longitudinal roles of Developing, Domain-specific, and Social.

Overall, case study selection resulted in representation of six roles. Table 4 shows a summary of the selected cases and their purposes. All three of the case study youth had complete data records: fully video-recorded interviews, complete researcher notes, and complete audio for parent interviews. Additionally, I attended both interviews for all of the case study youth, providing me with contextual awareness of the interview settings.

Names used in the following sections are pseudonyms, and photos have been modified to protect the identity of the participating youth. However, it should be noted that parents of the participants included as cases gave explicit permission for the use of their child's photo, initialing either the consent form option, "I agree to allow researchers to use my child's photo in future publications" or "I would like to approve any photos or video clips prior to use in publications or presentations. Researchers will contact me for explicit permission, and will not use my photo unless I approve." In the case of the latter preference for photo approval, the photos used were approved by the parents prior to their use.

Table 4
Summary of selected cases and their purposes

Case Purpose	Trait	Alias	Age	Gender	2008 Roles	2013 Roles
Reinforce observed trends	Increase in skill	Harvey	9 > 12	M	Developing, Domain-specific	Power, Domain-specific
Challenge norms	Uncommon role shift	Rose	11 > 15	F	Developing, Domain-specific, Non-motivated	Power, Social
Highlight emerging trend	Use of mobile device	Camilla	11 > 15	F	Rule-bound	Developing, Domain-specific, Social

Selected Cases

Increase in Skill

In early 2009, a second researcher and I visited the home of a pair of siblings, both boys, whose mother replied to an email requesting participants for our investigation into how children searched on the Internet. When we arrived at the home, the two boys, Jay, age 7, and Harvey, age 9, were seated at the table in the brightly painted dining room. The household was busy, with a younger son in a highchair messily eating dinner,

the boys' father typing on his laptop in the living room, and the boys' mother ironing and talking with the family. Harvey, the older brother, can be seen in Figure 81 during his participation in both studies. Harvey was a child study Developing and Domain-specific Searcher.

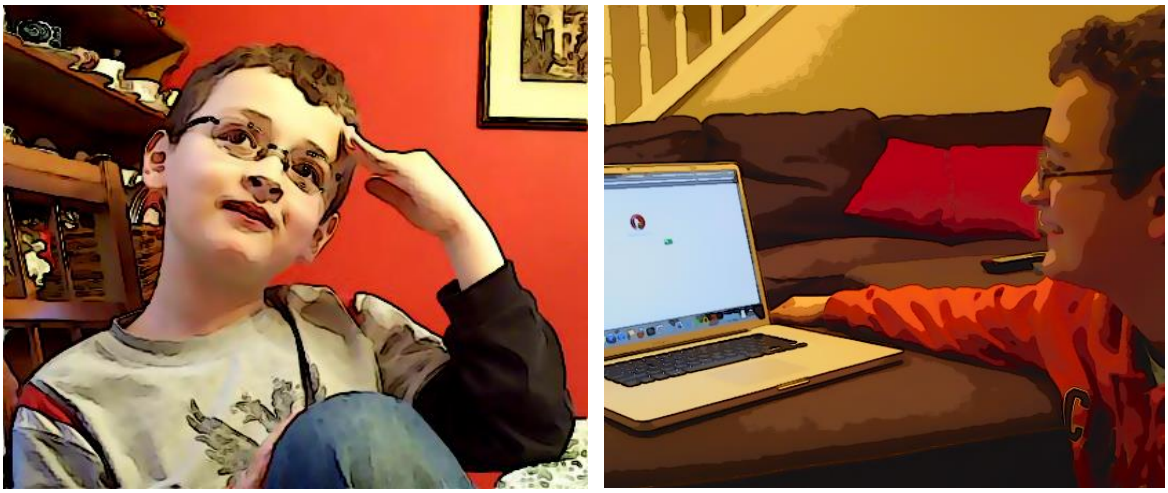

Figure 81. Harvey. Age 9, left, and age 12, right, talking with a researcher.

When asked to search for his own interest in 2008, Harvey searched for images of DeLorean cars, typing [delorean pictures]. Harvey had recently seen the movie *Back to the Future*, in which a DeLorean car features prominently. Finding an image he liked, Harvey said, "Ta-da!" and clicked the image, retrieving a page with a thumbnail and a link to see the full size image. Rather than navigating Harvey to a larger picture, the link took him to a page filled with advertising content. While verbally agreeing with the researcher that he had found his sought information, Harvey appeared to press the backspace button to navigate away from the undesirable page. Concurrent with his keystroke, he was greeted with a recorded male voice proclaiming, "Congratulations, you won!" Harvey laughed, and distracted, needed the search task repeated before he could proceed; see Figure 82 for Harvey's smiling response to the advertisement.

Figure 82. Harvey distracted. Harvey laughing at an auditory advertisement he encountered while retrieving a photo.

Harvey continued searching for his own interest, searching for programs for the palm pilot he had inherited from his father, typing the query [tungsten e2 programs]. He discussed his palm pilot excitedly, revealing his domain of interest in technology. When determining the Vice President's birthday, he left the dining room to retrieve the palm pilot, preferring to access the calendar feature on the device to answer the task rather than rely on an Internet search or his computer's calendar.

Prior to beginning the interview in 2008, Harvey showed the researchers around his home, highlighting his home's wireless router in the basement. Harvey described that he knew how to reset the router when needed. During his 2008 interview, Harvey's searching was consistently interrupted by the failure of his household Internet connection. Each time the connection failed, Harvey jumped up from the interview and ran to the basement to restore the connection. When his home Internet connection was interrupted,

Harvey expressed his frustration to not only the researchers, but also to his mother, who was observing his interview, and to his father, who was working nearby in the home during his child study interview:

Interviewer: …And what did you type in? Yeah, I think that tool bar doesn't work. You're gonna have to go to the page.

Interviewee: The Internet's not working. Can I turn that computer on?

Harvey's mother: Sweetie, it's not connected to the Internet.

Interviewee: Not again.

Interviewer: Open another tab. See if it'll do it.

Interviewee: Nnnnooooo. It has like been not working.

Interviewer: Try to type in Google.

Interviewee: Uuuuhhhhhhh. [Thumps hand.] Can we try restarting it, Dad? Why do you think it's not working? The Verizon guy fixed it like a couple days ago.

Harvey's father: But he didn't fix it I guess.

Interviewee: Uggggggggg.

As a Domain-specific Searcher, Harvey belonged to the role most likely to express frustration during the child study. For Harvey, his frustrated outburst was likely tied to his domain of technology; he was frustrated that he was not able to use his specific knowledge to fix the connection problem. At age 12, Harvey did not show in-context frustration, however, his Internet connection remained reliable throughout the interview, and he did not experience other technology-related problems.

Due to his technology interests, Harvey also gained knowledge of when visiting specific websites could help him find sought information and when specific websites were unlikely to help:

> Interviewer: And, um, how come you clicked National Geographic instead of Wikipedia?
>
> Interviewee: Cause um, Wikipedia, is useful if I just want to read about palm pilots or whatever, or iPhones or whatever, but I don't, that's not a very good source if you actually want information and use it.

Harvey was 12 years old when I visited his home for the second time, and after inviting me in, he explained he was engaged with a piano lesson, but that he would finish shortly. While waiting for Harvey's lesson to conclude, I interviewed his mother to find out what had changed regarding Harvey's search habits since my previous visit. Harvey's mother described that his interest in technology had continued to grow, and he had recently completed an online course on search engine design through the website Udacity (http://www.udacity.com). As described by Harvey's mother, "[he] actually took a class through Udacity. On programming web search engines, so he knows a lot more than he did two years ago… he's like leaps and bounds grown in what he knows about technology."

Harvey's interview confirmed his technology-focused interests: he searched for [raspberry pi] and [mac os 10], talked about his programming skills, and discussed technology-focused websites. Harvey's interest in technology, present at age 9, not only continued as he grew older, but also aided him in gaining search skills. For Harvey, there was a strong connection between his domain of technology and his high level of search

skill. Due to his technology interests, Harvey enrolled in an online class at Udacity, with the specific topic of search engine design. This focused search education likely aided him to be more competent when searching. Harvey discussed CNET as well as Wikipedia. Due to his frequent searching on technology topics, he was aware of the content of CNET and felt he could rely on the site's information. Additionally, Harvey discussed freely searching on Google to seek information that related to technology topics, increasing his comfort with search.

Harvey used five terms as a child study participant, placing him well above average when compared to the other participants in his child study roles. One of Harvey's domains of interest as a child study participant was technology, and this interest continued as he grew from age 9 to age 12. However, Harvey's technology specific vocabulary use was constant; he also used five terms as a longitudinal study participant. However, when Harvey described his search and computer use habits, he revealed the ability to accurately articulate his domain knowledge with an appropriate vocabulary. Harvey used terms not common for other searchers: scripts, HTML, command prompt/terminal, CNET, algorithm, and interface, as examples. HTML was used by two other participants, algorithm by one, command prompt by one, and CNET by one other participant. Perhaps precipitating Harvey's increased domain vocabulary was his experience with online education.

Harvey's case demonstrates a typical gain in search skill over time. The information gathered during the interviews with Harvey and his mother shed light on how such gains in skill can occur for some searchers. In Harvey's case, he was exposed to more influencers from outside of his immediate family via his enrollment in an online

search engine design class. Harvey also demonstrates the typical barrier between siblings for participants in this study, as he does not discuss his younger brother, Jay. Harvey is a consistent Domain-specific Searcher, and his case illuminates how the domain of technology can contribute to the acquisition of search skill, vocabulary, and source knowledge.

Unusual Role Shift

Rose lived outside of the geographic area of most of the other participants in the search studies, and in a rural area in contrast to most participants. During the child study, she was homeschooled exclusively, but as a 15-year-old, she spent part of each weekday at a public high school taking classes, returning home at lunch to finish her studies under the guidance of her mother. When I interviewed Rose during the child study, the family home was under repair, and Rose, her older brother, and her parents had moved into a mobile home situated near to the house. During the longitudinal study when I returned, the construction was complete, but the family's computer remained sited in a shed on the property; family members travelled outside to use the aging laptop. See Figure 83 for images of Rose during both studies.

As an 11-year-old gum-chewing child study participant, Rose described how she searched for images of manga, or Japanese print cartoons, comics, or video animations. When she found an unfamiliar image, Rose saved it to her computer, but she pointed out that she already had encountered most of the pictures she could find by searching. Rose declined to answer some interview questions, and frequently responded to other questions with a single word. Although never overtly expressing frustration, Rose seemed to expect her Internet connection to be extremely slow, and stated several times that she did not want to wait for the results of her queries. Rose displayed Developing, Domain-specific, and Non-motivated roles during the child study.

Figure 83. Rose. Age 11, left, and age 15, right, talking with the researcher during her study interviews.

As a Non-motivated Searcher, Rose displayed the role most likely to use offline information during the child study. When asked about her motivations for information seeking, Rose discussed looking for information in offline contexts:

Interviewer: What makes you look for information?

Interviewee: Well, see, a lot of things I'm interested in are Japanese and hard to find. Things like that, or a bookstore or anything. So uh, books I like and stuff.

During the child study, Rose was also a Domain-specific Searcher with the domain of Japanese manga, as well as a Developing Searcher. Both of these roles had high percentages of knowledge of sources in comparison to other roles. Rose indicated knowledge of sources more often than almost all of the other child study participants, indicating knowledge of websites surrounding her domain. For example, Rose knew of the image sharing website Photobucket (http://www.photobucket.com) and a particular manga artist's website.

While Rose's child study reliance on offline information could have negatively affected her online search ability, her obscure domain propelled her to use the computer. Additionally, it is possible that Rose's early exposure to community-based websites such as Photobucket due to her domain searching facilitated the transition away from Domain-specific Searcher and into the role of Social.

Rose presents an atypical case for examination in relation to the visual context. During the child study, Rose made statements indicating her awareness of images as content available to her via search 12 times, and discussed video content twice. She additionally talked about YouTube twice. The context of all of her conversation about visual content surrounded her domain of Japanese manga:

Interviewer: And how come you use Google?

[…]

Interviewee: Yeah. Or sometimes I look for anime to watch and I look for…let me think…and I look for anime episodes. Mostly I use YouTube for that or mostly pictures of anime from mangas.

As Rose only talked about varied Internet media in the context of her domain, she did not fall into the role of Visual Searcher, despite conducting several searches for images; her interest did not lie with information in visual format but rather with viewing manga.

When asked during the child study, Rose reported two sources of search frustration as an 11-year-old:

Interviewer: What about annoying? Is there anything that's annoying about finding information?

Interviewee: When our keyboard messes up. Our keyboard has a problem so whenever we're searching for something we look up and then it isn't there.

Interviewer: So what is it, it doesn't type?

Interviewee: Yeah. Sometimes it doesn't type.

Interviewer: What about hard. Is there anything hard about finding information on the computer?

Interviewee: I know that I misspell things.

Rose's mother described Rose's typical frustrations as stemming from the computer hardware or software when asked during the child study parent interview. Perceived software/hardware errors and spelling difficulty were the most common frustrations for child study participants.

As an 11-year-old, Rose reported a single restriction placed on her computer use by her mother; Rose was not allowed to visit YouTube. During the interview with Rose's

mother, additional rules surfaced, including time restrictions, that Rose needed to ask permission prior to using the computer, and that Rose's mother, while not directly observing the computer use, somewhat arbitrarily permitted Rose to visit websites such as eBay (http://www.ebay.com) only occasionally.

At age 15, Rose was noticeably changed. No longer interested in manga, and showing no frustration, Rose was more talkative, describing her computer activities stemming from spending time with friends who lived nearby. She described posting photos on different websites; Facebook, but also deviantART, a website where people share their artwork with others. For the longitudinal interview open-ended search tasks, Rose searched for [lyra hoop] (a large hanging ring used to perform aerial acrobatics) and lyrics to the song "Speeding Cars" from Imogen Heap, a female English musician. Rose proved to be an adept searcher on the closed search tasks as well, and was able to complete even the more difficult searches. During the longitudinal study, Rose displayed the roles of Power and Social.

Despite Rose's frequent statements of using visual content as a child study participant, during the longitudinal study, she did not indicate awareness of images, videos, or YouTube at all. Rose was not allowed to watch videos on YouTube during the child study, limiting Rose's discussion of video content, although Rose's mother did not indicate any constraints at all on Rose's computer use during the longitudinal study. Rose's longitudinal lack of interest in visual content available on the Internet coincided with the absence of her domain of interest; as a 15-year-old, Rose was no longer interested in manga.

At age 15, Rose stated she had no search frustrations. During the longitudinal study, Rose discussed her cell phone being a source of aid for spelling difficulty:

> Interviewee: Well it depends on what it is, like if there school stuff if my mom wants me to, she'll like quiz me on history and stuff. If she wants me to like find the definition of words then I'm too lazy to go find the dictionary, so I just use my phone for that.

As for the faulty keyboard, Figure 84 shows the solution implemented by Rose's family; a secondary, functional keyboard sits in front of the laptop and is used in place of the original.

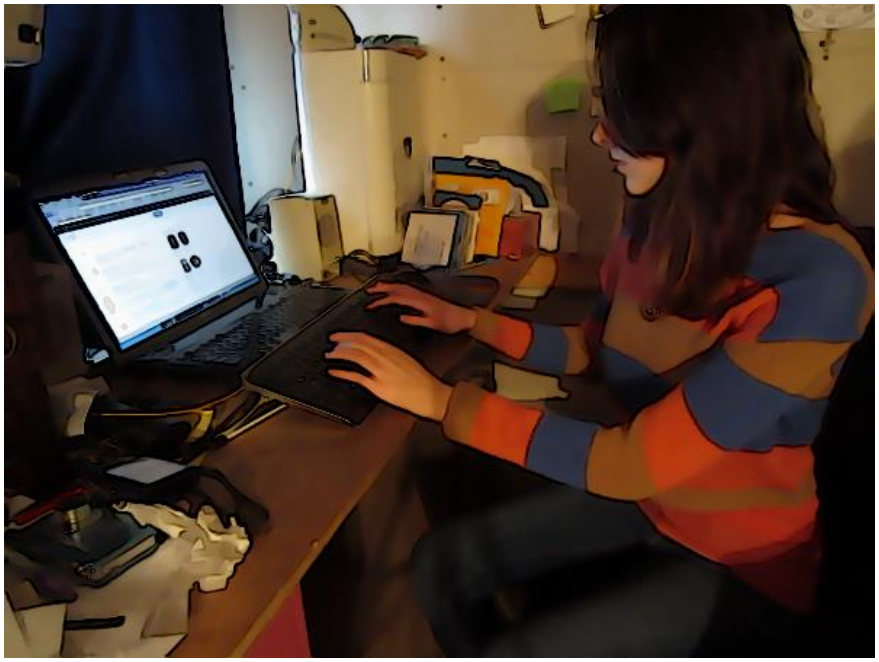

Figure 84. Avoiding frustration. Rose using a secondary keyboard to type on her family's laptop.

Demonstrating changes in household rules, Rose as a 15-year-old did not mention any rules imposed on her computer use, and Rose's mother confirmed the lack of household restrictions. During the longitudinal study, Camilla reflected this freedom despite mentioning one rule, enacted by her teachers:

Interviewer: Um. That's cool, your teachers don't mind that you use your technology in class?

Interviewee: If, some teachers don't want you to, but if it's for like that purpose, it's ok, but you can't pull it out and be like texting or like be on Facebook or whatever in class.

Rose's computer use became freer as she aged.

Rose transformed from a Non-motivated to a Power Searcher in the time between the child and longitudinal studies. For Rose, several factors likely contributed to the change in role. First, Rose did not inhabit the Non-motivated role in isolation; she was also a Developing and Domain-specific Searcher. Her domain of Japanese comics in combination with her willingness to search allowed her avenues from which to approach the computer; rather than repeated negative experiences with search, she was able to leverage a particular interest to begin to explore the search engine. Additionally, as a longitudinal participant, Rose was much more exposed to the influence of others, displaying the role of Social Searcher. She had a cell phone with a data plan, attended school part-time for technology-specific classes, and discussed conducting Facebook photo shoots with friends living nearby. For Rose, the increased exposure to other people at the intersection of technology and social activities created the motivation needed to build search skills.

By including Rose for a case examination, I was able to understand the factors that contributed to her unusual shift from a very low-skill role into a very high-skill role. Rose had a number of changes in her life in the time elapsing between the two interviews. At age 11, Rose was fairly isolated in her computer use, but by age 15, she was using the

computer with several different groups of friends. Possibly accounting for this change was Rose's transition from homeschooling into half-days at a local public school, where she took science and technology classes. It is interesting that Rose's family kept the computer in a shed behind their home, and that this had not changed when I interviewed rose a second time. In extreme weather, the shed would be uncomfortable to work in, as there was not heating or air conditioning. Additionally, rather than replacing their broken laptop, Rose's family simply purchased an inexpensive keyboard to enable typing. Rose's case illuminates how social interactions can alter the roles an individual youth displays as well as how formalized technology education alters search ability. Interestingly, Rose seemed to translate her 11-year-old interest in manga into more sophisticated use of social media as a 15-year-old- for Rose, although not quite demonstrating the role of Domain-specific at age 15, she had definite habits surrounding knowledge of social domains.

Device Use

Camilla, age 11, and her younger brother, age 9, both participated in the child search study. Scheduling the family was difficult, and an initial appointment to interview Camilla and her brother was forgotten by the family; they were climbing into the family car to attend another engagement when I arrived. During the child study I interviewed Camilla's mother, but during the longitudinal study, Camilla's mother was with the family dog at the veterinarian, so I spoke instead with Camilla's father. Sometime between the studies, Camilla's family acquired songbirds; during the longitudinal study,

it was occasionally difficult to hear Camilla's responses over the raucous morning chirping of the birds. See Figure 85 for photos of Camilla during both studies.

Figure 85. Camilla. Age 11, left, and age 15, right, during the child and longitudinal study interviews.

Camilla was unique in the child study in not only owning her own convertible laptop, but travelling with the computer to school each day. During her interview, Camilla described her process for search as based in the school-sponsored databases, although she did discuss using Google when not finding what she needed within the databases. Camilla described Google's information as "dangerous," as it could potentially be incorrect. Camila's mother portrayed Camila as able to multitask, completing school assignments and shopping online simultaneously. Camilla displayed the single role of Rule-bound as a child study participant.

Camilla, as a Rule-bound Searcher, was one of the 10% of child study participants to discuss verifying information. Camilla was heavily influenced at age 11 by teachers or other adults at school. She discussed school as in influencer five times during the child study, more than any other participant in either study. She also reported triggering due to school during both studies.

Interviewee: Uh-huh. And a lot of times, sometimes, if we find information about it, then we'll write it down or copy and paste it into somewhere else and um, ask a teacher or look in a book.

Interviewer: Oh, so even if you find it, you double check?

Interviewee: Yes.

Interviewer: Cool.

Interviewee: Because there is no way to really check because there are some things that our class comes up with, with our teacher to find good websites. And then we don't have to go up to our teacher and say, "Is this a good website?"

Interviewer: Oh, so if your class finds a website that is good, you guys then make a note of it?

Interviewee: Uh-huh. If it has like a lot of general information but it was just one topic, then we'll probably make a note of it.

Camilla's description of verifying websites with other sources seems to be a trait endorsed by and perhaps originating from her classroom at school. Additionally, her description of verification is broad and tied to notions of reliable websites. At age 15, Camilla did not discuss verification, although she was still highly influenced and triggered by school. Camilla was surprisingly the only participant to discuss fact-checking during the child study but not during the longitudinal study. This could be due to her conceptualization of verification as tied to reliability, which she also does not readdress as a longitudinal participant, or due to shifting out of the Rule-bound role.

Among all 50 youth, Camilla was the most consistent participant over time in terms of reasons for selecting websites; she reported selection due to a rule, website

recognition, and the snippet or website title during both studies. Camilla displayed the role of Rule-bound Searcher during the child study, describing her consistent approaches to selecting websites:

> Interviewee: Like marinebio.org. I always look for like, organization, um, because that's like a trustworthy.
>
> Interviewer: Oh, so you look for dot org when you're reading it?
>
> Interviewee: Yes.
>
> Interviewer: Okay.
>
> Interviewee: Or something like that. But we don't really look for websites that are just made by people.

Her tendency to choose websites based on rules still existed during the longitudinal study, however, Camilla was as likely to follow her rules regarding result selection as disregard them (albeit reluctantly):

> Interviewer: Why did you click Wikipedia?
>
> Interviewee: Um, all the other searches looked like websites that people had made themselves. I know that Wikipedia is where people just contribute, but.
>
> Interviewer: And why didn't you want to go to a website that somebody made?
>
> Interviewee: Um, the information could be outdated even though Wikipedia is made by people who are not like professionals, like random people can just contribute, the information is usually kept up to date or changed often.
>
> Interviewer: Ok, how do you know that?
>
> Interviewee: I don't know, they told us that in school; it's kind of gullible for me to believe, but.

In Camilla's case, the stability of her selection criteria was perhaps partially due to her child study role of Rule-bound creating ingrained patterns, and partially due to the age at which she was formally taught the majority of her search behaviors. Per Camilla's mother, children at Camilla's elementary school received their personal convertible laptops in 5th grade, around age 11, coinciding with the child study interview.

Camilla at age 11 was a Rule-bound Searcher. Her principal rule was to use the school-subscribed databases, which she accessed at home via a login provided by the school. Choosing the Grolier's database, Camilla was able to locate articles on the topic of dolphins, the first imposed search task posed to her. However, when looking for information on what dolphins eat, Camilla encountered difficulty:

> Interviewer: All right, so now that we searched for dolphins, can you look for information on what dolphins eat and do the same thing, tell me about it?
>
> Interviewee: Okay. I think I'll come back and search about what dolphins eat.
>
> Interviewer: So you get back, but then you said you'll go back in the other article you were in?
>
> Interviewee: Uh-huh. And I think I'll go to…taste. It says that a dolphin does seem to have taste buds at the base of their tongue but it doesn't say much about how they eat so I'm going to look at a different one.
>
> […]
>
> Interviewee: Uh-huh. And most of these articles have probably the same information. This has the exact same sentence and –
>
> […]

Interviewee: And this is the exact same paragraph so sometimes, they share information. Probably science.

[…]

Interviewee: This article doesn't have anything either. Okay, I tried all the main articles so I can go to use Google now.

Once in the Google search engine, Camilla entered two queries, [dolphin eating habits], which she decided was too specific, followed by [dolphins]. During these searches, Camilla described that she was looking for a website with a .org domain, as these were more trustworthy. Camilla then chose a related search proposed on the search engine results page, "what dolphins eat." At this point, Camilla had visited six separate sources. For her seventh choice, Camilla broke her domain rule, clicking on dolphins-world.com, where she found an answer.

Camilla's database and domain rules made many of her search process choices quicker; in the database, she felt comfortable clicking any result, and on Google, she narrowed her choices to .org sites. However, while supplying confidence and speed to her result selection, Camilla's rule adherence hampered her ability to choose a result containing the desired information. Until she deviated from her rules, Camilla was unable to find an answer.

When I revisited the family home in 2013, Camilla had changed her search and computer use habits significantly. She chose to use her personal iPhone during the interview rather than her personal laptop. Camilla discussed using her phone to communicate with friends via text, and the interview was briefly interrupted when one of her friends stopped by to visit. She also repeatedly discussed listening to music and

searching for bands using her phone. In a change from having a planned approach for search tasks as she had at age 11, Camila ran into problems when parsing the complex search tasks, as she relied on the search engine to provide complete answers rather than piecing the needed information together from separate queries. Camila retained her earlier suspicion of the validity of some search results, remarking that the information she found regarding the Vice President's birthday might be incorrect. During the longitudinal study, Camilla displayed three roles: Developing, Domain-specific, and Social.

Camilla demonstrated the common trends relating to knowledge of sources: longitudinal increase in source knowledge and role-related source knowledge. As a Rule-bound child study participant, Camilla did not report knowing any open Internet sources, as she relied heavily on curated databases requiring subscription. At age 15, Camilla had transition into a Domain-specific and Social Searcher. As an occupant of these roles, she did report knowledge of sources. Camilla's domain of music lead her to the website YouTube to watch music videos, and her social device use made her aware of Facebook, Instagram, tumblr (http://www.tumblr.com), and Twitter. She was additionally aware of Wikipedia and wikiHow (http://www.wikihow.com) as general information sources.

As a child study participant, Camilla was already familiar with using her personal tablet computer in a mobile way. Her mother reported during the child study that Camilla's school assigned laptop was "pretty much attached to her hip." Camilla used her iPhone as a longitudinal participant when asked to use the computer or device with which she was most comfortable. Both of Camilla's parents were present during the longitudinal study, and they described her incorporation of her iPhone into her everyday technology use:

Camilla's mother: She can go back and forth seamlessly with a lot of things going on.

Camilla's father: Yeah.

Camilla's mother: She can have music playing on her iPhone, she can be texting her friend, and she can be going back and forth between, um, a shopping site and typing a paper.

Camilla depicted her own iPhone use similarly:

Interviewer: Ok, and then how long are you on your phone, when you get on?

Interviewee: well, I'm probably on for like 5 minutes at a time, but I get on like 100 times a day, so.

Interviewer: Ok, what are you doing when you hop on your phone real quick?

Interviewee: Um, I'm usually talking to my friends or texting them or just going on Instagram or something.

Camilla's iPhone use was not limited to her home. During her longitudinal interview, she duplicated a search for [how to fall asleep]. Camilla originally conducted this search the previous night as a way to entertain and soothe a child while babysitting at another family's home. She also reported carrying her iPhone to and from school each day, using it to listen to music between classes and conducting searches for personal topics as well as in the context of academics:

Interviewee: Like in class if someone needs an answer to something, not like on a test but if someone's like, or if the teacher asks, "Oh, did you hear about this event, can we get some more information about that?" And then everybody just kind of pulls out their phones, and like, "Well, this happened."

In addition to descriptions of how Camilla used her mobile phone, during the longitudinal study, Camilla and her parents talked about her use of the computer, particularly in the context of completing school assignments. In Camilla's case, her ownership of a mobile device did not completely satisfy her technology needs, and she remained a heavy user of not only her own laptop, but also an occasional co-user of her mother's laptop for specific programs such as Microsoft Word or PowerPoint. Per self-report, Camilla used a laptop between four and five hours a day, supplemented by simultaneous use of her iPhone.

As a longitudinal study Social Searcher, Camilla provided insight into the many ways youth engage with social media and the effects of social media on their day-to-day lives:

> Interviewee: People draw a lot of information about people from social media; there are some kids at school that I've never talked to before, but just by kinda seeing what they post on Facebook or Instagram or Twitter, I can kinda understand like, a little bit about their interests, and not like how they are, cause it's not like meeting somebody in person, but um, kind of what their vibe is, like if they like certain things. So I can see if that person is like intriguing to me, like if I should talk to them in school, or if it's like, uh, I don't really, like that person doesn't really spark my interest.
>
> […]
>
> Interviewer: So this might be hard for you to answer, since you started using social media when you were fairly young, but do you notice a perceptible

difference in like, who your friends are and like who you talk to, who you are interested in knowing, based on your use of social media?

[…]

Interviewee: Well I think that I- not like met more people cause I knew that they went to my school- but I kind of, became friends with people that I wouldn't have become friends with just from school. Um. Like there are a couple people, I don't know, like an example, like if I post some photo or something, and somebody else was like, "Oh, I didn't know you liked that," and then there are a couple people that I've actually become friends with now just from talking to them on Twitter or something, like if I said, "Oh, I'm doing this right now," and "Oh my god, I love that!"

Camilla was also an avid user of the SMS function in her iPhone, according to her parents, and confirmed by Camilla during her interview. Camilla's first mention of her email account was that she used it out of necessity to share information, and her second mention email was brief and historical:

Interviewee: Um, I think I got, well, I had like Gmail in like 5th grade; I think that was like school-oriented though. If I needed to send something to a teacher. And then I got a Facebook in like eighth grade, and that was when I started having Instagram and tumblr and whatever.

Interviewer: So now you have all of them. Do you have Twitter?

Interviewee: Um, almost. I have a Twitter, yeah. Um, and an Instagram, and a Facebook, but I don't use Facebook.

Camilla indicated that she not only used email sparingly, but also was discerning in her choice of social media platforms. She additionally was able to enlarge her circle of offline friends by engaging with people online.

Camilla did not dramatically broaden her search skill in the time elapsing between the two studies, but did broaden her role profile. The addition of the roles of Domain-specific and Social were largely due to the lifting of the restrictions on her computer use from her school at the time she was given her own smartphone by her parents. Camilla, in addition to using her smartphone to connect with others, also was highly social in-person, with friends arriving at her home during my visit when Camilla was age 15. Camilla's case demonstrates how restrictive educational search instruction can be for youth, and the dramatic changes that occur when these restrictions are lifted.

Camilla exemplifies the trend of Rule-bound Searchers ceasing to acquire new knowledge of interface features. Although a Rule-bound Searcher only during the child study, she was aware of link color, maps, number or results, related searches, and the shopping filter during the child study. As a longitudinal participant, she did not mention any new features, but did repeat her knowledge of related searches and maps. However, for Camilla, there is the added factor of her device use; it is possible that her use of and familiarity with the iPhone was an impediment to sharing or gaining knowledge of interface features.

Summary of Case Studies

Within this chapter, I began by providing motivation for including case study analysis. I then detailed the selection process for the three included case studies of this chapter. The case studies provided evidence pertaining to the search abilities and preferences from participant self-report, from parent interview data, and from my own observations as a researcher, and overall were able to lend an alternate perspective to the interpretation of findings.

Chapter 7: Discussion

In this chapter:

- Discussion
  - Search roles
  - Skill-based search behaviors
  - Alternate searching strategies
  - Support behaviors
  - Responses to interview questions
  - Summary of discussion

This chapter contains discussion surrounding the findings regarding search roles, including updated longitudinal role profiles and a graphic associating roles with each other based on similar characteristics. The numerous search behaviors are additionally addressed, with reference to relevant literature when appropriate.

Discussion of Search Roles

In seeking to address the first research question of this dissertation, "What are the transitions in search role occupancy over time in youth?", this section summarizes the uncovered patterns within and between the roles for the child study and for the longitudinal study, and includes interpretations of the observed role shifts. In cases where the following text reads that a particular role lead to particular findings, it is meant that the findings represent only participants in these studies. The following section relies on data generated by the first and fourth phases of analysis and presented in Chapter 5.

Perhaps most notable in terms of findings pertaining to the search roles is the addition of a wholly new role, that of Social Searcher, for the participants during the longitudinal study. The role of Social Searcher was mainly comprised of participants previously showing the roles of Distracted or Power, although every child study role had

some occupants shift into the role of Social Searcher. The data pertaining to the types of influencers, references to influencers, using the computer with others, and using websites and applications designed for communicating with others all show increases during the longitudinal study, and in particular are prominent for those youth displaying the Social Searcher role. For youth in this study in 2013 at ages 11 to 15, computers are assimilated into social lives to a much higher degree than for youth in 2008 at ages 7 to 11. Other researchers have confirmed the increase in searching on social topics in older youth (Duarte Torres, Hiemstra, & Serdyukov, 2010b), or noted social behaviors in youth searching in public libraries and have attempted to design search systems to support co-search (Detken, Martinez, & Schrader, 2009).

The Power Searcher role had several interesting findings. There was the longitudinal change of increased expertise with search, as evidenced by the larger number of Power Searchers present during the longitudinal study. Power Searchers during the child study were likely to only be Power Searchers; they did not often occupy multiple roles. However, during the longitudinal study, Power Searchers were not as isolated, showing strong overlap with other roles: Domain-specific, Visual, and Social in particular. As participating youth gain search skill over time and shift into the role of Power Searcher, they simultaneously use their increased skills to explore search in new ways; by searching images, connecting with others, or by discovering specific topic areas in which to concentrate their exploration. Youth in the longitudinal Power role seemingly are able to transfer their search expertise to areas such as to social media or domains as their personal interests change with age.

All seven child study roles proved able to transition into the longitudinal Power Searcher role. In the case of Non-motivated and Distracted Searchers, this is a surprising yet encouraging finding, as it indicates the potential for youth, despite beginning as inexpert and unwilling searchers, to expand their search knowledge and transition into skilled searchers. Power Searchers were also the most likely role to remain stable between the studies, with only one participant shifting out of the role, so it seems that Power Searcher skills are retained over time.

The role of Non-motivated seemed to be more dominant for the older longitudinal participants, as longitudinal Non-motivated Searchers showed connections to only two roles and were likely to not display any other roles. However, a closer examination of individual youth provides a different picture. Child study Non-motivated Searchers did not remain Non-motivated Searchers during the longitudinal study, heavily shifting into the Developing role, with two youth transitioning into the Social Searcher role and one youth shifting into the Power Searcher role. The change in Non-motivated Searchers, who were unwilling to conduct searches, to shift into the role of Developing, who do display willingness to search, is encouraging, as it indicates that unhelpful attitudes, beliefs, and experiences surrounding search are able to be altered over time. Overall, as all the child study Non-motivated Searchers shifted to other roles, there is strong evidence to presume that the role of Non-motivated is not a long-term hindrance to search literacy.

As transitional as Non-motivated Searchers appear, this was not true for all roles. Child study Rule-bound Searchers were very likely to remain Rule-bound during the longitudinal study. Rule-bound Searchers are unwilling to deviate from their search

habits, and the preference for rule-adherence and high influence from school may lead to long-term role stagnation.

Interestingly, there appears to be a divide between the roles of Rule-bound and Visual. Child study Rule-bound Searchers did not become longitudinal Visual Searchers, and child study Visual Searchers did not become longitudinal Rule-bound Searchers. No youth during the child study displayed both of these roles, and during the longitudinal study only two participants were both a Visual and Rule-bound Searcher. Given this divide, youth displaying either role will likely benefit from distinct approaches to search intervention or education.

There are several other role relationships of note between the child and longitudinal studies. Child study Developing Searchers shifted into all eight longitudinal study roles. Broad transitions such as this could be due to the large number of participants in the Developing role moving into the comparatively small number of longitudinal roles. Domain-specific Searchers, also large in number, did not transition to the role of Non-motivated Searcher during the longitudinal study. Possibly, the domain of interest to the participant prevented the trademark indifference of Non-motivated Searchers.

Search Role Profiles

To develop profiles of each search roles in youth in this study spanning ages 7 to 15, I assessed the most distinct search behaviors for each search role. When a particular search role displayed a high magnitude of difference from other roles and the difference persisted over time on a particular search behavior, the difference served as an identifying characteristic; youth belonging to the role consistently display these characteristics or

consistently display them more or less often than youth in other roles. Some roles are easily identified, while others require careful observation of subtle search habits or approaches to specific tasks. Additionally, some roles have many identifiable characteristics while some roles stand apart from others on only a few points. The following section presents updated and longitudinal profiles of each role.

Identifying Developing Searchers. Developing Searchers are distinguishable mainly by their attitude towards searching, appearing willing and excited towards search tasks and computer use. Even when challenged with difficult search tasks, Developing Searchers maintain an observable demeanor of curiosity.

As the results have shown repeatedly, youth from this study falling into the role of Developing do not have traits causing them to stand apart from youth in other roles. Rather, youth in the role of Developing appear average on almost all search behaviors. The tendency towards average performance for nearly every search behavior serves as an identifier for the role of Developing.

Identifying Distracted Searchers. Distracted Searchers are not youth who simply explore while searching, unexpectedly clicking links or searching new topics. Rather, they are repeatedly distracted when searching and they require prompting to remain on or return to the search task in which they are engaged. In some instances, Distracted Searchers may remain interested in other topics, not returning at all to the task at hand. Causes of distraction for these searchers are mainly based within the computer, but are not limited only to the computer.

Distracted Searchers are aware of very few features of the search interface, even as adolescents. They are unaware of advertisements, and may experience difficulty in

distinguishing when a link will lead to a sponsored website. Distracted Searchers do not verify or discuss verifying found information using multiple websites. Finally, Distracted Searchers verbally report more frustration than youth in other roles with the spelling and typing required to search on most computers or mobile devices.

It should be noted that the role of Distracted was the most sparsely populated role during both studies, with six child study participants and only three longitudinal study youth. Foss et al. (2013) did not observe the role of Distracted at all in their study with adolescents ages 14 to 17. Distracted Searchers are relatively infrequent in children, and the role may be extinct in older adolescents.

Identifying Domain-specific Searchers. The main characteristic of Domain-specific Searchers remains their expert or near expert level knowledge pertaining to specific interests. Whether they direct their attention towards online gaming, shopping, or exploration of music videos, youth in the role of Domain-specific display extensive knowledge of their domain interfaces and display a positive affect towards their domain. Domain-specific Searchers are often linked with the lower-skill role of Developing until the age of 11. After age 10 or 11, they are more often observed as also occupying the highly-skilled role of Power. For youth under age 11, domain knowledge does not transfer notably to the search interface. However, it appears that Domain-specific youth over the age of 10 or 11 are able to take specific skills from their preferred contexts and apply them when searching for information.

Domain-specific Searchers do not display many behaviors at largely different percentages than youth in other roles. This is likely partially due to their close affiliation with the role of Developing at or under the age of 11; many Domain-specific Searchers

are also Developing Searchers, and Developing Searchers tend to perform at average levels by comparison to other roles. In addition, Domain-specific Searchers rank centrally of all the roles during both studies when compared on skill-based search behaviors; they do not over- or underperform any roles in demonstrating search behaviors requiring specific knowledge.

Identifying Non-motivated Searchers. Non-motivated Searchers are more easily identified by the behaviors they fail to display than by the behaviors they do display. They do not discuss many features of the search engine, especially at age 11 or younger. Non-motivated Searchers do not discuss aiding others with computers or searching. Non-motivated Searchers also do not report selecting websites from the results page due to website recognition.

Identifying a Non-motivated Searcher is largely accomplished by understanding affect and listening to speech (or lack of speech) during search tasks. Silence is an indication that a searcher may be largely uninterested in searching or computer use, as is terseness when responding to questions. Non-motivated Searchers do not spontaneously read found information aloud as do searchers in other roles. When discussing searching or the search interface, Non-motivated Searchers use computer or search vocabulary terms at lower rates than youth in other roles. Non-motivated Searchers express in-context frustration more often than youth in other roles, particularly after age 10 or 11.

Identifying Power Searchers. Youth displaying the role of Power are unique among the search roles in their ability to parse complex tasks requiring multiple searches into separate queries. Power Searchers are verbal, and explain at length when asked questions about their decisions or other aspects of searching. In their verbal responses,

Power Searchers are likely to correctly name computer and search-related features, as they know many technology vocabulary terms. As they are reflective, they are able to provide reasoned justifications for their methods of search.

In terms of displayed search behaviors, Power Searchers know many features of the search engine, particularly in comparison with their peers in other roles. Youth falling into the role of Power Searcher also know of sources for information, especially above the age of 10 or 11. Power Searchers report using the URL when selecting results from the search engine results page, and at age 11 or under especially, youth in other roles are unlikely to report using the URL. Power Searchers are the only role to use social media or networking sites at age 11 or younger, and are more likely than almost all other roles (except Social Searchers) to frequent such websites at age 10 or 11 and above. Lastly, Power Searchers are frequently triggered to begin searches for their own personal interest, especially at or over the age of 10 to 11.

Identifying Rule-bound Searchers. Youth falling into all roles espouse rules to explain their choices when searching. Only youth who adhere to their own rules, even when the rules are detrimental to the search process, are Rule-bound Searchers. While youth frequently follow their rules shortly after stating them or when engaging in a typical, familiar search, it is much more uncommon for youth to continue to follow a rule when approaching different types of search tasks and for entire searching sessions.

Rule-bound Searchers are strongly influenced by adults at school, as they discuss school, teachers or other adults in the educational setting frequently. Rule-bound Searchers are also highly likely to report that they are triggered to begin searches due to school. While Rule-bound Searchers are highly influenced by school, they are less likely

than youth in other roles to discuss influence from siblings, especially at or under the age of 11.

Identifying Social Searchers. The role of Social Searcher is only observed in youth at or above the age of 10 or 11. Social Searchers engage with computers or mobile devices mainly to communicate with others or share information via social media or networking sites. Probably related to their primary engagement with the computer, all Social Searchers are aware of sources for information; they are familiar with specific websites. Social Searchers freely discuss not only the people influencing their computer use, but are also articulate in describing ways in which other people affect them.

Social Searchers use many computer vocabulary terms, outpaced only by Power Searchers. In terms of device ownership and access, Social Searchers are highly likely to report owning or using a mobile device. Finally, Social Searchers are likely, and much more likely than youth in other roles, to report that they are triggered to begin searches due to the influence of other people.

Identifying Visual Searchers. Youth in all roles conduct intentional image searches to exemplify the capabilities of the search engine or to quickly retrieve a picture. However, repeatedly conducting intentional image searches is much less common, as is applying visual search to tasks more easily accomplished using text search. These behaviors indicate a strong preference for information in visual formats, and are unique traits to youth belonging to the Visual role. The preference of the role for visual information can occasionally occlude more reasoned or rapid approaches to a particular search task; judging relevance of image and video content is difficult, and watching videos often consumes more time than reading the same information.

Visual Searchers do not frequently differ greatly or consistently over time from youth in other roles; they did not have consistent role-defining behaviors. However, Visual Searchers do show a greater likelihood of discussing aiding other people with search or computer use than youth in other roles. Predictably, Visual Searchers are also highly aware of images, videos, and YouTube, discussing these at higher percentages, wider age ranges, and more often than searchers in other roles.

Search Role Groupings

After describing the eight longitudinal search roles according to their most defining characteristics, there remains the question of role groupings. While each role is distinct from the others, some search behaviors are strong role identifiers for more than one role. Figure 86 illustrates these overlaps visually. At the top of the graphic, the color-coded row of circles contains high-level search behaviors. In the lower portion of the graphic, the correspondingly-colored circles contain the exact search behavior displayed by the connected role. For example, both Power and Social Searchers are highly aware of sources for information; the high-level behavior of source knowledge is light blue, as is the circle connecting the two roles and defining the source knowledge as high. There are four major groupings of search roles: Power and Social; Visual; Developing, Domain-specific, and Rule-bound; and Non-motivated and Distracted. It is interesting that these groupings coincide with the categorization of the roles by skill level, as presented in the next section. The groupings also reveal the behaviors necessary for a youth to display to shift from one role to another. If a child displays the role of Non-motivated, for example, he or she could move to another role by changing any of the three behaviors connected to the Non-motivated role.

Figure 86. Search role groupings.

Definitions. The following definitions specify the intended interpretation of the terminology used in the search role groupings graphic. The definitions are drawn largely from the *a priori* coding structure (Appendix D). The first six definitions apply to the terms used in the circles at the top of the graphic. The remaining definitions are for terms found within the graphic and are included for clarity.

Search preference: Patterns of search choices for open-ended search tasks.

Affect: The emotional state of the youth while searching. Fleeting emotional displays should be disregarded, but repetition or strong reactions are worthy of note.

Verbal discussion: The content of the conversation with youth. Often, verbal exchanges will contain repeated topics, which serve as indications of role.

Interface knowledge: Verbal discussion or verbal discussion combined with use of features of the search engine. Features of the search engine include, but are not limited to: autocomplete, did you mean, showing results for, advanced search, images, maps, news, next page, and related searches.

Complex tasks: Tasks that present as a unified problem but which require multiple queries to complete. (Foss et al., 2012, 2013)

Source knowledge: Retaining a knowledge base of available websites. Recognition of websites, directly navigating to a website, explaining why a particular website is appropriate for the search task, or discussions of websites without visiting them all constitute source knowledge.

Parse: Breaking complex tasks into separate queries that the search engine can process.

Willing: Verbal indications of interest in tasks, engagement with search tasks.

Frustration: Verbal or physical indications of impatience, irritation, or similar emotions when conducting a search. Youth may utter groans, exclamations, bang the keyboard or mouse, slump their physical body position, or give other indications of frustration.

Deviate: To change topics from the initial search query. Deviating can occur via browsing behaviors or via new queries.

Domain query: Queries formulated around familiar content. Familiarity can be with the topic of the query, the websites returned after query entry, or indicated by verbal discussion of historically conducting similar queries.

Rules: Verbalization of self-imposed search guidelines.

Social query: Query performed to connect with other people, on a social networking/media website, or based on the influence of other people.

Visual search: Verbal statement of intent prior to conducting search, or navigating to an image or video search interface prior to query entry. Not opportunistic clicking of video or image results.

Discussion of Skill-based Search Behaviors

Role Ranking

The question of whether the presence of any particular role is more advantageous than any other role is one that I am reluctant to address, as it leads to interventions focused on altering the behavior of youth, rather than to altering adult approaches to interface design, search support, and education. Search roles currently describe role traits not only in terms of skill, but also in terms of alternative ways youth obtain information and a wide range of contextual factors affecting search. Because search roles are inclusively defined, if they are evaluated and ranked for skill, role identification in individual youth can broadly detect areas of search strength as well as deficit. For this

reason, it is of interest to determine which roles display skilled behaviors, as skilled behaviors are linked within roles to other factors affecting search.

In order to identify whether some roles are based more in searching skill than in preference, habit, or affect, I selected search behaviors that would highlight search-specific knowledge or factors directly beneficial to the search process. These behaviors were: recognizing and correcting problems, knowledge of interface features, knowledge of sources, advertisement awareness, vocabulary, encountering unfamiliar terms, aiding others, verification, and in-context frustration. I was interested to discover whether the child and longitudinal study roles would rank similarly when compared across the skill-based search behaviors, as this would indicate consistency over time in skill displayed by a particular role.

Using the eight skill-based search behaviors as separate categories and treating the child and longitudinal data separately, I ranked the roles under each category according to the percentage of participants in each role displaying the search behavior. I then assigned a score to each role based on its ranking; the role with the highest percentage of participants displaying the search behavior was assigned a score of seven (for the seven child study roles) or eight (for the eight longitudinal study roles). In the case of ties (two roles with the same percentage of participants displaying a given behavior) I assigned the same score, and in the absence of any role occupants displaying the search behavior, I assigned a score of zero. I then added the scores for each role to achieve an overall ranking of the roles per study.

Reading Table 5 confirms the high skill level present for the top-ranking Power Searchers, and that this skill level was present during both studies. Additionally, Non-

motivated Searchers rank last during both studies when examined just on skill-based search behaviors, possibly revealing some of the cause behind their reluctance to engage with the computer. These two roles provide clear direction when considering the types of behaviors to share with all youth. Presenting as a definite mid-range role, Domain-specific ranked fourth during both studies, which may suggest the role of Domain-specific acting as a skill bridge.

Table 5
Role Ranking by Skill-based Search Behaviors

Ranking	Child Study	Change	Longitudinal Study
1	Power	=	Power
2	Developing		Social
3	Rule-bound	▲	Visual
4	Domain-specific	=	Domain-specific
5	Distracted	▼	Developing
6	Visual	▼	Rule-bound
7	Non-motivated	▼	Distracted
8		=	Non-motivated

Also interesting is the fall of the role of Developing from second place during the child study to fifth place during the longitudinal study. While child study Developing Searchers displayed the main characteristic of willingness and excitement surrounding searching, another defining characteristic was the inability to conduct complex search tasks. A searcher displaying all of the traits of the Power role would have been excluded from the role of Power if he or she did not break the complex tasks into separate searches. Simply approaching one search task in an unplanned way does not appear to have negated the other abilities possessed in child study Developing Searchers, and the lack of

only this ability could explain their high child study ranking. Longitudinally, the roles of Power, Social, Visual, and Domain-specific outrank Developing, but there is a high amount of overlap for these roles; a longitudinal Power Searcher was likely to also be a Social or Domain-specific Searcher, or both. Longitudinal Developing Searchers are also outranked by longitudinal Visual Searchers. Like Domain-specific, the preferences present for Visual Searchers may lend specific search skills to youth.

During both studies, Rule-bound Searchers ranked lower than Developing Searchers. This is unexpected, as Rule-bound Searchers presumably followed their self-imposed rules as the rules allowed them to bypass typical breakdown points when searching. However, the rules reported by the participants did not provide guidance for the skill-based search behaviors used in ranking the roles. Child study Rule-bound Searchers did not have rules allowing them to learn about the search interface, gain knowledge of specific sources for information, or expand their computer-related vocabularies. Rules adopted as youth are beginning to learn to navigate the Internet as young searchers seem to inhibit the development of useful search skills far into adolescence, as evidenced by the poor ranking of the longitudinal Rule-bound Searchers and the likelihood of Rule-bound Searchers to remain in the role over time.

For other roles, Social Searchers ranked highly during the longitudinal study. However, there is a large overlap between the roles of Social and Power, as 30% of Social Searchers are also Power Searchers. This co-occupation could partially explain the second-place ranking of longitudinal study Social Searchers. Social Searchers additionally engage in a wide variety of online activities. Although these are generally specific to communication with others, it appears that their preferred activities transfer

well to skill-based search in the same way as the preferences for Domain-specific or Visual Searchers transfer.

While ranking above most other roles during the child study, longitudinal Rule-bound Searchers were aware of fewer features than searchers in most other roles. This would seem to indicate that for Rule-bound Searchers, knowledge of the search interface is gained early, between the ages of 7 to 11. However, this early proficiency does not seem to propel Rule-bond Searchers to continue to gain skills surrounding knowledge of search engine features as they grow older, and they become outpaced by their peers in other roles.

Knowledge of Features

Search interfaces contain numerous features designed to aid users with spelling, navigation, or discovery of resources. However, children and adolescents are not always aware of these features, and do not unilaterally assume that the presence of such features is necessary. Interestingly, some research using Participatory Design methods with youth to create ideal search interfaces shows that youth did not desire help or spelling correction features on their search interfaces.

Marchionini (1989) described an age effect of choosing to use system features in his participants. Older youth, around age 12, were much more successful at using system features than were participants around age 10. Participants under the age of 11 in Solomon's (1993) research with OPACs used system features infrequently, and Hirsh (1999) reported no participants using system features. Bilal (2002) found that children did not use the help feature of the search portal Yahooligans!. Druin et al. (2009) describe

that children did not use the drop-down spelling assistance even when having trouble spelling difficulty, as the children's attention was focused not on the screen, but on their own hands as they struggled to type. Solomon (1993) states that knowledge of interface features become easier as users become more familiar with a system, but that learning the features can be a daunting task.

Google's autocomplete feature has changed over time. The left side of Figure 87 is the autocomplete box for a search on dolphin food from approximately December 2008 (Druin, Foss et al., 2009), while the right side of Figure 87 is the same search's autocomplete box for June 2013. There are fewer choices in the 2013 version, and the user is no longer informed of how many pages will be returned when choosing a search suggestion. However, in other aspects, such as on-screen location and functionality, the autocomplete feature remains the same. Child study and longitudinal study participants were aware of the autocomplete feature at similar rates, perhaps due to the comparatively limited changes to the feature over time.

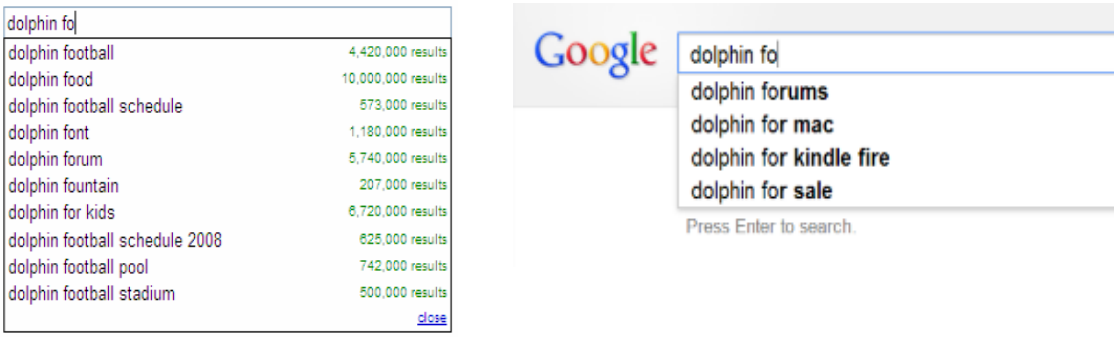

Figure 87. Autocomplete over time. The autocomplete box for a search on dolphin food ([dolphin fo]) from approximately December, 2008 and from June 28, 2013.

The Google search results page underwent changes between the child and longitudinal studies. The left side of Figure 88 (Druin, Foss et al., 2009) illustrates the "Did you mean" feature as of 2008, which suggests an unhelpful correction for the misspelling of "schedule" ([scedwal]) entered as a query. In the 2013 version of this search to the right of Figure 88, the "Did you mean" feature is replaced by text reading "Showing results for" and the correct interpretation of the query. There is a third spelling correction feature, that of "Including results for," although no study participants indicated knowledge of this feature. The three possible query interpretations and the change in color from red to black text for the 2013 interface seem to have resulted in decreased awareness among youth of spelling correction as a feature during the longitudinal study.

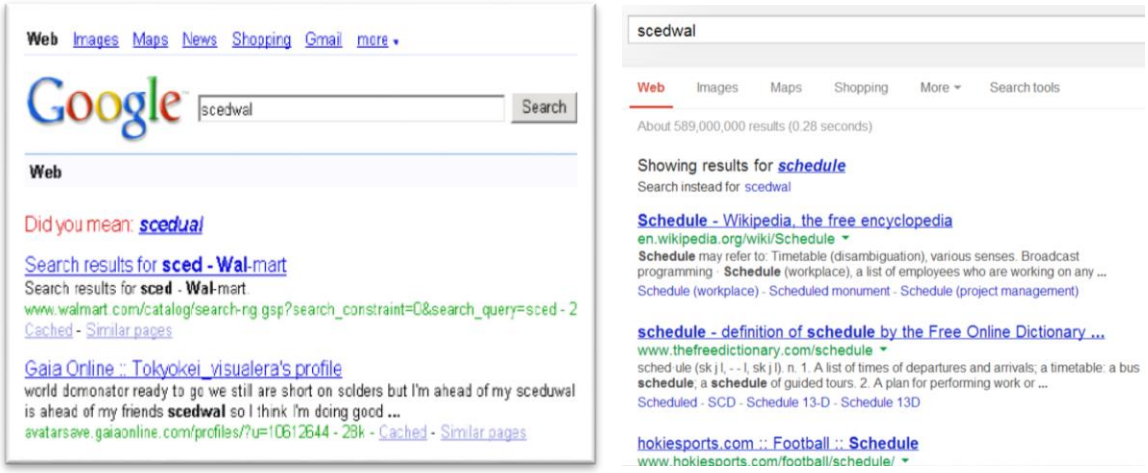

Figure 88. Search results over time. The search results presented by Google for the same misspelled query from approximately December, 2008, left, and from June 28, 2013, right.

Other changes include the option of navigating between search filters such as images, maps, or shopping moving from the top-left of the 2008 interface to a placement immediately below the search box in 2013. This does not appear to have greatly affected feature awareness in youth, as child and longitudinal participants discussed maps,

shopping, and images at similar rates. Another notable change is the position of the URL (in green text) for each search result. In 2008, the URL was located below the snippet from the website, while in 2013, the URL is more prominent, located under the linked website. This change has perhaps resulted in increased awareness of the URL; longitudinal participants reported using the URL when selecting results more frequently than child study participants.

Interestingly, there appears to be a ceiling for understanding the functions of the search engine when examining knowledge of features by role. This ceiling is evidenced by the high number of features described by Power Searchers across both studies. Power Searchers did not display improvement over time in feature awareness or use, but rather leveled off during the longitudinal study, in comparison to the other roles, which all showed improvement during the longitudinal study.

Youth in this study in 2008 most frequently discussed the next page, Did you mean, and the autocomplete features. In 2013, the participating youth most commonly discussed related searches and the AppBar. The Google search interface changed in appearance and function between 2008 and 2013, possibly altering the perceptions of youth. Also, while younger youth in this study are frustrated by their spelling ability, focusing them on spelling aids, older youth are more likely to use social features such as Gmail or YouTube, both accessible via the AppBar.

During both studies, participants at older ages knew more features of the interface than participants at younger ages. Additionally, over time, participants in all three age groups gained knowledge of search engine interface features. However, the rates at which the age groups gained knowledge of features suggests that there is a ceiling; participant

youth learn the function of search engine tools that will aid them, but do not exhaustively explore the search engine interface.

Features new to 2013. The longitudinal participants were aware of features not mentioned by the child study participants or features that were not a part of the interface during the child study. Twelve percent of longitudinal participants discussed using advanced search operators. However, half of the longitudinal participants who talked about advanced operators discussed using operators that have no effect on search results. A 13-year-old boy used parentheses to search for [joe bidens birthday (day of the week)] and another participant described:

15-year-old-girl:

> But like, using quotes and stuff if you want to search for those exact words, and separating stuff with commas and excluding certain words.

A 12-year-old girl used advanced operators by refining her Vice President search by adding a question mark. As described by Google's search help pages, most punctuation is ignored by the search engine (Google Inside Search, 2013), so these youth were not improving their search results by using punctuation. Adult participants in Aula & Nordhausen (2006) also erroneously used advanced search operators, which the authors note were simply excluded from the query by the Google search engine.

Other features only mentioned longitudinally included search terms appearing in bolded text on the results page, by 8% percent of participants. Six percent of longitudinal study participants discussed the Easter Eggs present within the Google interface. These three participants mentioned: typing [askew], [do a barrel roll], the answer to life, the universe, and everything, [once in a blue moon], and traversing the Pacific Ocean on a jet

ski. The Knowledge Graph, introduced in 2012, was discussed by 6% of longitudinal participants as "the info box," "something to the right," and "here, but I've never seen this thing before" (boy age 15, girl age 14, and boy age 11). Sitelinks were also discussed by 6% of longitudinal participants, who referred to this feature as "sub-divisions," "the outline of the page," and "sub-topics" (boy age 12, boy age 15, and girl age 15).

Knowledge of Sources

During the child study, fewer participants by role and age were aware of sources for information on the Internet than during the longitudinal study, when most roles and age groups were highly aware of sources. Knowledge of sources appears to be a search behavior that continues to increase over time until most participant youth have at least one known site, although not every participant discusses knowing sources. These findings are reflected in an exploratory study with 10 and 11 year old children, which found that children did not make note of useful sites when conducting series of searches, instead retyping queries in order to revisit sites (Hirsh, 1999).

Advertisement Awareness

For younger searchers in this study, those age 7, advertising content was difficult to differentiate from other website content. Prior research confirms the lack of awareness of advertisements presented by the search engine in youth. Duarte Torres and Weber (2011) found that children up to age 12, and particularly those ages 6 and 7, were more likely to click on advertisements presented by the search engine than were users in other age groups. Other researchers attempting to identify appropriate websites for search engines to present as results for children characterize advertisements as indicators that a

website is unsuitable for or not designed for use by children (Eickhoff, Serdyukov, & de Vries, 2011). Researchers using a different approach, that of engaging children about what features of search interfaces were desirable or undesirable, found that advertisements were almost always met with dislike (Large, Beheshti, & Rahman, 2002).

Vocabulary

Other researchers have attempted to classify pages to present to children as results using vocabulary contained within the text on the website (Eickhoff et al., 2011) or have proposed ways to use the search interface to expand children's vocabularies on searched-for topics (Collins-Thompson et al., 2011). Slone (2002) analyzed the vocabulary of public library Internet users of a broad age range when asked to describe the Internet. Slone reported that users who employed more sophisticated vocabulary words (e.g. modem, network) were also users of Internet tools, focused in their searching, and knew when to stop searching. However, Slone did not conversely find that users who described the Internet using vague terms were less sophisticated users.

Longitudinal study youth used more vocabulary words per participant than child study participants. Longitudinal youth additionally knew terms not verbalized during the child study, showing ongoing change in computer and search vocabulary and reflecting the changing search landscape. The middle and oldest participant groups showed similar rates of vocabulary terms used, and additionally were comparable to the Power Searchers in both studies. The youngest participants showed vocabulary term use closer to rates displayed by Non-motivated searchers, although they did show an increase in computer-related vocabulary during the longitudinal study. Given the similarity of rates of term use

by the two oldest age groups, it appears that youth gain their computer vocabularies at age 12 or 13, and show little continued improvement. However, this interpretation does not include comparisons over time for newer terminology as it becomes popularized in everyday speech. Terms such as mobile, social, or apps were not present for child study participants, not because they did not know the terms, but because the terms were not in common use.

Aiding Others

Other researchers have found instances of youth desiring to help their peers when searching. In a study of child users of a public library, Dresang (2005) reports children describing how they could help their peers to learn search skills, such as finding new websites. Fidel et al. (1999) describe how adolescent searchers in the school setting relied on their peers to answer questions while conducting searches.

Helping others to search or to use the computer was a behavior only discussed during the longitudinal study; child study participants did not report aiding other people. Even for youth from this study living in the same household, search information does not appear to transfer among youth before age 10 or 11. Child study participants were also not highly likely to use the computer with other people and reported fewer influencers, friends in particular, than longitudinal study participants. Allowing younger searchers to explore the Internet together would likely improve the flow of helpful information among youth.

Verification

Participants in both studies reported encountering contradictory or incorrect information online, and youth found conflicting information even during the study interviews. This highlights that verifying found information may often be necessary. In an early study with 10 and 11 year old children, Schacter et al. (1998) describe that very few of their 32 participants pursued multiple solutions to the assigned search tasks. In another study with elementary-aged children, only one participant continued to pursue the search task even after locating the correct answer (Kammerer & Bohnacker, 2012). Similarly, during both current studies, older participants were more likely to verify information using multiple sources than younger participants. All three age groups additionally showed an increase during the longitudinal study in verifying information to percentages above those during the child study. Not only is verification more important as youth from this study age, it appears to be more important over time as well.

There is a probable link between checking multiple sources and engaging in searching due to school assignments. For youth seeking information to fulfill school assignments, accuracy and consistency matter greatly, and can be achieved via verification. Verification and searching triggered by school were additionally both more likely for participants as age increased during both studies.

In-context frustration

The youngest age bracket of participants during both studies displayed more frustration during the interviews than the older two age brackets, and in general, the roles

displaying lower levels of searching skills had higher levels of in-context frustration. At the same time, roles with higher skill levels displayed less in-context frustration.

Shenton & Dixon (2003) describe participants in their large study comparing CDROM datasets to information on the web becoming frustrated with the web presenting too many sites with information that was not useful. Fidel et al. (1999) provide examples of their high school aged participants exclamations of frustration while searching, particularly with slow-to-appear results. Youth in the current study were frustrated by both of these factors (irrelevant results and speed) as well.

A recent study with adults found that emotion, whether registered by tracking facial movement or per participant report, had no effect on the outcome of the search process (Lopatovska, 2014). This study found that surprise and neutral emotions were most frequently recorded by the facial expression software and that participants did not report feeling strong emotions when viewing videos of themselves searching, with only 4 out of 30 participants describing frustration. The author acknowledges that these findings are inconsistent with much of the existing literature and that future work is needed, and it should be noted that this study included adult, not youth, participants (Lopatovska, 2014).

Discussion of Alternate Searching Strategies

Youth searchers have developed a number of purposeful behaviors that allow them to compensate for difficulties and enhance their experiences of searching. These strategies are not overtly positive or negative, but are responses to each searcher's personal experiences with the search interface. Additionally, these behaviors are per self-

report, described as usual habits or preferences by the participants; they are not uniformly observable from the available data.

Use of Offline Information

There is discussion in previous literature regarding youth opinions and use of offline information sources. Davies (2011) describes that some adolescent participants reported enthusiastic and frequent Internet use at mid-adolescence. However, the same participants at slightly older ages seemed to have been able to determine when engagement with online information was most appropriate, and reported refraining from using social media and using textbooks as primary sources for schoolwork rather than the Internet. The oldest participants in the current study were age 15, and showed a decline in using offline sources over time. Given the findings of Davies (2011), it would be interesting to revisit participants from the current study when they reach ages 16-19 to see if their use of offline information similarly increases.

Other research has found that as youth age, they become less likely to turn to print resources. Kolikant (2010) interviewed students ranging from about 14 to 18 years of age regarding their use of the Internet for school and their self-perceptions on learning. Kolikant found that the participating students had positive views of the Internet as it related to schoolwork with 76% agreeing that it was fun, easy, convenient, and interesting. The participants had a more negative perception of books, with 64% endorsing the statement that books consumed energy, were boring, or tedious. Purcell et al. (2012) discuss teachers reporting that as students age from middle to high school, they become less likely to use print books as resources.

Quality of Information

For every role, there was a large increase over time in discussions of the quality of information retrieved or encountered when searching, with longitudinal study percentages surpassing those of the child study. In the current search landscape, reliable, correct, and trustworthy information is highly valued.

In a study of high-school students' information seeking over the course of a two week project, Chung & Neuman (2007) found that for the students in their study, having reliable sources for information was the most important reason students gave for why they chose certain website. According to the students in this study, reliability could be determined by the organization or individual providing the information. The authors additionally note that reliability was stressed by teachers and the library media specialist involved with the students in the study. In a study with college students, Choi (2010) similarly demonstrated the importance of reliable information, as participants were likely to check the quality of the information they retrieved before deciding whether it was relevant to their needs.

Result Selection Criteria

For both studies, more participants reported using the snippet or website title as result selection criteria than reported other reasons for choosing a result. When researchers asked participants to identify which part of the result entry they read, the participants in both studies most frequently reported reading the title or the snippet. In combination, these findings highlight the importance of the snippet and title for youth attempting to locate relevant results.

Although youth over the age of 11 discuss many possible ways to choose a result from the search engine results page, such as awareness of sources and URLs, self-imposed rules regarding domains, and the selection criteria of website recognition, these youth report relying most heavily on the snippet and website title when choosing which websites to visit. This finding indicates youth depend on the search engine results page to inform them regarding which linked website would be most appropriate for their needs.

Hutchinson, Druin, & Bederson (2007) discuss that young children select books based on the book cover and illustrations. Transplanting these findings to the Internet and the search engine results page, children do not have a parallel to colorful covers and drawings within the search interface, likely making result selection difficult.

Bilal (2012) summarizes her own series of studies on children's searching for different types of tasks. The children were most likely to select results near the top of the results page rather than farther down the results page. This ties to the current longitudinal research when considering that "choose the first result" and "results get worse" were rules reported by the participants, and that following a rule was the third-most commonly reported reason for result selection.

The most commonly reported result selection criteria during this study was selecting a result based on the website title and snippet. Collins-Thompson, Bennett, White, de la Chica, and Sontag (2011) explored the behavior of searchers within a search log dataset when the website title and snippet were of a lower reading level than the content on the associated website. They found that searchers spent much less time on pages that were represented on the results page by titles and snippets that did not

accurately reflect the website content. For young children, then, it is highly important that the results pages accurately reflect the content of their associated websites.

Self-imposed Rules

Other researchers have noted the rule-following behavior of youth and the problems it can cause. When describing youth entering queries into the Google search engine, Kammerer and Bohnacker (2012) discuss that some of their participants had difficulty with searching using keywords as prescribed by parents and asked researchers for approval to use natural language queries. In early research investigating children's use of OPAC system, Solomon (1993) found that children resorted to rule-following. Solomon notes that the first rule many children seemed to follow was to pluralize their search query, and that the rules speed up the search process as well as allow children to lessen the cognitive load required to search. Solomon also discusses "ritual moves," or habitual ways children begin searches (p. 255).

The most commonly reported self-imposed rule during the child study was "use Wikipedia." During the longitudinal study, tied for the most commonly reported rule was "don't use Wikipedia." School became more prominent as an influencer for almost all the roles during the longitudinal study, and examining the interview transcripts reveals many longitudinal youth discussing that Wikipedia was not allowed as an information source by teachers at school. The increased influence of teachers after age 11 seems to have a large impact on participant youth opinions regarding appropriate and useful websites for information.

Davies (2011) provides a thoughtful discussion regarding the formation of self-imposed rules for adolescents in a longitudinal examination of the interplay between parental and adolescent attitudes towards technology in the home environment. Davies notes that a self-imposed rules in adolescents seem to be the result of the acceptance of wary or reticent attitudes towards technology held by parents, the desire to perform well academically which is best accomplished via textbooks, or due to attempts to distance themselves from prevailing ways of interacting with peers online. The findings from the current research show that youth who are more influenced by teachers and propelled to computer use due to school assignments are more likely to be Rule-bound Searchers, partially confirming Davies (2011). It is worth noting that very few longitudinal participants displayed both the role of Social *and* the role of Rule-bound, so Davies' finding of social distancing may additionally carry weight.

Discussion of Support Behaviors

Device Use

Longitudinal study participants discussed ownership and use of devices far more often than child study participants. This finding is true for all three age brackets and roles as well, with the lone exception of the Distracted role. The majority of the devices discussed by the youth have Internet connection capability as well as Internet search capability, but with the exception of the searchers who completed the interview search tasks while using a mobile device, ascertaining how the devices affect search behaviors is difficult.

The youngest participants reported fewer devices than did participants in either of the older age groups. However, the youngest participant group showed signs of adoption of devices more frequently and earlier than older youth, as participants at ages 10 or 11 during the 2013 longitudinal study had greatly outpaced the 11-year-old 2008 child study participants in reporting device use or ownership. Other researchers note similar trends. Blackwell, Lauricella, Conway, & Wartella (2014) found that 26% of the 8- to 12-year-olds in their study of web site preferences owned a mobile device such as a smartphone or tablet and that the participants used these devices to access similar content as they would on the computer. Purcell et al. (2012) report that teachers are beginning to allow students to use cell phones and other mobile devices to access the Internet during class time, indicating that devices are becoming more accepted for youth to use as well as own.

The Visual Context

Images proved to make more of an impact than videos on participants during both studies. In addition, participants discussing images during the child study were likely to discuss images again during the longitudinal study, demonstrating that knowledge of how to access image content is long-lasting in individuals. However, verbal mentions of images did not increase longitudinally; images were commented on by the same number of participants in each study. It appears that at a given time, images only influence approximately 70% of participant youth. Large et al. (2000) found similar results in their study of 12-year-old searchers competing a class research project. In this study, many students searched for visual content to include in their poster presentations. However, there was a faction of students who reported that textual information was more important

that information conveyed in images. Students in this study additionally were unenthusiastic regarding video and audio content available to them via the Internet.

Hirsh (1999) discusses participants in her study being highly selective of image content in order to choose images that contained the maximum amount of relevant information, for example, individual athlete photos as opposed to a photograph of the entire team. Eickhoff, Serdyukov, & de Vries (2011) discuss that visual content existing within a website may be a way to classify the site as more child-friendly, as young children find visual information easier to process than text. As the Visual Searchers in the current study showed low search skill levels, it is possible that they prefer visual information as a way to compensate for their difficulty with search.

Despite the stability of discussions of image content, video content rose in prominence for the participants in the longitudinal study, whether in reference to videos in general or specific to the website YouTube.

Influencers

At all ages for participants in this study, there is a core group of people affecting youth in terms of search. These influencers are present over time, and are discussed by youth even without prompting. Comprised of fathers, mothers, siblings, friends, and teachers, this core group is in a unique position to aid young searchers. During the longitudinal study, the youth discussed more influencers of different types than they did during the child study. This likely reflects the increased personal freedom present as youth age into adolescence; changes in household rules and parental supervision directly impact the ability of youth to use the computer and their devices in social ways. Three

longitudinal study participants discussed the study researchers as influencers, although they had only brief interactions with the researchers three to four years previously. This seems to indicate that minor interventions with youth regarding search skills can have a lasting impact. Friends were notably stable influencers; nine of the 10 child study participants discussing friends also discussed friends during the longitudinal study. Finally, although mothers were discussed by fewer participants longitudinally, more participants discussed mothers during both studies than any other type of influencer. Though youth rely less on mothers as they age to aid with searching, mothers do seem to be a consistent source of support over time. Davies (2011) discusses that adolescent searchers can adopt the views of their parents towards technology, whether positive or negative, indicating that mothers and fathers exert a large amount of influence over their children's search habits and attitudes.

More participants in the longitudinal study discussed friends than did participants in the child study, and friends proved to be the category of influencer with the largest amount of longitudinal growth. At the same time, participant youth increased in engaging in social computer activities. Some of the ways in which youth used the computer socially, such as chatting or communicating via social media sites, are unlikely to occur with a parent or teacher. Friends seem positioned to affect searching indirectly, via improved typing ability gained from text chats, increased source knowledge from joining social networking sites, or conversationally triggering searches. Hirsh (1999) and Large and Beheshti (2000) both discuss children seeking information for school projects that would be interesting for their peers, illustrating other ways friends can affect search behaviors.

By role, the most frequent influencers show varied patterns of change over time. For fathers during the child study, percentages of youth in all roles are similarly likely to discuss their fathers. During the longitudinal study there is a broader distribution of participants in different roles who discuss fathers; fathers of youth aged 10 to 11 or older showing greater and lesser amounts of influence depending on role. For all roles except Distracted, there was a longitudinal increase in discussing friends. This ties to the increase in social behaviors described by participants during the longitudinal study. Youth in some roles show decreased dependence on mothers after age 10 to 11, although at younger ages mothers are discussed at similar percentages for all roles.

For the youngest participant group, there was a notable increase in discussions of adults at school as influencers during the longitudinal study. This increase is likely due to these participants being assigned more homework at higher grade levels, which they complete using the Internet. While the older two groups of participants moved away from mentioning mothers and fathers during the longitudinal study, the youngest participants talked about their mothers and fathers more frequently during the longitudinal study than during the child study; it appears that youth do not begin to shift away from parent influence until around age 10 to 11.

In the child and longitudinal studies, there were seven sibling pairs and one set of three sisters. Examining only the sibling data for incidents of mentioning influences from also-enrolled brothers or sisters reveals differing trends during the child study as compared to the longitudinal study. As child study participants, 12% (two participants, but not a sibling pair) of the siblings talked about their brother or sister. One child study sibling stated that he knew of a website due to observing his older sister, and a second

participant mentioned that his younger brother played games on the computer used during the interview. The remaining siblings either did not mention each other or only mentioned siblings in response to the researcher's question, "Who else uses this computer?" In contrast, during the longitudinal study, 47% of the individual siblings discussed their also-enrolled brother or sister. Three siblings, all younger, talked about their older siblings helping them with search. Three other siblings discussed engaging in computer activities such as watching television episodes, shopping, or learning new websites with their siblings also enrolled in the studies. Finally, two siblings, one younger and one a twin, talked about observing their siblings use the computer. Information regarding search does not appear to flow freely between youth living in the same household between the ages of 7 to 11. Around age 11, a transition occurs, and siblings begin to affect each other regarding search habits and knowledge.

Method of influence. Of interest when understanding the broader search behaviors displayed by longitudinal youth is the question of whether parents and teachers in fact relax their household or classroom rules on computer use as youth age. The data supports that this is the case; the oldest participant group reported their influencers making rules less during the longitudinal study than during the child study. For the middle age bracket of participants, while there was an increase over time in reporting influencers making rules, the increase was slight. For the youngest participants, there was an increase over time in reporting rules. These results show that parents and teachers begin to relax rules on computer use around age 12 to 13, and that by age 14 to 15, youth have much freer access to computers.

The Social Landscape

Social Searchers engage in some social activities at higher percentages than participants in other roles, but for other social activities, Social Searchers are outranked. Social Searchers are more likely to act on the influence of others, visit social media sites, and use computers with other people. They are highly likely to use text, voice, or video chat, by comparison to all other roles except Power. Interestingly, Social Searchers rank near the bottom of the roles when reporting their use of email. Possibly, Social Searchers use devices to engage in their social activities, and find emailing is unwieldy when carried out using devices. Also, it is possible that email is a form of communication that is reserved for formal situations, and youth have less need to communicate with others in this way, or that Social Searchers are more aware of and prefer to use trendier or shorter forms of communication. Non-motivated Searchers show relatively low percentages of social computer use behaviors; this is unfortunate as social computer use could pose a way to engage Non-motivated Searchers with the affordances of computers.

Child study participants were only social in two notable ways: acting on the influence of other people and using computers simultaneously with others. In contrast, longitudinal study participants displayed social search and computer use in numerous ways. While still likely to co-use computers and follow through on the recommendations from others, youth during the longitudinal study also discussed email, using social media or networking sites, and chatting, whether via text, voice, or video. The longitudinal increase in social computer behaviors coincides with the longitudinal increase in discussions of influencers, and the growth of friends as influencers in particular.

As discussed, social use was uncommon in child study participants. However, for four categories of social use discussed during the child study (by only a handful of participants), the same individual youth discussed the same type of social use again during the longitudinal study. When adopted at early ages, social computer use habits seem to be stable characteristics.

Distraction

Distraction during the current study become less pronounced as the participants aged. Fidel et al. (1999) similarly discuss distraction as less of an issue for older youth. Adolescents in Fidel et al. searching for a school assignment were extremely focused. They maintained their attention on the searching task at hand by using written assignment sheets and referring to them frequently. This is consistent with Foss et al.'s (2013) finding of extinction of the role of distracted in adolescents between the ages of 14-17.

Responses to Interview Questions

Specific interview questions posed during both studies illuminated areas of interest per participant historical recollection. The findings discussed below are not based on observational data, but provide valuable information regarding search processes and affect.

Triggers

The intention in asking participants to indicate their search triggers was to gain a more complete understanding of the information needs of youth. Knowing why youth initiate search sessions opens many interface design possibilities; designers can attempt

to meet typical information needs of youth up-front. The trigger of personal interest was largely consistent for participants as many youth reported it during both studies. School similarly was a frequent trigger and stable in individuals. Solomon (1993) found that children were largely motivated to begin searches within OPAC due to personal interests, followed closely by the need to complete homework assignments. These two factors seem to drive much of the searching in youth of all ages. Youth in the longitudinal study were more triggered by other people; the data regarding influencers and social computer use also show longitudinal increases in other people affecting youth searching. Additionally, the growth for specific methods of influence during the longitudinal study shows that not only are other people triggering search, they are also supporting search in youth.

Participants during both studies reported the same categories of triggers. For youth in this study, regardless of age or a changing technology landscape, the initiators to begin searches remain the same. School in particular is largely an age-specific trigger; in a study with adults, this trigger would be much less common. Observable in the data spanning just four years, it is possible to see the shifts in information needs as youth age: away from entertainment and daily life and towards school, personal topics, and curiosity driven by others.

Rule-bound and Non-motivated Searchers both display limiting characteristics. For Rule-bound Searchers, it is their tendency to adhere to a pattern of conducting searches that may be unhelpful, and for Non-motivated Searchers, it is general disinterest with computers. It is interesting then that these roles are both highly triggered to begin searches by information needs stemming from school and less likely to begin searches

due to personal interests. For Rule-bound Searchers, adhering to guidelines is possibly a habit developed in response to frequently searching for information to meet requirements imposed by school. For Non-motivated Searchers, the imposition of school assignments instead results in a polarized view of search and computers.

Search Stoppers

The interview script asked youth their reasons for stopping searches in order to gauge barriers to successful search. No one response stood apart as a main reason for stopping searches during the child study. Longitudinally, however, the youth were much more likely to discuss finding the information. This change represents gains in skill as well as perception of success over time.

Reporting successfully completing searches was more frequent for the longitudinal study participants than for the child study participants. Although other results indicate similar levels of frustration and that youth require assistance from others during both studies, these persistent problems do not appear to be encumbering youth in their attempts to access information after age 10 or 11 and in the current search landscape.

Explicit Frustrations

In responding to the interview questions regarding historical recollections of frustrations stemming from search, the child study participants were most likely to report spelling and typing as sources of frustration. This decreased greatly for the longitudinal youth, and at the same time, longitudinal youth reported their influencers being more likely to help in this area than during the child study. Child study participants were also

highly frustrated with software or browser errors; these errors were perceived by the youth, and may or may not have actually been the result of computer-based problems, but were described as such by the participants. As longitudinal participants, the youth discussed this type of frustration much less frequently, indicating that it was likely that youth were able to more accurately describe the sources of their frustrations.

Other researchers have found similar frustrations to those reported in the current research. Large et al. (2000) found that children were most frustrated by not being able to find a few very relevant websites or by receiving too many websites as results. Other participants in Large et al. (2000) reported no frustrations. Fidel et al. (1999) noted that speed was a source of a lot of frustration for their adolescent searchers.

Summary of Discussion

This chapter provided discussion surrounding the transitions in search roles, skill levels, and search behaviors presented in Chapter 5. The following chapter opens with actionable guidance to broad groups of stakeholders of youth search literacy: parents, educators, designers, and researchers. The limitations, contributions, and future areas for the research conclude the chapter.

Chapter 8: Implications

In this chapter:

- Adult stakeholders
  - Parents
  - Educators
  - Designers
  - Researchers
  - Actionable findings
- Limitations of the research
- Contributions of the research
- Future work
- Summary of implications

As adult stakeholders to youth search are in unique positions to affect youth search in the future, implications drawn from the findings and discussion provide areas for consideration or action. The limitations, contributions, and future work stemming from this research conclude the chapter.

Adult Stakeholders

Adult stakeholders to youth search include parents of children and adolescents, educators in the fields of information and technology, designers of search tools, and researchers investigating search. In the following sections, I propose methods for adults to employ to enable shifting all searchers into more skilled search roles. In particular, I focus on ways to encourage Power Searcher traits in youth of all roles. Included in the discussion of encouraging search skill are methods of supporting youth regardless of their displayed search roles. Each role has distinct strengths as well as deficits and adult stakeholders, while encouraging more skilled search behaviors, should also support youth in their current search roles.

Parents

Mothers are major influencers of searchers when they are young, between the ages of 7 to 11, and fathers begin to influence their children slightly later, around age 10 to 11. Mothers in particular are eclipsed by friends as influencers as youth grow older than 11, and fathers seem to have an even shorter window of influence, lasting from age 10 at the earliest until declining after age 13. Although parents are not perpetual influencers, youth are aware of the computer and search habits of their parents, and minor interventions have long-lasting effects. Parents are therefore in a position to impart search skills with no great effort by modeling useful search strategies.

Parents are also able to observe and describe what search processes cause frustration in their children. As contextual frustration is displayed by youth in less-skilled roles, such as Non-motivated, Distracted, and Developing Searchers, aiding youth to overcome their frustrations is important. Additionally, in youth age 11 and younger, search interruptions such as connectivity, outdated software, uninstalled plugins, or pop-up ads are a major source of frustration, and are all preventable with routine computer maintenance. Parents can prevent negative reactions to the computer in their younger children by performing periodic checks and upkeep of family computers.

Household search and computer use rules were not always in alignment with the rules in place in the classroom setting. In the case of Rule-bound Searchers, heavy exposure to school rules created unhelpful search rituals. Coordinating house rules with rules taught at school could provide consistent messages for youth learning searching skills and provide a balance between restrictions on computer use at school and the freer access in the home. Parents could communicate with their child's school to determine

what the information literacy educator is planning on sharing with their child regarding search, and reinforce the same search concepts, or teach their children compromises to school rules.

The findings from this research show that domain expertise ranks moderately well when contributing to role skill levels, as Domain-specific Searchers are fairly skilled and Power Searchers demonstrate a high level of source knowledge. Domain expertise is also likely to translate directly into search skill over time, as Domain-specific Searchers are likely to become Power Searchers. In the home environment, youth have the luxury of free time to pursue their own interests. For youth who are either unskilled or disinterested with the computer, such as Non-motivated Searchers, parents can leverage real-world hobbies and interests to draw youth into using the computer. Parents can introduce image search to youth interested in visual content, allow children who play instruments or sing to explore music videos on the website YouTube, or encourage children to use social media to communicate with their friends.

There is a social barrier for youth at or below age 11, and information regarding search is not passed among youth. Even within households, siblings do not appear to interact together using the computer until after age 11. The role of Social Searcher is a highly skilled role, and youth displaying social behaviors often also display the role of Power Searcher. To break down the social wall prohibiting the flow of search information on a peer-to-peer level, parents could support youth in the sharing of skills and strategies by encouraging in-person computer co-use among siblings and friends, can demonstrate how to use video, voice, and text chat systems, or could permit their children's use of email, depending on parent's comfort levels.

Ease of verbally discussing search is a trait displayed by Power Searchers. The unstructured and safe home environment is particularly suited for encouraging youth in all roles, and especially less-verbal Non-motivated Searchers, to talk about technology and searching. Parents can use search and computer-related vocabulary when talking with their children to develop familiarity and comfort with terminology.

Educators

Despite the fact that youth search at home far more than at school, school is a frequently reported search trigger by youth in all roles and across all ages. As completing assignments drives youth to search, adequate support regarding *how* to search should be provided by adults in the educational setting. Google provides useful search instruction on their Search Education webpage (www.google.com/insidesearch/searcheducation), and this resource could be implemented in a classroom. Google Search Education (N.D.) provides lesson plans, live training in video form, as well as hosts the A Google a Day (http://www.agoogleaday.com) search challenge. Video lessons would be especially engaging for Visual Searchers, and Power Searchers could expand their knowledge of features of the search engine through solving A Google a Day.

Complex search questions involve a lack of one-to-one correspondence between the search task and the search queries required to answer them; complex tasks require that youth have the skills to break complex tasks into component parts. To teach these skills, search can be taught as a step-by-step process that involves dynamic generation of a search plan based on initial query results, as opposed to a fixed query-entry-followed-by-result-selection process. In the classroom, information literacy educators can encourage

trial and error within the search interface rather than formulaic strategies to build adaptable skills in youth.

The participating youth in the longitudinal study demonstrated an increased awareness of video content. Much educational information is available on the Internet in video format, including online education sources such as Udacity, Coursera (http://www.coursera.org) or Khan Academy (http://www.khanacademy.org), how-to videos from sites such as Instructables (http://www.instructables.com) or the variety of videos available from YouTube. Awareness of visual information could be extremely advantageous to youth searchers who want to use the Internet as a tool for learning. Educators could promote awareness of sites such as these as well as incorporate visual tools into coursework to aid youth to learn in new ways that coincide with their preferences. Using video content would support Visual Searchers as well as increase domain knowledge for youth in all roles, which is desirable when helping youth to build search skill.

The change observed in this research of youth relying more heavily on online sources as age increased may point to a window of opportunity for education regarding specific online websites for information. As younger youth were more focused offline, redirecting their attention to online information at ages 7 to 11 may not be ideal timing for building a knowledge base of websites. However, youth between the ages of 11 to 15 showed that their awareness and use of offline content decreased while their knowledge of online sources for information simultaneously increased. Leveraging this change in youth after age 11 may be the ideal time promote education regarding online information sources, especially as youth in more highly skilled roles such as Power or Social are

aware of many sources for information, and know which websites to select based on their source knowledge when they encounter a results page.

Rule-bound searchers did not have rules that contributed to the development of increased skill over time. More adaptable strategies would be favorable over rigid rules; with rigidity, rules can become more of a hindrance than an aid to youth. While the domain name of a site may be important to note, youth should also be aware of other indicators of quality websites. Instead of rules regarding perfect query formulation, youth should be encouraged to enter many variations on the same query. When presented with many results, rules allowing youth to differentiate between sites and change the ordering of their selections based on the conditions of the search would alleviate some of the challenge of the search engine results page. In addition to teaching new and adaptable rules, teaching exceptions is equally important, as when rules are rigidly followed they can act as barriers to successful information seeking.

A small number of youth during the child study were new to Internet search, and as part of the interview script, when these novice youth were unable to navigate to a search engine, the researchers briefly introduced Google, demonstrating how to navigate to the site, how to type a query, and explaining the linked websites and images on the results page. Some of the youth who were introduced to Google during their child study interviews discussed learning to search from the researchers as longitudinal participants, recalling the brief tutorial occurring years prior. In the context of search education, this is an encouraging finding, as it demonstrates that even minor early interventions by adults can have long-lasting effects on youth. However, as exemplified by the persistence

through time and low skill level of the Rule-bound role, youth are as likely to recall detrimental interventions as helpful ones.

Youth during the longitudinal interviews demonstrated their habits of keeping their mobile devices close at hand, checking notifications from friends or news apps, and in some cases, receiving phone calls and texts during the short time span of the interviews. Mobile devices are owned at high rates (Lenhart et al., 2011), and were highly integrated with daily life as reported by youth and their parents in the longitudinal study. Using the already-familiar routine of interacting with a mobile device can provide a way to informally spread search knowledge, especially when attempting to connect with Social Searchers. Texts from educators or educational systems that contained search tips, hints or challenges, or the development of a mobile application devoted to search literacy could reach youth via their devices, easing the in-class burden of teaching search skill.

Designers

This longitudinal research provides numerous opportunities to designers of search tools. The information regarding search skill acquisition through social means, increased social computer use, reoccurring frustrations, strategies more skilled youth develop, and effects of the changing search landscape all pose actionable areas for development. The greater level of insight provided by the data of this thesis can allow designers to implement changes that can directly support search competency in youth.

Youth in all roles described learning to search from watching others. This represents an opportunity for designers to develop search tools that make the search patterns of others more apparent. For example, Moraveji, Morris, Morris, Czerwinski, &

Riche (2011) developed a classroom tool called ClassSearch for teaching and learning the successful search strategies of others. The system displays queries and websites visited on a large screen at the front of the classroom. The instructor then easily points out successful queries and sources to the class for discussion. Systems such as this would support social computer use for youth in all roles, and would be especially suited for supporting Social Searchers.

Capitalizing on the social behaviors of searchers aged 11 to 15 is another avenue designers to explore. Youth age 11 to 15 in this study were more often triggered to search for social reasons than younger youth, reported learning to search through observing others, searched while sharing devices with others, and engaged with social media. Integrating search with social networks would not only support the current behavior of youth, but also draw youth into search concurrently with seeking social connectivity. Research conducted in this area includes work exploring how to integrate Web 2.0 features such as the bookmarks or tags of others into one's search results (Amitay et al., 2009) and increasing relevance of documents based on social media status updates or whether people the searcher knows have interacted with the documents (Karweg, Huetter, & Böhm, 2011).

In this study, youth at or under the age of 11 were most frustrated with spelling and typing. Google's Voice Search (http://www.google.com/insidesearch/features/voicesearch), a feature allowing users to speak their queries, could potentially eliminate frustration for youth with typing and spelling difficulty. Voice search is readily available on mobile handheld devices,

although for families with older home computers, this feature is not always accessible due to the requirement of integrated or functional microphones.

At ages over 11, there is more frustration with irrelevancy of results and having to enter multiple queries for a single search task. Both of these frustrations are directly related to keyword choices. The related or similar searches feature of many search engines' results pages can reduce query entry to a click and alleviate query formulation difficulties. Youth are more aware of the related searches as they age, but simply repositioning the related terms feature within the search engine results page could encourage more awareness and use; ease of query refinement via less typing and suggestion of near-synonymous terms could possibly alleviate the most prevalent search frustrations for youth age 11 to 15.

The willingness of youth in both studies to act on influence from others and the anecdotal tendency, particularly for the longitudinal participants, to ask the researcher for help while searching indicates that youth are open to learning how to search more effectively from external sources, and this potentially extends to the interface itself. A similar idea is proposed by Collins-Thompson et al. (2011) as an alleviant for reading difficulty in children. In their research into a method for presenting reading-level appropriate results pages, the authors suggest allowing the interface to teach critical vocabulary for searched-for topics if the user does not enter the vocabulary as search terms (Collins-Thompson, Bennett, White, de la Chica, & Sontag, 2011).

Designers of search tools could help youth by attempting to duplicate or scaffold the successful skills demonstrated by Power Searchers. Power Searchers seem to be aware of sources before searching. Presenting websites with diverse content as highly

ranked results, as opposed to websites useful to only specific search scenarios, can help to establish known sources. Additionally, an interface designed to support building a knowledge base of sources might allow users to choose to see already viewed sites higher on the results page to establish site familiarity. Power Searchers had the ability to break apart complex search tasks into separate queries. Youth in other roles often struggled with this skill, entering complex tasks in natural language. A search engine tool suggesting a step-by-step search that is triggered by the appearance of a lengthy or natural language query could support the development of parsing skill. Wecker et al. (2010) have established work in this area by providing prompts to searchers within the context of an ongoing search.

Interface changes between 2008 and 2013 affected what the study youth did and did not know regarding the search engine features. Visual changes increased awareness of the AppBar, the relative stasis of the autocomplete was reflected in rates of awareness of the feature, and the altered position of the URL in the search results resulted in the increased importance of the URL when selecting results. There was also a ceiling for understanding features; youth did not continue to gain knowledge of the search engine features after reaching the ceiling. Designers of search tools should be aware that even minor interface changes can affect youth greatly, and that there is a limit on the number of features with which youth will ultimately engage.

Researchers

To clearly observe the social nature of computer use in youth, researchers should be aware that methods other than the in-context interview should be used. The interaction

during interviews prohibits social activity such as checking Facebook, responding to Skype messages, interacting via email, or watching YouTube videos through a friend's account. Other methods could be used to observe these behaviors; perhaps asking youth to log their computer use with a video diary would more readily show aspects of social behavior that cannot be captured during a one-on-one interview. Additionally, social information can be obtained via interviews with parents, siblings, and friends of the youth.

During the course of this research, although the characteristics of the search roles themselves were consistent over time, there were changes in the youth displaying the roles as they aged. Abilities such as typing skill, reading level, domain knowledge, and sophistication of personal interests all affected how the roles manifested in individual youth. These changes required the longitudinal addition of a more difficult search task to the in-context interview protocol in order to accurately measure search skill. Other researchers should familiarize themselves with the population of searchers they intend to study by conducting pilot studies to gauge base levels of searching and computer ability to develop the most ideal search tasks for their population.

Although this study produced a framework of roles for viewing youth search behaviors via qualitative analysis, it is possible that a structured quantitative analysis would also be useful. The qualitative approach of this research was intended to develop a large-scale understanding of youth search and to identify the relevant areas for further, in-depth research. Other researchers have used quantitative measures to explore more definitive areas of interest and understand user competence (e.g., Large Beheshti, & Rahman, 2002; Madden, Ford, Miller, & Levy, 2006; White & Morris, 2007). Applying

quantitative methods to further refine or explore the observed role differences and search behaviors in similar areas as previous research, such as for complex searching strategies, would strengthen the body of literature on youth search.

As discussed above, a few longitudinal participants reported influence from the study researcher's prior home visit. For those planning research with multiple interactions with the same group of participants, knowing that the participants are likely to not only remember any interventions but to also have allowed the interventions affect their typical behavior is valuable information.

Limitations of the Research

This research has a number of limitations. First, due to the qualitative nature of this research and non-random sampling method, it is not possible to generalize the role framework and search behavior findings to all youth, merely to the youth who participated in this research. For an exploratory study such as this one, the lack of generalizability is im0roved by a comparison to findings from other researchers as described in this chapter, and future work can test the theories developed from this research to apply to a broader population.

The population participating in this research was largely suburban families, and a criteria for participation was that the family had a computer with Internet connectivity in their home. It is well-established in the literature that urban or low-income families have far differing Internet connectivity and computer ownership rates than higher-income or suburban families (Araque et al., 2013). The search behaviors and roles described in this research may or may not be present for youth in urban or low-income homes; future

research with urban or low-income youth would establish search behaviors and roles in different populations.

Due to the difficulty in observing social behaviors directly during an interview setting, most data regarding the social use of the computer in the interview participants was collected anecdotally from participant testimony. This weakens the strength of the role of Social Searcher as an observable phenomenon.

There are noted risks to longitudinal research, namely that by re-enrolling the same participants, they become non-representative of the general population of youth with home access to the Internet (LeCompte & Preissle, 1993). However because of the length of time elapsing between the studies, and given that participants were visited only twice, it is unlikely that this is a problem for this study.

Due to the increase in mobile technologies in use by youth and by their families, it is difficult to accurately ascertain a complete picture of youth searching. The interviews took place on the home computer or device which the participant most often used, however, this was unlikely to be a mobile device, although the participants frequently used their mobile devices to search. There are likely to be differences in search habits due to the different interfaces and technologies between laptops and smaller devices, and these differing search habits are largely unrecorded.

For this work, I have been funded by Google, Inc. To reduce the conflict caused by the funding source, I was careful when interviewing not to verbally mention Google before the participant or prior to the participant using Google to search, in order to allow the youth to establish a preferred search engine. There were two search tasks where the participants were directed to use Google to allow for ease of comparison of search

behaviors, but these tasks occurred late in the interview, after the youth had the opportunity to establish their preferred method of search.

An additional concern during this longitudinal research was that I was closely involved with almost every interview as the primary researcher. While collecting data, I was aware of which factors would be of interest during analysis, and this made me more likely to focus on existing, established trends during interviews. As I was aware that my focus could be skewed to reinforce my assumptions, I attempted during each interview to allow the participant to lead the discussion in any direction, rather than verbally pulling them toward an answer with which I was familiar. Additionally, when there was a second researcher available to assist with the interviews, I asked the second researcher to conduct the interviews. As the secondary researchers were not aware of the analysis process, it was possible to obtain completely candid interview exchanges between participants and researchers.

Nearly all of the examined search behaviors showed increases during the longitudinal study. Several factors likely contributed to the consistently higher longitudinal percentage rates. First, the older longitudinal youth were overall more verbal than they were as child study participants. This lead to more available data. Second, as the primary researcher conducting nearly identical interviews over a period of years with youth ranging from 7 to 17 and their parents, I undoubtedly became more skilled at eliciting responses from participants. Third, after the exploratory nature of the child study, I became more attuned to the trends of pertinence to this research, and asked participants follow-up questions based on these trends. Finally, as the coding scheme was

developed inductively based on data collected from youth ages at 7 to 11, it was a predictable outcome that the same youth would outperform themselves at older ages.

Contributions of the Research

There are four main contributions this research makes to knowledge of how youth search on the Internet. Firstly, this research establishes a framework of roles that youth display over time. By comparing roles over a time span of three to four years, this research provides prevalence data, demonstrates relationships between roles, and shows how youth are likely to change in role occupancy. Increased knowledge regarding roles is important when thinking of ways to support diverse groups of youth.

This research secondly describes in-depth how search behaviors change over time. Establishing the changes in search behaviors leads to highly specific areas for intervening to encourage development of search skill and to areas of future research.

Thirdly, the case studies of selected youth provide in-depth insight into the factors contributing to change or stasis in roles and search behaviors in individual youth. Through the use of cases, I provided a more complete picture of the interplay of the roles and search behaviors for individuals, as well as factored in parental perspectives and my own observations.

And finally, as a product of the analysis process, I distilled the most prominent indicators for each search role and included these indicators in a summary graphic for understanding search roles.

Future Work

Search roles are clearly situational and contextual, as they depend on factors such as task complexity, the physical environment of the search, the emotional state of the searcher, and the prior experience of the searcher. In the context of this longitudinal study, I was able to establish a framework of search roles, but whether this is the same framework that would emerge when interviewing only experienced searchers, conducting research in the laboratory, or using only difficult search tasks rather than a mix of imposed and open-ended tasks is not established. Unravelling how these and other factors contribute to displaying search roles is of interest in future research.

Summary of Implications

In this chapter, I provided role profiles, definitions, and a graphic grouping the eight search roles. I also applied the findings from Chapter 5 to specific groups of adult stakeholders to youth search. The noted limitations and contributions of the research are by no means an exhaustive list, but represent the most applicable areas of improvement and impact of this research, and the discussed future areas for research will contribute further to understanding the process of Internet search in youth.

Appendices

Appendix A: Longitudinal parent protocol
Appendix B: Longitudinal youth protocol
Appendix C: Longitudinal study emergent coding structure Appendix
D: Child study *a priori* coding structure (Foss et al., 2012)

The appendices contained in this section include the parent and youth interview protocols used during the longitudinal research and the two code structures created during different data analysis phases.

Appendix A: Longitudinal Parent Protocol

PARENT INTERVIEW SCRIPT

{Greeting} We are [names] from the University of Maryland here to interview you and your child for our research study on how youth search the web over time. Your child is one of about 60 participants in this study and we appreciate your input. Before we begin, can you please sign here indicating your permission to allow us to record both interviews (audio and video)?

OK, I'm just going to ask you some questions about your home computers and your child. If I ask you something that doesn't quite make sense, please feel free to ask me questions back.

1. How do you think your child has changed as a searcher since the last time we visited you?
2. How many working computers do you have connected to the Internet?
3. [if more than one] Which computer does [name] use the most?
4. Does your child share the computer with anyone or does he/she have his/her own?
5. Does your child have a cell phone? Is it a smartphone?
6. How long has [name] been using computers?
7. Where do you think he or she learns about computers and searching?
8. Does he/she search with anyone else?
9. How many days a week does he/she use the computer at home?
10. How many times per day does he/she use the computer at home?
    a. How long each time?

11. Does your child [name] **search** for information on the computer? If so, how often?
12. What does your child usually search for? Is that for home or for school?
    Is there anything else they search for? (repeat)
13. Does anything frustrate your child [name] when it comes to searching on the computer?
14. **[If YES to 11]** How can you tell when your child is frustrated with the computer?
15. In general, do you ever offer help or support when your child is searching?
    a. If so, what type of assistance do you give?
16. Do you put any constraints on your child's use of the computer?
17. If you could create a new tool for your child for searching on the computer, what would it be? How would it work?
18. Up until now, I've asked you about your child. Now, may I please ask you a couple of questions about you (optional – and your spouse/partner)?
    a. Do you work inside or outside the home?
    b. What do you do? (optional – what does your spouse/partner do)?
    c. How comfortable are you with using the computer? Would you say you are beginning to learn, comfortable, or an expert?

       □ beginning to learn □ comfortable □ expert
    d. How comfortable is your spouse/partner with using the computer? Would you say they are beginning to learn, comfortable, or an expert?

       □ beginning to learn □ comfortable □ expert

Thank you for all of this information. Now we'll move on to working with your child [name]. You're more than welcome to join the fun. If you do, please don't interact with him/her, so that she/he is primarily interacting with the researcher.

Appendix B: Longitudinal Youth Protocol

University of Maryland Research

REMINDER: DON'T INITIATE THE WORD GOOGLE BEFORE QUESTION 19.

Interview Number:

YOUTH INTERVIEW SCRIPT

Thanks for taking the time to talk to us today! We're really excited that you are helping us out. We want to know more about how you look for information using the computer. This isn't a test – there are no right or wrong answers, and the information you share with us will be used to help us understand how youth search and who helps them learn to search. If you want to stop at any time while we're talking, just let me know.

BASICS

1. You were X when we interviewed you last time. How old are you now?
2. What grade are you in?
3. How many years have you been using the computer?
4. Who else uses this computer?

5a. How many days a week are you on the computer at home?

5b. How many times per day are you on the computer at home?

5c. How long each time?

6a. How many days a week are you on the computer at school?

6b. How many times per day are you on the computer at school?

6c. How long each time?

7. If I ask you about your computer use, would you say you are a “beginner”, “intermediate” or “advanced” using the computer?

   ☐ beginning ☐intermediate ☐advanced

8. What things do you know how to do on the computer? What things could you improve on or learn how to do?
9. Would you say you were “beginning”, “intermediate” or “advanced” using the computer last time we interviewed you (when you were X years old)?

   ☐ beginner ☐intermediate ☐advanced

10. What is your favorite thing to do on the computer?
    a. Will you tell me about it?

Up till now, we’ve talked about general computer stuff. From here on, we’re only thinking about searching for information, ok?

11. What makes you look for information?
12. Can you show me and explain how you usually look for information on the computer?
13. Let’s pretend I‘ve never searched for something before. Can you show me how it works?
14. When do you *stop* searching and why?
15. How did you learn how to search on the computer?
16. If you needed help when searching, who would you want to help you?
    a. What do they help you with?
    b. Do you search with anyone? When?

17. Can you search for information on squirrels and explain to me what you did?

Attempt: ☐Yes ☐No

Query

1:_____

Location: ☐Google Toolbar Textbox ☐Other Toolbar Textbox

☐ Google Webpage Textbox ☐Address Bar

☐ Other Webpage Textbox ☐Other:

Autocomplete: ☐Yes ☐No

Squirrels

Successful? **Y N**

Typing Approach: ☐Hunt and Peck ☐Varied ☐Full QWERTY

Method of entry: ☐Mouse ☐Enter Key

Result #

Clicked:

Result Page #:

a. Why did/didn't you click X?

b. Did you find what you were looking for?

Cool. Now that you have searched for squirrels….

18. Can you look for information on what squirrels eat and explain to me what you did?

Attempt: ☐Yes ☐No

Query

1:_____

Location: ☐Google Toolbar Textbox ☐Other Toolbar Textbox

☐ Google Webpage Textbox ☐Address Bar

☐ Other Webpage Textbox ☐Other:

Autocomplete: ☐Yes ☐No

Squirrels EAT

Successful? Y N

Typing Approach: ☐Hunt and Peck ☐Varied ☐Full QWERTY

Method of entry: ☐Mouse ☐Enter Key

Result # Clicked:

Result Page #:

a. Why did/didn't you click X?

b. Did you find what you were looking for?

19. If you were searching on Google for your own interest for something you've never searched for before, what would you search for?

Attempt: ☐Yes ☐No

Query

1:_____

Location: ☐Google Toolbar Textbox ☐Other Toolbar Textbox

☐ Google Webpage Textbox ☐Address Bar

☐ Other Webpage Textbox ☐Other:

Autocomplete: ☐Yes ☐No

OWN INTEREST

Successful? Y N

Typing Approach: ☐Hunt and Peck ☐Varied ☐Full QWERTY

Method of entry: ☐Mouse ☐Enter Key

Result # Clicked:

Result Page #:

a. Why did/didn't you click X?

b. Did you find what you were looking for?

20. Let's do another search using Google. Which day of the week will the current Vice-President's birthday be on next year?

Attempt: ☐Yes ☐No

Actions:

Query

1:_____

Location: ☐Google Toolbar Textbox ☐Other Toolbar Textbox

☐ Google Webpage Textbox ☐Address Bar

☐ Other Webpage Textbox ☐Other:

Autocomplete: ☐Yes ☐No

VICE PRESIDENT

Successful? Y N

Typing Approach: ☐Hunt and Peck ☐Varied ☐Full QWERTY

Method of entry: ☐Mouse ☐Enter Key

Result # Clicked:

Result Page #:

a. Why did/didn't you click X?

a. Did you find what you were looking for?

21. This question is a little different. Do you think Michael Jackson's music was more popular in 1983 or in 2009, and why?

Attempt: ☐Yes ☐No

Actions:

Query

1:_____

Location: ☐Google Toolbar Textbox ☐Other Toolbar Textbox

☐ Google Webpage Textbox ☐Address Bar

☐ Other Webpage Textbox ☐Other:

Autocomplete: ☐Yes ☐No

Michael Jackson

Successful? Y N

Typing Approach: ☐Hunt and Peck ☐Varied ☐Full QWERTY

Method of entry: ☐Mouse ☐Enter Key

Result # Clicked:

Result Page #:

a. Why did/didn't you click X?

b. Did you find what you were looking for?

<u>Can you go back to a results page so we can talk about it? This is a Google results page.</u>

22. What do you think is good about the results page?
23. What do you think is bad about the results page?
24. Is there anything frustrating or annoying or hard about finding information on the computer?
25. What sites do you use to search?
26. If you could create a magic tool to help you find information better on the computer, what would it do? How would it work?
27. Do you have any questions for me?

"Thanks so much for showing me how you search. We really appreciate your help in teaching us more about this. Hopefully with what you and other kids tell us, we can make the computer better for kids to use."

28. Important summary observations **[Fill this out immediately following the observation. Don't wait until the next day!]**

Appendix C: Longitudinal Study Emergent Coding Structure

Created 5/28/13

*Parenthetical category names are those used when presenting the findings, while bolded category names are those used during analysis.

Books or Physical Media (Use of offline information) **-** Indication of off-line media use. Discussion of reading, references from books, using pen and paper to answer interview search tasks

Can't Pronounce (Encountering unfamiliar terms) - Child encounters words they have difficulty pronouncing while reading on websites.

Creation- Discussion of using the computer to facilitate the creation of new things. Knowledge of features of the computer allows the child to make things.

- **Gaming-** Using the computer to make or modify computer games, gaming driving creation
- **Media-** Music, Video, Photo- Making or editing videos and photos, creating CDs.
- **Office Software-** Using Word, PowerPoint, Excel, etc. as aids in creation. NOT just stating use or knowledge of Word for example, but statement of using it to make something
- **On-Computer Creation-** Making new things that exist within the computer
- **Programming-** Creating new items via computer coding/programming. NOT just statement of knowledge of programming language

Devices- Use of device during interview OR household ownership of device. Coded once per kid per device.

- **E-reader**
- **Gaming System**
- **iPod Touch**
- **Leap Frog**
- **Palm Pilot**
- **Portable Keyboard**
- **Smart boards, Touch Screen Monitors**
- **Smartphones**
- **Tablet**
    - **iPad**

Expectations of Answer Prior to Search- Child indicates that when searching they have expectations of what the answer should be

Expressing Frustration (In-context frustration) **-** Verbal exchanges with researcher where the child seems to be frustrated with search tasks OR with interview context

Good Quotes- Interesting, insightful, funny

Helping (Aiding others) **-** Instances where child verbally indicated they help others with search or computer use.

Last Question- Child asks a question in response to the interview question, "Do you have any questions for me?"

Own Topics- Searches entered during the interview by the participants that are not directed by the researcher. At any time or in response to interview questions.

Reliability- Verbal statements of sites that are reliable to use

Social Use- Ways participants report using technology with other people

- **Acting on Influence-** Acting on recommendations from others, not enough context to know if it is co-use or not. Not doing an assignment or following a rule, but engaging in activities the kid wants to do based on other people's influence.
- **Co-use of Same Machine-** Two or more people sharing the same device
- **Email-** Verbal mentions of using email
- **Games-** Involving others in gaming
- **Screen Sharing or Remote Desktop-**
- **Shared Account-** Sharing an account with someone else
- **Social Media-** Facebook, tumblr, etc.
- **Telephone as Intermediary-** kids calling one another and talking and using the computer at the same time, calling each other about the computer
- **Text/Voice/Video Chat-** Using chat to communicate
- **Using Two Machines in Same Space**

Technology Problems during Interview- Child experienced software or hardware problems during the course of the interview. Per instance.

Verification- Double-checking the source of the information, looking at two websites to ensure good information

Appendix D: Child Study *A Priori* Coding Structure

*Parenthetical category names are those used when presenting the findings, while bolded category names are those used during analysis.

Awareness of Ads: If the child explained the presence of advertisements

Age: Taken from parent's response to age prompt on the consent forms

- **Seven**
- **Nine**
- **Eleven**

Asks for Help: When the child asked the researcher directly for help, not when the child indicated they needed help. Per instance.

- **Navigation**
- **Spelling**
- **Typing**
- **Query Formulation**

Declines VP

Distracted: The child does not respond to researcher questions, then requires multiple prompts to return to the interview. Multiple instances per child coded.

- **Ad**
- **Bathroom**
- **Game**
- **Physical Environment**

- **Video**
- **Webpage**

Doesn't Know VP: One of three paths in response to the fourth query, the other two being **Knew VP** and **Declines VP**. These children do not use the name of the Vice-President when entering their query into Google.

- **Finds Birthday**: locates the birthday of the Vice-president.
- **Finds Calendar**: Locates a calendar
- **Finds VP**: Locates the name of the Vice-president
- **Ineffective Search**: Attempts search but enters queries that are unable to produce useful results, such as searching for the keyword "birthday".
- **Reads Results or Web pages**: Indicated by the child progressing through the query, spending time looking at the screen
- **Reiterates**: The child modifies the original search query by adding or removing keywords, begins an entirely new search
- **Uses Alternate Strategies**: Using programs on the computer other than Google to locate information, or using reference material in the physical environment to locate information

Fixes Problems on Own (Recognizes and corrects problems**)**: Using a variety of strategies to avoid typical breakdown points. Child recognizes that they have made an error, or will encounter a problem, and avoids it without help. They do not have to be successful in their search, just be able to know where problems are likely to arise.

Strategies include reading autocomplete menu or clicking did you mean to avoid spelling problems, knowing web pages to read to find information.

Gender

- **Male**
- **Female**

Grade: Per child in response to the question "What grade are you in?"

- **First**
- **Second**
- **Third**
- **Fourth**
- **Fifth**
- **Sixth**
- **Seventh**

How Influencer (Method of influence)**:** Using the influencer quotes from kids, reorganizing the quotes into categories based on how the person mentioned influenced the kids. Any mention of another person. Not mutually exclusive; one quote can be in more than one category.

- **Answer Questions**: Influencer is relied on as a source of information
- **Encourage to Use**: Influencer encourages child to use computer or tells child directly to use computer

- **Fix Technology Problems**: Influencer overcomes difficulties surrounding the technology the child uses
- **Helping to Make Easier**: Influencer generally helps, either before the child is searching or while the child is searching- not technology help, not spelling/typing/keyword help
- **Keywords/Typing/Spelling**: Influencer helps child spell, type, or formulate keywords
- **Learn from Watching**: Influencer uses the computer in such a way that his or her habits are apparent to the child
- **Making Rules**: Influencer places guidelines around the child's use of the computer
- **Search Together**: Influencer searches with the child, use of the computer together
- **Showing New Websites**: Influencer passes websites of interest along to the child, influencer piques interest in child

I Don't Know (Uncertainty)**:** Child states "I don't know" or "I'm not sure" "I have no idea" or "I can't…" in response to a researcher question, not conversationally. ("I don't know why dolphins eat squid, that sounds gross" would not count, but "I don't know how to search for dolphins" would. 3/19/11

Immediate response to VP Question: what the child did after the researcher asked, "Which day of the week will the vice president's birthday be on next year?"

- **Clarify or Qualify VP Question**
- **Decline**

- **Guess**
- **I Don't Know**
- **Type a Search**

Influencer: Verbal mention from child of other people having effects on the child's use of computers or searching. Not in response to researcher question "who else uses this computer?", as that is coded elsewhere. Mutually Exclusive (1 category per instance from kid), but multiple instances per kid can be coded.

- **Extended Family**
- **Friend**
- **Parents-** Dad or Mom coded into parents, and also coded into own categories. "I ask my mom" is both parents and mom.
    - **Dad**
    - **Mom**
- **School/Teachers/Speech Therapists**
- **Sibling**
- **Virus Protection**

Knew VP: One of three paths after researchers asks the fourth query, the other two being **Doesn't know VP** and **Declines VP.** These children included the name of the vice president in their initial search query looking of the day of the week of his birthday.

- **Found his Birthday**: locates the birthday of the Vice-president.
- **Found the Day of The Week**: Completes search task

- **Reiterates**: The child modifies the original search query by adding or removing keywords, begins an entirely new search
- **Searched for a Calendar**: Used Google to find a calendar
- **Searched for his Birthday**: Query was specifically for the birthday
- **Searched for the VP**: query was specifically for the Vice-president
- **Used Did You Mean or Autocomplete**: Verbalization not necessary

Knowledge of Features: Verbal explanation of the features of Google given at any point during the interview, or use with verbal explanation; **not** simply use of given feature. Needing prompting to explain use of feature is fine. Is NOT mention of feature without using it and/or verbally explaining it: kid reading off top-left filter does not constitute knowledge of those features, only indicates that the kid can read. One instance per feature per kid- multiple uses only counted once

- **Advanced Search**
- **Already Visited Link**
- **Autocomplete**
- **Did You Mean**
- **I'm Feeling Lucky**
- **Languages**
- **Maps**
- **Next Page**
- **Number of Results**
- **Quotation Marks**

- **Related Searches**
- **Shopping**
- **Top-left Filter**

Knows Sources: Child demonstrates prior knowledge of sources of information verbally. Know about site/s, have visited them before, and can determine which sites are appropriate for the task at hand.

Multiple Strategies: not relying on the Internet for every stage of search.

- **Book**: child refers to a physical book that they would use to find their answer
- **Calendar off-line or iCa**l: child use a calendar not found through searching
- **Fact-Check**: Child verifies information found on the Internet
- **Program**: Child uses a program on their computer to supplement their searching

Other Search Engines: Other search engines mentioned by the child at any point during the interview AND any search tools or web pages mentioned by the child specifically in response to "Do you use and other search engines". Count one mention per kid per search tool (If kid says Yahoo! repeatedly, only one count).

- **AOL**
- **Ask.com**
- **Blackle**
- **Browser**
- **Comcast Power Search**
- **Dogpile.com**
- **MSN Encarta**

- **School Database**
- **Website Not Primarily Used for Search**
- **Wikipedia.org**
- **Yahoo!**
- **YouTube**

Part of Results Used (Components of results): Results page presents bolded search terms, blue page title, black summaries, and green URLs. Coded if child indicated which part of the results page they used when selecting a result. Per instance.

- **Bold/Keyword**
- **Blue/Title**
- **Black/Summary**
- **Green/URL**

Refer to Images: Child mentioned the inclusion of images or videos in Google results at any point during the interview. Per instance.

Role: Defined and coded during previous analysis.

- **Developing**
- **Distracted**
- **Domain-Specific**
- **Rule**
- **Visual**
- **Power**

- **Non-Motivated**

Rules (Self-imposed rules): Statements made by child during the interview explaining usual behavior, or guidelines helping them to search that they are able to verbalize. Do not have to be adhered to by the individual child- this category is attempting to gather all the rules kids have together and analyze them as a whole.

- **Choose the First Result:** Child states they pick the first result from the results page
- **Don't use Wikipedia:** Child states that Wikipedia should not be used or is an unreliable site
- **Go through Results in Order:** Child states that they start at the beginning of the results and read the returned page in the order Google presents
- **No Inappropriate Sites:** Child states that they use kids sites or have rules about where they go to avoid inappropriate material
- **Results Get Worse:** Child states that the results at the beginning are better than in pages further back
- **Search Databases First:** Child has rules on the order in which resources can be used
- **Spelling:** Child states that they have better results with correct spelling
- **URL and Site Info:** Child has rules about the suffix of the URL or about the metadata on the site
- **Use Specific Keywords:** Child believes certain keyword usage is better
- **Use Wikipedia:** Child states Wikipedia is a reliable/useful site

Search Frustrations (Explicit frustrations): responses to the questions, "Is there anything frustrating/annoying/hard about finding information on the computer?"

- **External Frustrations**: Frustrations stemming from the computer; hardware or interface. Children seem to blame the computer, not themselves.
    - **Ads**
    - **Reliable Information:** Child is frustrated that information does not seem truthful
        - *Not enough Information: category preserved for paper writing, but coding is aggregated numerically into Reliable Information. Child is frustrated that information is not complete.*
    - **Results:** Frustrations with selecting results.
        - *Too Many Results: category preserved for paper writing, but coding is aggregated numerically into Results. Child is frustrated with amount of results.*
        - *Unrelated Results: category preserved for paper writing, but coding is aggregated numerically into Results. Child is frustrated that results unrelated to the search are presented in the results list.*
    - **Speed:** Child is frustrated with the length of time the system takes to present results or is frustrated with the amount of time it takes to complete a search.

- **Internal Frustration**: Statements of can't, blame for not finding information seems to be with the child.
    - **Developmental Level**: Child reports frustration due to reading, typing, or spelling difficulties.
    - **Query Formulation**: Child reports frustration surrounding selecting keywords or formulating queries.
- **No Frustrations**: Child reports no frustrations.

Search Stoppers: Responses to the question "What make you stop searching?" Not stoppers of interview search tasks, but verbal responses to the one interview question.

- **Bored**: Child states that they become bored
- **Found Information:** Child states that they found what they were looking for
- **Gathered Enough**: Child states that they have enough information/mention of quantity of info
- **Activity Off Computer:** Child states that they move on to another activity
- **Parent Directs Get Off**: Child states that their parent tell them to get off the computer
- **Unexpected or Wrong:** Child states that they can't find/something is wrong with connection/etc.

Selection Criteria (Result selection criteria): Child explains what makes them pick certain results over others, generally in response to "What made you pick that one?", but child can volunteer the info.

- **Influencer**: Selects sites based on information from external source, such as a person or helping program like virus protection.
- **Kid Friendly**: Picks sites on the basis that they are for kids or have simple language
- **Reliable Website**: Uses criteria such as when the page was updated and prior knowledge of what the page should say
- **Rule**: Follows a predetermined rule to select web pages
- **Site Recognition**: Picks sites they are aware of
- **Summary**: Pick sites based on the summary in the results page

Self-Assess: Child's response to researcher asking how good they are at using the computer.

- **Still Learning**
- **Ok**
- **Really Good**

Share Computer With: Who the child reports also uses the computer used in the interview.

- **Extended Family**
- **Friend**
- **Parent-** Code all parent mentions here as well as in "mom" or "dad" as subcategories
    - **Dad**

    - **Mom**
- **Sibling-** code all sibling mentions here, and also in older or younger if known- some older and younger is anecdotal from researcher knowledge, not from interview transcripts
    - **Older Sibling**
    - **Younger Sibling**

Triggers: Child's verbal response to "What makes you look for information?"

- **Browser**: Child states their Internet browser makes them search
- **Personal Interest:** Child states they want information, find something interesting, are prompted by daily activities to know more, find searching fun, etc.
    - **Fact Check**: Using searching as a way to validate information
- **School**: Assignments, projects, homework
- **Activity**: Shopping, events, holidays, extracurricular activities
- **Search Engine**: Child states that their search engine makes them look for information
- **Game**: Searching is driven by a desire to play games
- **Friend**: Child searches on the recommendation of a friend/peer

Vocabulary: Child has at least one instance of saying term. Researcher does not say term first. Multiple instances of same term ignored. Source coding, not references.

- **Backspace**
- **Bookmark**

- **Browser**
- **Cache**
- **Click**
- **Copy and/or Paste**
- **Cursor**
- **Delete**
- **Double Click**
- **Download**
- **Favorite**
- **Homepage**
- **Keyword**
- **Link**
- **Log on/off**
- **Screen**
- **Scroll**
- **Search Button**
- **Search Engine**
- **Spacebar**
- **Tab**
- **Type**
- **URL and or Address bar**
- **Username**

Good Quotes: Insightful, funny

Own Computer: Whether the child has his or her own computer that is not shared.

Immediate response to VP: the child's initial reaction. Subsequent actions irrelevant. Mutually exclusive.

- **Clarify or Qualify the VP**: if kid asks researcher to repeat the question or clarify the VP question
- **I Don't Know**: In response to the VP question
- **Decline**: child does not search (quit interview early, too hard, etc.)
- **Guess:** child gives a date, guesses at the answer before searching
- **Type a search**: child begins searching.

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