Internet Search Roles of Adults in their Homes

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ABSTRACT

Internet search is one of the major activities that American adults engage in online. Building on studies of youth Internet search roles, this paper investigates adults' online information seeking processes within the home. Through in-home interviews and observations of search task performance with 40 adult participants, we identify and describe characteristics of 9 search roles. By comparing these roles with those of youths, we explain how previously identified roles, such as *Power Searcher* and *Social Searcher,* have evolved in adult populations, and how new roles, such as *Efficient Searcher* and *Interest-driven Searcher*, have emerged. We also review the challenges and benefits associated with search roles and their potential impacts on search performance. The findings of this study provide a better understanding of how contextual factors influence search roles in relation to ELIS, what can be learned from search roles, and opportunities to support different search roles.

Author Keywords

Home Internet search; search roles; everyday life information seeking; search strategies; adult searchers
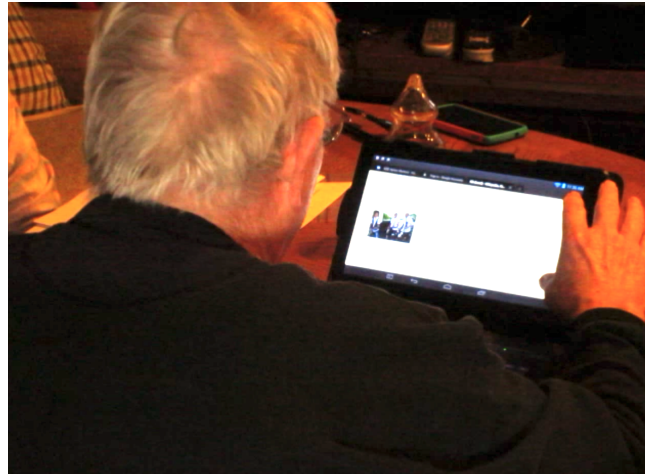
ACM Classification Keywords

H.3.3. Information Search and Retrieval; H.3.5. Online Information Services

INTRODUCTION

With the prevalence of information and communication technologies, the Web has become the primary source of information in the United States and other technology-driven societies [32]. Researchers investigating web search behaviors have identified several situational (e.g., search modes) and personal factors (e.g., search skills, age) as important elements that contribute to behavioral variabilities among Internet searchers [7,23,24]. Yet these studies mainly focus on web search behaviors in work-related settings. As Internet search has become deeply embedded in the lives of so many people, the questions of

Figure 1. Interviews and observations were conducted where participants would normally perform in-home search tasks. Here, a participant is conducting search tasks using his tablet.

how and *why* people search have become critical for both researchers and designers working to support people's online search practices [17,22,32].

Investigations into Everyday Life Information Seeking (ELIS) allow us to examine the complex relationship between adults' search-related skills, diverse social positions, information needs, and behaviors in non-work-related settings [6,20,36]. These investigations also enable to address challenges unique to this context. Research highlights challenges for adults in properly locating and utilizing online information resources [19]. Additionally, as new technologies and their search interfaces are introduced into adults' daily spaces (e.g., the home), they must adopt new strategies to use these systems for everyday life information seeking. Adult searchers also need to address diverse, information-related problems associated with their multiple social positions (e.g., professional and caregiver) [17]. These social positions can lead to more complex *collaborative search* and *on-behalf-of* search behaviors, which reflect social dynamics surrounding adults' daily lives [4,28]. Together, these unique challenges within ELIS activities make today's adult Internet searchers a population with diverse search needs and behaviors.

In the paper that follows, we describe a research study which identified adults' Internet search roles in the home. Internet search roles are defined as a set of behaviors describing attitude, search skill, and patterns in relation to Internet search [12]. The investigation of home Internet use

can provide a realistic understanding of how today's adults engage in online information seeking activities for everyday matters within their daily context. Even with the prevalence of mobile technologies and their access to information anytime, anywhere, home Internet use remains important for people's information seeking across a range of everyday life contexts such as job opportunities, government services, and health information [9,22,29,41].

This study builds upon our knowledge of youth Internet search roles and extends this understanding to adults [8,13,14,15,16]. To capture adults' natural interactions with Internet-equipped devices (e.g., laptop, tablet, mobile phone), we conducted in-home, semi-structured interviews and task-based observations of their online search behaviors with 40 adult participants. Results show how previously identified youth Internet search roles such as *Power Searcher* and *Social Searcher* evolved in adult populations, and how new roles such as *Efficient Searcher* and *Interest-driven Searcher* emerged. We review the challenges, benefits, and potential impacts on search performance associated with these search roles. This study contributes to our understanding of how in-home contexts influence search roles in relation to ELIS, what can be learned from search roles, and opportunities to support adult searchers with different search characteristics and needs. This work will benefit practitioners and researchers in supporting adults in taking full advantage of search engines and designing future search systems, as well as understanding search behaviors for everyday matters using the Web.

RELATED WORK
There has long been interest from numerous disciplines about how people seek for information online for everyday matters. In this section, we first review existing knowledge of ELIS studies investigating information seeking for non-work-related purposes and then review online information seeking strategies, including a description of the search roles in youth which this work builds upon.

Home as a Context for ELIS
The notion of ELIS has been widely used in studies exploring information seeking behaviors across a range of everyday life contexts [36,39]. ELIS is a process of acquiring various informational elements through which people orient themselves or solve problems in accordance with their values, attitudes, and interests [36,39]. In ELIS studies, place is an essential element of how contexts afford social and spatial meaning, and shape information seekers' behaviors [11,35]. Thus, ELIS researchers use field research methods to investigate naturalistic information behaviors at places such as homes, public libraries, and community clinics [26,30]. Notably, Rieh [34] investigated online information seeking at home and argued that people engage in web search activities at home than at workplaces for more diverse goals. She emphasized the home as a context that interplays with diverse social, cultural, situational, and individual factors outside the home, and

that within this context one's information seeking is both motivated and disrupted [34]. Interestingly, despite the diversity of participants' goals, search engines were described as a last resort that was turned to when no specific web sites came to mind [34].

Expanding on these ideas, other research has posited that the home is the most essential place where people engage in online activities for diverse goals from entertainment, work-related tasks, getting health information, and planning for the future [22,41]. In addition, modern technologies have expanded the home's role as a hub where a person can engage in diverse personal and social activities through networked platforms [44]. These studies suggest the need to investigate adults' Internet search at home in order to better understand how various social, affective, situational context of search can shape ELIS of today's adults at home and effect their search roles. Our study investigates adults' natural interactions with search engines in the home environment to understand and identify search roles during everyday information seeking.

Identification of Online Information Seeking Strategies
As Internet search has become a part of our culture, researchers have sought to understand how people search for information online [23]. Whereas earlier studies focused on describing common behavioral modes of web search (e.g., [7,24]), a renewed interest in individual search differences and personalized search experiences has led to studies exploring behavioral variability among users [46]. Researchers have identified factors affecting search patterns such as cognitive style, tasks, personality, and user intent [16,21,26,27,38,46]. In exploring relationships between individual differences in search, Ford et al. [16] focused on unraveling the elements of successful search outcomes. They argued that cognitive styles contribute to characteristics regarding how the user interacts with information sources and assess search outcomes. *Imager cognitive style*, for example, was associated with preference of visually-oriented information sources, purposeful internet use, and poor retrieval effectiveness [16]. In our work, we similarly explore individual differences in search behaviors while using Internet Search Role framework to better investigate how various attitudinal, behavioral, cognitive factors are related to adults' search behaviors, strategies, and performances.

Search Roles of Youth
Researchers have investigated people's search patterns as Internet and computer use gained popularity for daily information seeking (e.g., [5,10,12,13,14,18]). Foss and colleagues introduced a concept of *search roles* to explain Internet search behaviors of youth [12,13,14,15]. Foss et al. conducted interviews in the home environment to capture youth's natural processes of online information seeking, focusing on what characteristics in search processes determined different search roles and how to support young people of different search roles. By identifying search roles

of children (ages 7, 9, and 11) and later determining their search roles as adolescents (between ages 14 and 17), Foss et al. were also able to understand how the roles change over time [15]. The Internet search roles of youth include:

- *Power Searcher*: Searchers who are aware of sources, can use advanced search features of the search engines, or can explain their search strategies when asked.
- *Developing Searcher*: Searchers who display unplanned search paths and varied approaches to solve a single task, have a limited knowledge of search tools, or are unable to verbalize their search processes.
- *Social Searcher*: Searchers whose computer use is driven by social factors, whether searching or not.
- *Domain-specific Searcher*: Searchers who display expertise within content or site domains similar to *Power Searchers,* but whose expertise does not always translate to searches outside these domains.
- *Rule-bound Searcher*: Searchers who display constrained search patterns, repeating the same steps for every search.
- *Visual Searcher*: Searchers who prefer visual media (e.g., images, video) in their search results.
- *Non-motivated Searcher*: Searchers who display a reluctance to conduct a search and a short search path.
- *Distracted Searcher*: Searchers who easily lose track of the given search task and instead perform unrelated tasks.

This categorization of search roles reflected age-related social and cognitive characteristics. For instance, the *Distracted Searcher* role was found among child searchers but not among adolescent searchers [15]. The absence of the *Distracted Searcher* role with adolescents was explained by their social development, growing awareness of social expectations, and accumulated search experiences [15]. Conversely, the *Social Searcher* role was not observed among children, but adolescents frequently discussed their social ways of searching and using the Internet [15]. Between the two studies, however, mobile devices emerged on the consumer market. Together, these examples suggest that as people age and as new technologies emerge their search roles and personal and social landscapes of Internet search may change. The present study builds on the understanding of youth Internet search roles presented by Foss et al. [15] to develop an understanding of adult search roles, factors influencing adults search roles, and how to support adults in different roles.

METHOD
To determine the Internet search roles of adults, we conducted in-home interviews with adults, followed by task-based observations of online search behaviors.

Participants
Participants were recruited via email between November 2014 and February 2016 from the US states of Virginia, Maryland, and the District of Columbia. To achieve diversity in race and age, we reached out organizations such as Parent-Teacher Associations, local neighborhood communities, and community groups. Snowball sampling was also used by asking participants to forward the recruitment email to others who may be interested in participating in the study.

Respondents to the recruitment advertisement were screened based on four criteria. Participants needed to: 1) be at least 18 years of age, 2) have Internet access at home, 3) have access to an Internet-equipped device, and 4) be willing to have two researchers visit their home. Participants were volunteers, and did not receive compensation for their participation.

Table 1 summarizes the age groups of participants by gender. We coarsely distinguished four age groups based on previous research, which indicated different patterns of four generations in both social backgrounds and technology use [31]. Participants ranged in age from 19 to 76, with an average age of 43 for the female participants and 37 for the male participants. The 40 adults included 23 Caucasians, 8 Asians, 4 African Americans, and 1 Latino. Three had multiethnic backgrounds and one participant preferred not to identify his ethnicity. The participants were 21 full-time workers, 13 students, 4 retirees, and 2 part-time workers.

Procedure
The in-home interviews were conducted to understand the search behaviors of adult Internet users. The in-home interview method allows for an understanding of naturalistic user behaviors because participants can use their own devices, search tools (e.g., search history), and other personal preferences (e.g., switching between multiple devices) in their everyday settings [26]. Researchers went to participants' homes in pairs throughout the study—one acting as an interviewer and the second as an observer. The first author conducted all of the interviews to ensure a consistent interview process, and two other researchers took on the observer role by turns.

The protocol consisted of two parts to understand both participants' perceptions regarding online information seeking and actual search processes of addressing given tasks: a semi-structured interview and the completion of five search tasks. Throughout both of these segments, the observer took detailed notes on interview answers and participant search processes including query transformation and performance. The interviewer took notes on observations and reflections on participants' responses.

Semi-Structured Interview
Upon arrival at a participant's home, the participant was requested to take the researchers to the place where they normally used the Internet-equipped devices for search. The interviewer explained the purpose of the study, outlined the study procedures, and data collection/use policy and had the participant review and sign the consent form.

The semi-structured interviews lasted an average of 54 minutes. Following the protocol described by Foss [12], the interview began with questions on previous experiences and

typical daily activities related to computer use and Internet search. It then explored specific search-related questions such as Internet search experiences, motivations of everyday search, and collaborative search experiences.

Search Tasks

The second part of the protocol consisted of five search tasks of increasing complexity and different types. To conduct this task, 2 participants used tablets, 11 used desktops, and 27 used laptops. The tasks were:

Q1. Can you search for information on squirrels and explain to me what you did?

Q2. Can you look for information on what squirrels eat and explain to me what you did?

Q3. If you were searching on Google for your own interest on something you've never searched for before, what would you search for? Okay, let's search for that.

Q4. On which day of the week will the current [local] governor's birthday be on next year?

Q5. Do you think R5's music was more popular in 2010 or in 2014, and why?

As the search tasks proceeded, the complexity was increased and the tasks required the ability of integrating the information obtained from separate sources. For instance, the final search task (Q5) was designed to search for information on a band who was not necessarily well-known to adults. Popularity is a subjective characteristic, and thus participants needed to determine how to measure the popularity of a band, and then to find the measurement for two discrete dates. Therefore, this search task required multiple steps in finding information: identifying who R5 is, determining a measurement of popularity, finding the relevant information, and combining the obtained information to answer to the question. Participants could opt not to complete any of the individual search tasks.

To capture thought processes of participants, we asked them to think aloud while conducting searches. The interviewer further probed the participant's search behaviors after each search task. Once the participant stopped searching, the interviewer asked if they found the information that they wanted and then proceeded on to the next search task until the completion of the study.

Immediately after each interview ended and the researchers left the participant's home, a debrief was held between the two participating researchers to discuss the search characteristics of the participant. Notes from each debrief discussion were transcribed into a memo.

Summary of Data Collected

Multiple forms of data were collected during the study to allow researchers to examine the consistency of different sources and produce a deeper understanding of the topic area. Participants completed a pre-study survey that asked for demographic information. Interviews were video-recorded, both researchers at each session took observational notes, and each session ended with a recorded

Age Group	Male	Female	Total
18-33	13	6	19
34-49	2	5	7
50-68	3	7	10
69+	3	1	4
Total	**21**	**19**	**40**

Table 1. Summary of participant demographics

debrief between the two researchers. The entire dataset yielded 35 hours and 52 minutes of video data, and 40 sets of observation notes, surveys, and interviewer memos.

Analysis

The qualitative analysis for this study was conducted iteratively with a team of five researchers. We used an elaborative coding approach for the analysis [2]. In this process, coding began with the theoretical constructs from the previous study with youths—a codebook that included the roles, definitions, and examples that were identified in the children and adolescents' search roles study [12]. Based on this codebook, researchers conducted focused coding through a constant comparative procedure, whose process involved comparing similarities and differences of participants' responses regarding search strategies, computer use, attitudes toward information seeking to generate adult search role categories [35].

Round 1. The video recordings of the first 20% (8) of the interviews were transcribed and one researcher conducted an initial analysis to distinguish search roles and areas of inconsistency with the existing codebook based on the interview transcripts, observation notes, and reflection memos. The main focus was to compare the emergent search roles to previous roles identified among adolescents. This first round of analysis yielded six new roles and four existing roles. The research team met twice to discuss these results, merged two similar roles to yield nine roles, and modified the coding scheme definitions to better reflect the adult participants' search experiences and characteristics.

Round 2. The research team conducted the second round of analysis after ~60% (25) of the interviews were completed. As with the first round, the same researcher conducted an analysis of these data based on the post-interview discussions with two observers, observational notes, debrief memos, and the video-recorded data. The researcher focused on categorizing new data into the nine roles and determining if any additional modifications were necessary. The entire research team discussed the analysis during the meeting and again iterated the adult search roles codebook. During this round, the team discussed four potential new roles and whether these roles were originally observed among youth. The team decided that two new roles were observed among adults, and the other two roles were evolved from previous roles identified among adolescents. After the discussion, the codebook was modified to include nine search roles—two new roles and seven existing roles.

Round 3. The third round analysis focused on finalizing adults' search roles after completing 95% of interviews (38). The research team discussed the validity of the adults' search roles observed, their definitions, and representative cases of each role. Names and definitions of the nine search roles were finalized, including *Power, Developing, Rule-bound, Domain-specific, Efficient, Disinterested, Interest-driven, Social,* and *Visual* search roles.

Final Coding. The three researchers who interacted with participants met to confirm that the roles applied to participants accurately after completing all 40 interview trials. One researcher then reviewed and re-coded the entire corpus of data, revisiting the video-recordings when necessary, and entering it into a spreadsheet for a last collaborative, systematic analysis with the entire research team. This spreadsheet was used for constant comparisons to determine search roles of each participant, and to identify the primary and secondary search roles of each participant based on the frequency with which different roles were used by an individual. The primary role was the most dominant characteristic of the person, and the secondary role captured less dominant yet important characteristic. Twenty-seven participants had multiple search roles.

RESULTS
This section begins with an overview of participants' Internet search backgrounds. We then present adults' Internet search roles: two new roles, five roles that evolved from those of youth searchers, and two that remained consistent (Table 2). We conclude with observations on search performance with regard to different search roles.

Participants' Search Experiences
With regard to search skill acquisition, participants showed differences in their experiences with computer use and Internet search. Participants in the youngest age group, 18-33 years old, described learning how to interact with computers while taking classes, doing homework, and playing games on computers either at home or at school. In contrast, older adults described learning computer skills to adapt to changing work and social environments. Across age groups, 13 participants (32.5%) had received formal training regarding how to search for information online. Twenty-seven participants (67.5%) had developed their search skills through trial and error. When asked about new search skills acquired within the last 6 months, 24 participants responded that they recently had not learned any new search skills. Eleven participants acquired new search skills (e.g., timeline search, advanced settings) by accident. Five participants learned new skills from teachers, librarians, or colleagues at schools or workplaces.

Adult Search Roles
Here we describe the Internet search roles of adults. We describe the *new roles* observed among adult participants, the *roles that evolved* and how they differ from youths, and *roles that remained consistent* across populations. Table 3 summarizes the Internet search roles of adults.

Youth Internet Search Role	Adult Internet Search Role	Evolved, New, or Consistent
Power	Power	Evolved
Developing	Developing	Evolved
Social	Social	Evolved
Domain	Domain	Evolved
Rule Bound	Rule Bound	Evolved
Visual	Visual	Consistent
Non-Motivated	Disinterested	Consistent (new title)
Distracted	-	n/a
-	Efficient	New
-	Interest-Driven	New

Table 2. Comparison of search roles between youth [15] and adult Internet search roles in this study.

Emergence of New Roles

In this study, *Efficient Searcher* and *Interest-driven Searcher* were identified as new roles among adult searchers. No patterns among participant demographics, such as age and gender, emerged for these roles.

Efficient Searcher. *Efficient Searchers* (7) were aware of and attempted to minimize the number of search steps they would take or the total time spent to find information. For instance, *Efficient Searchers* discussed the number of clicks left to reach the target information or expressed excitement when they quickly finished the search tasks. Participants in the *Efficient Searcher* role exhibited unique attitudes toward search activities in that search engines were exclusively considered a tool for achieving specific goals:

> *"Typically, most of my searches are relatively mundane, so I stop searching when I get the answer. What's on the movie theaters, what's the recipe, that sort of thing. [I] buy the tickets and bang. (...) I don't waste a lot of time. I don't get on to YouTube, and just link from video to video. I don't, except for reading more news, I don't waste a lot of time… just exploring." -P12*

In this description, P12 explained daily search activities as goal-driven, and viewed exploring online as a wasteful, time-consuming activity. *Efficient Searchers* sometimes skipped the self-selected task in our study (Q3). P8, for instance, discussed her general search habits that she only conducted a search activity "for a purpose" and did not like "just browsing," and skipped the self-selected search task.

Several *Efficient Searchers* had advanced search skills. However, as search engines were viewed as a tool by *Efficient Searchers* they seldom discussed their interest in new search interfaces and systems (e.g., voice search). For instance, both P34 and P39 used advanced search abilities in handling the current search system and successfully conducted the search tasks of this study. However, P39, whose Internet searches were predominantly for goal-driven activities like school-related work, displayed less enthusiasm toward search activities. In contrast, P34, whose main role was a *Power Searcher*, energetically discussed a new search platform (i.e., networked Television).

Role	Definition	Examples	Count[1]
Power Searcher	Adult searchers who possess advanced search skills; are aware of the reliability of different sources, able to use advanced features of search engines, able to use a variety of search strategies, and able to explain the presentation of search results	*"I usually type in my question, but this time, I'll use keywords."; "I searched the exact word within the text using ctrl+F."; "If you type in location names on Google, it usually gives you these images on the top."*	22
Developing Searcher	Adult searchers who are willing to conduct and are excited by search tasks and computer use; have limited knowledge on search tools; are not able to verbalize their search processes when asked and often have varied approaches to solve a single task	*"Search is like browsing a card catalogue to me. So excited!"; "I don't know how to get back to the result page."; the searcher tries search tasks but is not able to complete two or more search tasks*	5
Social Searcher	Adult searchers who ask for help from others or provide help to other people in terms of searching; conducting collaborative search to achieve common goals	*"This is where I'd call [name]."; "My daughter knows better about this topic, so I will wait for her to come home and search for me."*	9
Domain-specific Searcher	Adult searchers who have developed skills and source knowledge around a particular domain; have specific websites for conducting particular searches; their expertise and search skills are not necessarily limited to the domain of interest	*"I know several websites I would go to find science fiction books for kids"; "I browse [X site] to find leisure ideas."*	4
Rule-bound Searcher	Adult searchers who have developed their own search patterns, repeating the similar steps for most searches; frequently verbalize and follow rules about searching	*"I usually skip the first two results"; "I learned to only trust .edu or .org sources because .com can be anybody."*	9
Visual Searcher	Adult searchers who have a desire to retrieve information from visual sources such as pictures or videos	*"I'm a visual learner."; "I like browsing images first."*	4
Disinterested Searcher	Adult searchers who are not interested in either self-generated or imposed search tasks; do not choose search activity and Internet use as an activity	Not observed among participants	0
Efficient Searcher	Adult searchers who are interested in finding the exact information that they are looking for by interacting with the search engine a few steps	*"Don't want to waste my time on searching"; "I am one click away from my answer!"*	7
Interest-driven Searcher	Adult searchers who are willing to conduct and are excited by search tasks they find interesting; are aware of getting off topic and able to resume their original search	*"I spent too much time on this unrelated thing. So, I was searching for squirrels?"*	7

[1]Count includes both primary roles and secondary roles of participants in this study.

Table 3. The Internet Search Roles of Adults, including descriptions and examples.

Interest-driven Searcher. *Interest-driven Searchers* (7) were easily diverted to alternate search tasks or heartily pursued information on topics of interest. For instance, P18 kept a Rolodex next to his computer for the purpose of taking notes on his curiosities for later Internet searches. When discussing challenges in Internet search, he gave an example of his curiosity toward two composers (i.e., Did Giuseppe Verdi ever meet Franz Liszt?), which was written on the Rolodex. P18 then repeatedly brought up this topic throughout the interview session and later chose this topic for the self-selected search task (Q3).

In the sense that *Interest-driven Searchers* were often distracted during search tasks, this group of searchers might be comparable to *Distracted Searcher*, one of the roles identified among child searchers. However, the key difference between these two types of searchers was the ability to return their original search tasks. An *Interest-driven Searcher* remained cognizant of their search goals even when doing divergent searches. In the following example, P37 was inspired by the information found during a search activity and pursued extra searches:

"I'm just asking the question, 'cause that's how I talk to Google. 'What do squirrels eat?' And the answer is nuts. (...) Oh, I didn't know they eat eggs and baby birds! What? Squirrels! That's terrible. Oh my goodness. Baby birds." (P37 clicked on a search result and started reading a webpage describing squirrels' appetites in detail.) "See! Squirrels are bird killers! Ah! Huh." (Returned to the search result page.) "There's also birdfeeders, [squirrels] try to get in there, I don't know what they put in those. Just seeds, and nuts and stuff? I don't know. I wanna look that up." (Began dictating a search and typing it out.) "Why do squirrels eat out of bird feeders?" –P37

During the post-task discussion, P37 described how she often did tangential searches. *Interest-driven Searchers* did not worry about their divergent search paths to explore relevant information once they became interested in the topic, and could resume the original search tasks.

Evolving Search Roles
Here we present and discuss the five youth Internet search roles that presented differently in an adult population.

Power Searcher. As with young *Power Searchers*, adult *Power Searchers* (22) had advanced search skills (e.g., exact phrase search, Boolean search) and knowledge of search engines. Yet, the most salient characteristics of an adult *Power Searcher* was the ability to flexibly operate and verbalize multiple strategies depending on search tasks:

"So again, usually when I search I use the question format. (...) Hmm. Well, it's all of a sudden really not the information that I'm looking for, it's about [local] holidays…So I have to change how to search, so I'll search for governor of [state name] birthday." -P20

This participant flexibly utilized question-format and keyword-based queries for his search tasks. During the interview, he also explained advanced search strategies of using a particular search platform (i.e., Google) such as using quotation marks to find information containing the exact phrases and specifying particular sites to filter search results. Similarly, P28 and P40 described self-devised search strategies (e.g., noun-based queries) that they believed improved search efficiency beyond using search engine features. Other Power Searchers mentioned using various search interfaces for work (e.g., library database, Google Scholar), hobby-related searches (e.g., Stack Overflow), and different types of past or new search interfaces and systems (e.g., Netscape, voice search, Internet-equipped home devices). It is possible that adult Power Searchers developed their search skills through their interactions with different databases and search interfaces. Having a set of search strategies allowed these participants to quickly recover from search failure (i.e., quit a task without finding the information they wanted), which was a major benefit of being *Power Searchers*.

Rule-bound Searcher. *Rule-bound Searchers* (9) were characterized by the behavior of repeating similar search approaches for different tasks. Adult *Rule-bound Searchers* sometimes broke their rules for better search performance, but expressed their uncomfortable feelings when not following their rules. Rules that adult participants had commonly included: checking multiple sources, looking at the first few results (i.e., the "best" results), searching for results within the first three search results pages, or not using or only using particular resources (e.g., refusing Wikipedia, relying on .gov or .edu domains). These rules related to how the participants determined useful information among search results. Adult *Rule-bound Searchers* displayed similar patterns of search activity to young *Rule-bound Searchers*, except that adults' rules were more likely to be self-imposed than influenced by other people (*e.g.*, school authorities or parents). Except for two participants, who were a teacher (P5) and a student (P8), adult *Rule-bound Searchers* developed their rules based on their own experiences with search systems in a way to improve their search efficiency or outcomes.

Developing Searcher. *Developing Searchers* (5) displayed limited search skills and knowledge of search systems. Unlike youths, adult *Developing Searchers* were able to retrieve information for even the most complex search task (Q5). However, their processes were interrupted in many ways due to their incomplete understanding of how search systems worked and how to interact with search systems.

For instance, P13 encountered challenges related to her inadequate knowledge of search engines while searching for information on squirrels (Q1). While conducting the task, she clicked on what she believed was a search result, but was actually led to a different search system. This new search system showed another list of search results when P13 repeatedly clicked on the link from the original search:

"So! This is when I get frustrated because I don't know why I get keeping the same screen. But, I will go this site because I don't want them to dig my garden." (Pointed at the search results with her mouse) "How do I keep squirrels from digging in my garden?" (Another search results page opened.) –P13

P13 spent a significant amount of time on repeated search failures. Toward the end of the first task, she clicked on the featured search results rather than comparing the returned search results. Later, in a search task where the participant was asked to use Google (Q4), P13 added 'google search' at the end of her search query on Bing and believed that the search activities had been conducted on Google. While an answer was found, this again showcases how adult *Developing Searchers* might appear to have successful search habits, but encounter substantial challenges.

Social Searcher. Participants reported that they were generally solitary searchers. However, most participants searched with others when needed. As with youths, adult *Social Searchers* utilized their social networks to find information or conduct search tasks collaboratively. Twenty-seven participants (67.5%) described occasionally conducting searches with their colleagues (6), friends (9), and family members (15). Six participants mentioned work colleagues as someone they helped or sought help from with regard to work-related topics. Nine participants described friends as casual search partners, usually searching together when conversation sparked interest in a topic. Spouses and significant others were the most common search partners (9). Four female searchers described searching with their children for curiosity or school-related activities, and two participants mentioned helping their parents search for information. P3, for instance, emphasized that she would never stop searching for information on her son's illness. Adult searchers, unlike youths, encountered situations where their social positions of caring other people motivated social search behaviors.

Domain-specific Searcher. *Domain-specific Searchers* (4) had advanced source knowledge and search skills around a specific domain. Whereas youth *Domain-specific Searchers* displayed expertise only in the searches of the domain of interest, adult *Domain-specific Searchers* developed general search skills and were successful in general search tasks. This type of searcher often had key information resources that they could utilize for browsing or finding information. For instance, P17 explained how she utilized diverse social commercial sites for browsing:

> *"Another very big thing I do is, I use the Groupon site. The Groupon and Living social sites. One thing you save money, and the second thing they also give you the ideas about doing things, I like trying new things, the things that I'd never known about. (...) I think [finding] those things are not possible without a computer." –P17*

Like P17, several adult search users had domain knowledge related to their hobbies or leisure activities (e.g., travel, pop music, science fiction book). Adults' domain knowledge increased search efficiency in conducting particular search topics, but their search skills were not limited to the domain.

Consistent Roles

Two youth Internet search roles remained similar across an adult population: *Visual* and *Disinterested (Non-Motivated) Searchers.* Below, we describe their presentation in adults and the motivation behind renaming one of the roles.

Visual Searcher. *Visual Searchers* (4) had an inclination toward visual sources in selecting search results. Participants of this role tended to filter their search results in order to browse visual sources only or verbalize their preferences for images over text. For instance, P7 linked her visual learning style in obtaining new knowledge to explain her preference for visual search results. In her self-selected search task, she quickly filtered the search results to learn about Hmong culture through pictures, stating:

> *"I just peep through what they have in the first couple of slides, because I've never seen Hmong personally. I just wanted to look at images, what they look like, what things they wear. (...) I'll just keep scrolling down some, as soon as I noticed different patterns that they have similar pictures that's overlapping, I guess I would stop searching, and I'd go back to the website." –P7*

Disinterested Searcher. The previously described *Non-Motivated Searcher* was renamed to *Disinterested Searcher* due to the negative nuance of the former name. *Disinterested Searcher* is an information seeker who is not interested in either self-generated or imposed search tasks, and does not choose searches as an activity. *Disinterested Searcher* was not found among our participant group. We suspect the absence of this particular role to be due to the volunteer-based recruiting method. While *Disinterested Searchers* likely exist among adult populations, it seems unlikely that they would volunteer for this study.

Roles and Performance

Given the known issues with search task failures among adults [32], we compared the relationship between primary roles and the number of search tasks that participants failed to answer. A couple Power Searchers (2/17), a Developing Searcher (1/4), and the majority of Rule-bound Searchers (4/6) failed to answer one search task. Most Interest-driven Searchers (4/5) failed one or two search tasks.

The causes of failed search tasks were diverse. The seven participants (3 *Rule-bound*, 2 *Interest-driven*, 1 *Power*, and 1 *Developing Searcher*) who failed to answer the most complex search task (Q5) displayed different search processes. For instance, a *Rule-bound Searcher*, P23, emphasized using reliable sources and refused to answer based on a website that he deemed questionably reliable. On the other hand, P9, who was both an *Interest-driven* and *Domain-specific Searcher*, informed the interviewer that he did not have the domain knowledge to answer the question and skipped the task. A *Developing Searcher*, P15, reviewed search results of four queries and then answered that she did not know the answer. P1, who fell into both *Power* and *Domain-specific Searcher* roles, was hesitant in making inferences based on limited information. *Interest-driven Searchers* encountered search failures more frequently than other roles, but were more likely to have failures because of their attitudes toward self-selected search tasks than a lack of search skills or knowledge. For instance, P25 answered that she needed more information to satisfy her curiosity for the first search task. This participant also failed to answer the self-selected search task: *Do dinosaurs like music?* P25 knew that her question was not likely searchable, but tried the query out of curiosity. Like these examples, *Interest-driven Searchers* sometimes showed repeated search failures. These observations indicate that search failures may be related to attitude and ability to synthesize a variety of information.

Roles may imply these attitudes and abilities. Table 4 illustrates the differences in seeking and utilizing information between *Power* and *Developing Searchers* as an example. The *Power Searcher*, P40, used a noun-based keyword search strategy, filtered results throughout his searches, and synthesized the results himself. The *Developing Searcher,* P15, on the other hand, attempted to retrieve information that automatically compared specific results. Toward the end of the search activity P15 filtered her keywords to find record sales in a single timeframe, but gave up before reaching a conclusion.

However, it should be noted that the possession of advanced search skills does not necessarily lead to successful search outcomes. P16, a *Rule-bound Searcher*, had advanced search skills but was unsuccessful at obtaining search results due to repeating the same strategy of specifying a site (e.g., site:edu). As a result, P16 spent more time on this search activity than other participants who had more flexible search strategies.

	Power Searcher (P40)	Developing Searcher (P15)
Search Queries	1. r5 music 2. r5 music sales 2010 3. r5 album sales (with a search range in 2010) 4. r5 album sales (with search range in 2014)	1. who is R5 2. is R5 more popular in 2010 or 2014 3. R5 popular in 2010 vs 2014 4. R5 records sold in 2010
Result	"I found what I wanted."	"I don't know."

Table 4. Comparison of search queries and outcomes between a *Power Searcher* and a *Developing Searcher.*

DISCUSSION

Characterizing how adults search for information online in the home environment is a critical step toward supporting their daily search behaviors. This work contributes a new understanding of the Internet search roles of adults by expanding upon existing knowledge about youth Internet search roles, with findings identifying new search roles and new presentations of known search roles. Here we discuss these findings as they relate to (1) how contextual factors of home environments influence search roles in relation to ELIS, (2) what can be learned from search roles, and (3) opportunities to support different search roles.

Contextual Factors Influencing Search Roles

This study provides a better understanding on how search engines are used for daily information seeking at homes. With regard to ELIS, this study shows how social and personal factors within home influence everyday life information seeking behaviors, shaping the motivations and evaluations of Internet search outcomes. Corroborating findings from previous studies [41], our work suggests that in-home search is not just a solitary process, but also interacts with a broader sphere of social elements such as a person's job, hobbies, family roles, and other social roles [25,43]. As such, in-home searches are pivotal activities used by people to orient themselves and solve problems as well as to serve various roles that they have in different social worlds. Given this, this work's understanding of how individual's search roles evolve enables us to better understand how personal and social factors surrounding Internet search within homes change and influence ELIS and acquisition of search roles among adults.

With regard to individual factors, changing search skills as persons age can influence search behaviors. Previous work suggested that youths in the *Developing Searcher* role would acquire new search roles as search skills increase with age [15]. Our study finds support for this idea in the fact that there were fewer *Developing Searchers* (12.5%) among adults compared to youth searchers—34% of adolescents and 65% of children observed in the study by Foss et al. [15]. Findings of this study further suggest the relationship between *aging* and search skills. In our study, most *Developing Searchers* (4/5) were older adults aged 50 years and over. However, the successful completion of search tasks of adult *Developing Searchers* makes the link between aging and search skills complicated. To explain this, the notion of different types of search skills can be useful: the ability to use Internet technologies (i.e., medium-related Internet skills) and the ability to locate and use the required information to fulfill their needs (i.e., content-related Internet skills) [42]. Age has been negatively associated only with medium-related skills, and younger populations tended to perform better on operating Internet searches [42]. Accordingly, a potential explanation of this study's results may be that difficulty in utilizing Internet technologies, particularly those that are new, might influence an adult's ability to use the Internet for information seeking, thus the prevalence of the *Developing Searcher* role in older adults.

Changing social factors also influence search roles of adults. The emergence of new Internet search roles in our study (i.e., *Efficient* and *Interest-driven Searcher*) indicate the increased autonomy and ownership of adult searchers in the context of computer use. Unlike youth searchers, whose Internet access and computer use are often regulated by adult figures, adult searchers could develop new search behaviors of selectively engaging in search activities [45]. Additionally, remarks our participants made that were related to *on-behalf-of* or *collaborative search* activities indicate the complex web of social positions in which adults are situated. These social positions influence daily search motivations, content of search, and patterns of search behaviors in online sphere, so adults acquire new search roles to address their social roles [17,25].

What Do Adult Search Roles Tell Us?

By conducting this study with participants in their homes, this work expands our understanding on adults' daily information behaviors and search practices with increased quality and relevance of search results. The nine search roles could capture how both cognitive styles (e.g., attitudes toward information seeking, learning style) and search experiences (e.g., search expertise, flexibility) shape different Internet search behaviors. For instance, *Efficient Searchers* and *Interest-driven Searchers* had differing attitudes toward search practices (i.e., tool for problem solving vs. exploring new information), and their willingness to engage in Internet search led to their different search behaviors. Similarly, *Visual Searchers* preferred a particular type of information (e.g., visual cues), and *Domain-specific Searchers* utilized a set of information resources which they were familiar with to find information; these self-imposed constraints structured the scope of their searches. Similarly, externally-imposed constraints—or lack thereof—may explain differences between roles such as *Power Searchers,* who were open to learning new search strategies, and *Rule-bound Searchers,* who were reluctant to change their search strategies. These dimensions of Internet search roles are a key part of utilizing search roles to characterize how adults search for information online.

While prior studies suggest that the years of Internet use are positively associated with one's search skills [16,28], findings in this study suggest a more nuanced relationship between previous experiences with search systems and a person's ability to use new search systems. As Foss pointed out, the introduction of new technologies and interfaces potentially influence search habits and behaviors of the participants [12]. Her descriptions of search roles observed among youths did not fully explain today's search behaviors of adults are likely due in part to technological changes between when the studies were conducted. In our study, one *Rule-bound Searcher* exemplified such a case by insisting on using search strategies for library search systems, despite being aware that his strategy would not work well on the current search system (i.e., Google). A number of participants in this study similarly reported their use of different search systems prior to web-based search systems. Experiences from these systems (e.g., a search system used at a workplace, old search engines) might carry over in ways which are not necessarily useful in using other search systems [42]. Adult searchers may need to be adaptive in new search systems to successfully interact with search systems in the ever-changing search environments [19]. These findings further suggest that the ways of how current users interact with search engines can be used to project how they would interact with a new search system. The identification of search roles can be used to predict possible search behaviors and challenges that users might encounter when using future search systems.

Opportunities to Support Different Search Roles
Studies on search roles or information styles, including our study, do not suggest superiority or inferiority of any particular search role over others. As seen in this work, individuals of many combinations of primary and secondary search roles were able to successfully complete the same search tasks despite differences in the characteristics of their search roles. These findings suggest that supporting information seeking processes of searchers of different roles across new platforms may benefit both searchers and new platforms.

To support adult searchers of different search roles, search system designers should consider different degrees of search skills in conjunction with the unique personal and social needs found among adult participants. Certain search roles (e.g., *Power* or *Developing Searcher*) indicated different degrees of search skill. By detecting challenges in the search processes (e.g., [3]), adaptive search systems can provide systematic scaffolding for people with limited search skills to improve search processes and performances.

Similarly, our understanding of adult search roles could be used to design adaptive search options that support switching search modes between *exploration* of new information and *focused* search experiences depending on different levels of engagement [33]. Scholars have suggested the benefits of serendipitous information seeking

to the generation of new ideas and directions (e.g., [1,40]). However, adult searchers of *Efficient*, *Rule-bound,* and *Domain-specific* search roles might have limited opportunities for the serendipitous encountering of new information. Attitudes, rules, and domain knowledge related to search behaviors of these searchers restrict opportunities for stepping out of their routine search practices. Conversely, *Interested-driven Searchers* might sometimes need to be less distracted in order to complete their search tasks efficiently.

Designers should also consider how to support adult searchers who have diverse information needs. Adult *Social Searchers*, for instance, might go between searches while seeking information on behalf of other people as well as for their own benefit. This type of search behavior might not be supported well with current search options, suggesting the opportunity to support collaborative search practices occurring through multiple platforms [28].

LIMITATIONS
Four limitations to this study require acknowledgement. Firstly, researcher presence during the observed search tasks may have impacted how participants chose to address search tasks. Secondly, as participants of this research were volunteers, persons who enrolled were likely interested in search activities. Just as the *Disinterested Searcher* role was not observed in our study due to the nature of recruitment, it is possible that other, unseen roles may exist. Thirdly, participants were located in one U.S. region, and as context influences search it is possible that people from other regions or societies might present different search roles. Finally, while new roles emerged in this study it is unclear whether these roles may exist for youth or whether youth roles diverge into new roles. Future studies should address these limitations to provide a comprehensive understanding of search roles.

CONCLUSION
Understanding how adults conduct Internet searches in their homes is an important step toward supporting them in their everyday search tasks. In this study, we investigated how adults search for information online in their homes through in-home interviews and observations. Results of this study identify and describe nine Internet search roles of adults, the consistency and evolution of these roles, and describe how search performance changes with search roles. This study expands our understandings of variances in adults' Internet search experiences and contextual factors contributing to these variances. These findings will benefit the designers and developers of a breadth of information search systems as well as the persons who use them.

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