MEASURING ONLINE SEARCH EXPERTISE

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ABSTRACT

Earl Bailey: Measuring Online Search Expertise
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Search expertise has long been studied and used extensively in information seeking behavior research, both as a fundamental concept and as a method of comparing groups of users. Unfortunately, while search expertise has been studied for some time, the conceptualization of it has lagged behind its use in categorizing users. This has led to users who were defined as experts in one study who could be considered novices in another study. Not only does this make it difficult to know how search expertise impacts the issues being studied, it also makes it difficult to compare results between studies. It is clear that search expertise is more important now than ever as the information and misinformation available online grows exponentially. It must first be conceptually designed and modeled, and then it must be operationalized so that it can be reliably measured.

This research first examined prior research related to online search expertise and created a working definition and model. One-on-one interviews were then conducted with nine known search experts, who were asked to describe online search expertise. These same experts were then gathered into three separate focus groups where they examined and grouped the items gathered from their individual interviews. The items and groupings from the focus groups were then used to update the model and also to create an initial instrument to measure online search expertise. That initial instrument was then given to 14 targeted participants in one-on-one cognitive interviews. The instrument was modified based upon the results of those interviews and then given to four targeted groups of participants and the results from 466 of those participants were examined using statistical methods.

The results support the use of aggregate scores for past experience, self-rated search ability, and search skill ability as continuous measures of online search expertise. While the personality items used in the research suffered from the same inconclusive results as prior research, the inclusion of analytical abilities in future versions is indicated.

To my wife and best friend – Thank you for all your support through this process.
I could not have done it without you.

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CHAPTER 1: Introduction

The ability to locate and evaluate information is critically important in today's online environment (American Library Association, 2015). We are surrounded by information, immersed in it constantly, and interact with it in ways we do not completely understand (Ward, 2006). Finding the information we need is valuable in both negotiating and understanding our world (American Library Association, 2015). The rise of the Internet has increased the availability of information and given us new methods of interaction, so much so that "(i)nformation and communication technology have become central to the interaction of society" (Kidd & Keengwe, 2010, p. 127). In this age of ubiquitous information, the ability to discover useful information is paramount, but the growing volume of available information makes that task more and more difficult (Liaw & Huang, 2006). The online environment is "embedded in the larger information activities of life and customizable to individual preferences and abilities" (Marchionini & Komlodi, 1998, p. 115). Clearly, the ability to find salient information is more important now than ever before.

The sheer volume of available information is not the only issue facing us today. The available information is also constantly changing (Hsieh-Yee, 2001), and much of what is being created is increasingly unfiltered (American Library Association, 2000). Locating information that is valid and reliable has therefore become a much more difficult task. Individuals now have the responsibility of determining if information is true or false (Kidd & Keengwe, 2010), and so the ability to locate information to make this determination is critical. Those who possess the necessary skills to locate needed information have a distinct advantage over those who do not possess those skills.

The constant change of technologies in online environments further complicates the examination of these online search skills. Much of the early study of online search expertise was done using library card catalogs and databases, the primary means of locating information at that time (Moore, Erdelez, & He, 2007). The extent to which these results and measurement practices generalize to today's searchers and today's search environments is questionable. Indeed, Nielsen (2011) cautions that the ubiquity of the Internet and the constant use of Google have changed how we perceive and interact with information. Therefore, any method of conceptualizing and measuring online search expertise must acknowledge the reality of technological change or quickly become obsolete (Hargittai & Hsieh, 2012). Yet it must also still include other aspects of the searcher related to the task of type of information that are less dependent upon specific technologies.

Despite these difficulties, the clear importance of online search expertise indicates a pressing need for both understanding it and also using that understanding to assist others in growing their own abilities. Additionally, creating a way to measure online search expertise can potentially provide an important way to describe and understand users of online systems. Without such a measure, it would be difficult not only to classify users based upon their ability to find useful information, but also difficult to judge the effectiveness of system changes upon users possessing a range of abilities. Having a consistent way to evaluate and describe one's ability to locate information online is vital and will become even more so as information assets online continue to grow.

It is therefore not surprising that a person's ability to locate information has been studied extensively in information seeking behavior research (Moore et al., 2007), both as a fundamental concept and as a method of comparing groups of users. However, while its use as a measure to differentiate users has been extensive, that use has not been consistent across research or researchers (Aula & Nordhausen, 2006; Moore et al., 2007). This is due in part to an insufficient conceptual definition of search expertise or search ability, which is needed to create a conceptual foundation (Vakkari, 1997) upon which to base measurement. This deficiency is not surprising considering that interest in search expertise arose out of changes to library services, specifically the creation of online public access catalogs (OPACs). In early research, the focus was on methods by which inexperienced library patrons might use those new computerized catalogues, which were often difficult to learn and master. Catalogue users were generally described in this research as either high or low ability, and those categories were primarily used to evaluate systems and changes to systems. Perhaps this binary classification would have been sufficient had technology stayed static, but as noted above, it has not done so. The environment also influenced the study of search expertise as it related to domain expertise, a distinction made in part to separate the abilities of trained searchers from those of subject matter experts. The early operationalisms of search expertise were thus often restricted to a very specific subset of skills. Despite the issues, online search expertise must now move beyond those early operationalizations to encompass a range of abilities and become more consistently defined and used.

One approach to understanding online search expertise is to study and understand the basis for expertise itself in psychology and education. Expert knowledge, or expertise, has been defined as those "characteristics, skills and knowledge of a person (that is, expert) or of a system, which distinguish experts from novices and less experienced people" ("Expert," 2017). An expert is said to be "a person with extensive knowledge or ability based on research, experience, or occupation and in a particular area of study" ("Expert," 2017), so much so that the practice of that expertise is often seen as simple or effortless by those who do not possess it. Expertise has been conceptualized by describing the abilities and traits of experts (Sternberg, 2006), as well as by examining each of those individual abilities, such as how experts might organize information differently than novices (Glaser, 1987; LaFrance, 1989; Solomon, 1992; Hoffman, 1996). Some have argued that expertise is based primarily upon natural talent (Sternberg, 2006), while others believe that acquisition of skills plays a key role (Ericsson & Charness, 1994). Others have argued that experience teaches experts how to organize and represent information differently than novices, leading to an increased ability to see patterns in information (Glaser, 1987). This relativistic perspective views expertise as an attainable skill that can be cultivated to mature novices into experts (Chi, 2011). Indeed, many of these researchers argue that experts and non-experts are not fundamentally different in mental capabilities (Chi, 2006), but that experience is critical in order to turn novices into experts.

Researchers in information science have also used experience as a key factor in the development of search expertise and the maturation of novices into experts. In this case, experience was not meant to represent a particular field of study but rather experience in the specific activities involved with searching online, often described as experience as professional searchers (Hsieh-Yee, 1993; Marchionini, Dwiggins, Katz, & Lin, 1993). In some cases, this experience was specified further, such as experience using databases online (Fenichel, 1981; Allen, 1990; King, 1991; Pao, Grefsheim, Barclay, Woolliscroft, & Shipman, 1993) or experience with computers (Borgman, 1986). These methods had the advantage of being simple and easy to use, but were not used consistently across research, which led to uncertainty when comparing results, especially since the searchers designated as experts in one study could be designated as novices in another. Indeed, some researchers have specifically noted the need for consistent use of variables in information retrieval research as a fundamental need (Meadow, Marchionini, & Cherry, 1994). Others have noted that the improvements from experience to search expertise were often unpredictable, especially when that experience involved casual or leisure-based activities (Ericsson & Lehmann, 1996). Additionally, researchers often found very limited differences between the groups they identified as low and high ability based upon experience (Meadow, Wang, & Yuan, 1995; Wolfram & Dimitroff, 1998; Vakkari, Pennanen, & Serola, 2003). These results led some to note that they considered measuring search expertise using experience to be inadequate (Fenichel, 1981). Despite the relative ease of obtaining data about search experience, it is clear that researchers must discover and agree upon when and how it contributes to search expertise for it to be useful.

Unfortunately, it is not clear how to identify those specific aspects of search experience that predictably increase online search expertise. The specific aspects that matter must share some fundamental difference between them – a difference that sets them apart from other experiences. This idea of specific skills that matter is often referred to as *deliberate practice*, the accumulation of specific experiences often constrained by time or amount of effort needed (Ericsson & Simon, 1993) and directly impacting expertise. This idea is particularly important for online search expertise because the everyday use of it by many online searchers does not seem to qualify as deliberate practice, and since many use search solely to find simple information about a topic (Rose & Levinson, 2004) or treat it as if they were simply consulting an encyclopedia (Aula & Nordhausen, 2006). These lead to the question of whether online searchers by themselves have any chance of acquiring online search expertise through their searching experiences, with the assumption that online search expertise incorporates more than these simple searches.

If not, then the "uncertain quality and expanding quantity of information pose large challenges for society" (The American Library Association, 2000). The proliferation of low quality information online makes it even more difficult to understand the effect of experience upon online search expertise, for locating inaccurate or low quality information easily would not seem to increase the ability to locate higher quality information. This in turn complicates any attempt to understand, instill, or increase the levels of online search expertise within the citizenry, but this effort is also quite obviously important, for the "sheer abundance of information will not in itself create a more informed citizenry without a complementary cluster of abilities necessary to use information effectively" (The American Library Association, 2000). And yet experience, while complex, is also obviously not the whole of expertise, and other aspects must also be considered.

Other aspects of searchers have indeed been examined, but have often produced inconsistent results. Often, the focus has been on particular qualities of a searcher's mind or personality (Bellardo, 1985; Dervin & Nilan, 1986) or some mixture of innate abilities with past experience (Borgman, 1989). This focus has also been narrowed further into examination of the effect of problem solving ability in the searcher (Bates, 1979a; de Groot, 1946; Marchionini, 1997) or from a type of media competence (Hölscher & Strube, 2000). Creativity and mental flexibility have also been singled out as important components of online search expertise (American Library Association, 2015). Yet even where researchers agreed on what to measure, in practice the criteria used to measure online search expertise varied between studies (Aula &

Nordhausen, 2006; Moore et al., 2007), thus preventing the studies from being effectively combined into a meaningful body of knowledge. Creating a consistent measure based upon the shared understanding of the components of online search expertise is critical.

In order to create and nurture online search expertise, there must be a way to actually consistently measure it. Measuring the search expertise of the typical Web user presents unique challenges, for the Web population is both vast and diverse, including casual users as well as professional users (Aula & Nordhausen, 2006). Perhaps no typical Web user even exists, for the target is not stationary, and the online population constantly grows and changes (Hsieh-Yee, 2001). Without a consistent way of measuring online search expertise, it is impossible to measure progress and thereby determine the success or failure of any training that might have occurred. Past attempts to train Web users in online search expertise have in fact not consistently led to predictably better results (Camerer & Johnson, 1991; Dawes, 1994), suggesting that the problem of measuring online search expertise is far from solved.

The work described above has certainly contributed greatly to what is known about online search expertise, but it is limited in a number of ways. Perhaps the biggest limitation has been the lack of a rigorous conceptualization of the construct of search expertise (Vakkari, 1997), thus preventing individual studies from combining together into an overall body of research. Often search expertise was simply used to classify participants into high and low ability categories without any real conceptualization at all. Another limitation has been the lack of available instruments to measure online search expertise (Hargittai & Hsieh, 2012) or the fact that the measures that do exist include only items where searchers rate their own skills rather than actual tests of those skills (Hargittai, 2005). Certainly, the rapidly changing online environment limits the usefulness of research done using different technologies or environments.

Additionally, as noted above, much of the evidence from prior research is also inconsistent or even contradictory.

So, while search expertise has long been studied and used extensively in information seeking behavior research, it has not been consistently conceptualized or operationalized by researchers. This research intends to begin the process of creating a useful measure for online search expertise. In order to do that, all potential aspects of online search expertise will be considered, from system experience to environment to personality to learned skills. Creating a valid and reliable instrument to measure online search expertise will allow future studies to build upon one another as well as help in the design of information literacy programs.

1.1 Dissertation Overview

This chapter has discussed the nature of online search expertise and how its study and use have been limited by both the online environment and heterogeneous nature of online searchers. It additionally discussed prior study in expertise as the basis for understanding online search expertise. The goals of this research are to build a conceptual and operational foundation for measuring online search expertise that can be used and tested in multiple research environments. This will be accomplished by first defining online search expertise conceptually, then by creating an instrument to measure it. The specific questions addressed in this dissertation are:

- Q1: What is a current, usable, and applicable definition of online search expertise in the Internet age?
- Q2: Using this definition of online search expertise, how should it be quantified, observed, and measured?

The actual ways in which real searchers interact with information online and in their daily lives will inform the answers to both of these questions, as will the opinions of those who work with information professionally.

The nature of online search expertise as the interaction between the user's abilities and experience and the technology being used implies the need for examining both quantitative data for breadth and qualitative data for depth. This research therefore used a mixed methods (Tashakkori & Teddlie, 2003) design for data collection, using qualitative data to ground, create, and test the initial instrument and quantitative data to examine the data from the use of that instrument (Creswell, 2003). Search expertise as a construct has proven to be difficult to understand fully, and the combination of these methods provides more insight into its complexities. Both qualitative and quantitative protocols have inherent limitations (Creswell, 2003), and those limitations can be partially neutralized by the use of other methods.

Structurally, this research was conducted in four phases, as shown in Table 1. Brief discussions of the actual process follow, but each phase will later be discussed in detail, as well as discussing its contribution to the process of constructing the end measure for online search expertise.

Table 1: Research Phases

Phase	Tasks	Data/Methods
1	Building Initial Model Getting Starter Items (n~100)	Literature Review Interviews with Experts
2	Narrow the Set of Starter Items Create Initial Instrument	Starter List (n~100) Expert Evaluations
3	Test Initial Instrument Verify Items	Cognitive Interviews
4	Verify Modified Instrument	Validity Testing of Instrument Reliability Testing of Instrument

1.2 Developing a Model for Online Search Expertise

The purpose of the first phase was to create a usable model for online search expertise based upon both its usage in prior research and additionally on how it was defined by actual search experts. The results of the literature review from the domains of Psychology, Education, Information Literacy, and Information Science are discussed in Chapter 2 and 3, as well as the model that was developed. Chapter 4 discusses the results from the interviews with search experts, who were interviewed individually and asked for their thoughts regarding online search expertise (Phase 2). The results from the interviews were compared to the conceptual model to verify that it included all pertinent aspects.

As discussed above, online search expertise touches upon a wide field of prior study of expertise and includes a number of factors. While it is important to avoid preconceptions that might limit understanding, there are a few areas that were expected to be informative. These areas included general online experience, experience with specific types of search tasks, experience with the use of advanced search features, personality traits, patterns of information behavior, problem solving skills, task familiarity, vocabulary, and the use of technologies. These factors arose from the examination of prior research in expertise within psychology, education, and information science, and so those areas are further inspected here in order to create a conceptual model of online search expertise. This model is then used to structure and inform further examination as well as the creation of a preliminary measure.

1.3 Developing a Measure of Online Search Expertise

The method of creating a preliminary measure of online search expertise followed the standard process for creating a psychometric scale in order to maximize both reliability and validity. This process specifies typical steps designed to first obtain a clear and concise concept of the construct(s) the scale is designed to measure, followed by item generation, content validity testing, pilot tests, field tests, and finally factor analysis (Lynn, 2013). The second phase of this research took the lists of items related to online search expertise that were generated from the search experts and asked the same search experts in groups of three to four to discuss the concepts listed. This phase was used to further examine the construct of online search expertise through the experts' sorting and discussion of the items as well as using the groupings to examine the model created in the first phase. The results are detailed in Chapter 4 of this dissertation.

In the third phase, detailed in Chapter 5, the items were examined for inclusion in the initial instrument and that instrument was created. It was then tested in a series of cognitive interviews conducted with participants representing specific aspects of the population, including trained searchers, casual Internet users, students and academics, and frequent Internet users. The feedback from those cognitive interviews was used to examine individual items regarding their meaning to actual searchers as well as their usefulness. The initial instrument was then revised based upon the feedback from those participants.

The fourth phase, detailed in Chapter 6, took the updated instrument and tested it with four specific groups of participants online in order to establish its validity and reliability. Statistical testing was done upon all items to examine their usefulness as well as their discriminatory power. The results of this analysis were compared to the proposed search expertise model in order to evaluate and update the model.

The end result of this research is an instrument that can be used and further examined in a variety of research environments. As noted above, this research is critical not only because it will allow future research studies to be compared and therefore build upon each other, but also because it will give a framework to study online search expertise itself.

CHAPTER 2: Literature Review

This chapter examines past research in expertise within multiple fields of study and using multiple frameworks. The opening section examines the foundations of expertise as it has been studied and conceptualized, providing an overview of what will be discussed in later sections. Expertise is then examined using different psychological constructs and specific domains that were researched during its development. Search expertise is then examined as a specific case of expertise, using research from library and information science. Search expertise is also examined as a part of information literacy, a broad topic in Education. This review of past research is then used as the basis for both a definition and a model of online search expertise.

2.1 Foundations of Expertise

The study of expertise has taken place within the communities of psychology, education, and the sciences ever since knowledge itself was first organized and studied. Much of this study focused on the nature of expert abilities and whether those abilities could be imparted to non-experts. Some researchers have argued that natural talent was the basis for expertise (Sternberg, 2006), while others believed that acquisition of skills played a key role (Ericsson & Charness, 1994), arguing that expertise is domain-specific and does not extend beyond a particular domain. Some, like Meyer and Booker (1990), viewed expertise as both substantive, based upon training, experience, and knowledge, and also normative, based upon an ability to communicate within a certain field. Research has informed and transformed the conceptualization of expertise over time, so many of these theories have been changed or even been abandoned. Additionally, changes in focus and the advent of new theoretical frameworks, especially in psychology, often changed how expertise was conceptualized as well as how it was studied.

Studying expertise proved to be challenging to researchers, and most of that study fits into one of four major categories (Chi, 2011): (1) study of the cognitive processes of experts, usually through notes or diaries; (2) study of the environmental conditions around known experts or prodigies; (3) study of cognitive differences of the expert mind; and (4) study of the tasks that experts excel at performing. For many of these studies, researchers relied upon existing ideas in cognitive science and education, as well as practical insights from defined tasks like those in chess. The exact nature of expert abilities has also been extensively studied, particularly the organization and representation of expert knowledge (Glaser, 1987; LaFrance, 1989; Solomon, 1992; Hoffman, 1996). Some specific traits of experts have also been examined including lessened time spent solving problems, greater accuracy in solving problems, use of strategies to solve problems, and creation of schemas to represent problems (Sternberg, 2006). Ericsson and Simon (1979) also showed that expertise influenced motor skills, with experts having the ability to combine or condense serial actions in order to overcome both physical and mental limitations.

Expertise has been examined both from an absolute viewpoint, detailing the specific knowledge that would define an expert, and a relative viewpoint, examining the differences between experts and novices (Chi, 2006). In the absolute viewpoint, people can be categorized based upon specific criteria as: *novices* with little or no exposure to the domain; *initiates* with only introductory instruction; *apprentices* who are immersed in the domain and undergoing a program of instruction; *journeymen* who are competent but still require orders; *experts* who show skill and knowledge, often in subdomains; and *masters* who are qualified not only to practice but to teach (Chi, 2006). The relative viewpoint assumes that the mental capabilities of experts and non-experts are not fundamentally different and simply lists ways in which experts might be identified, such as in seeing features, generating better solutions, and better analysis of problems. Both of these approaches assume the importance of training rather than innate ability, but this aspect of expertise was not agreed upon for quite some time.

2.1.1 Nature vs. Nurture

The existence of expertise has been conceptualized and explained using two very different frameworks, the first using information processing or training and the second referring to abilities or innate talent. Innate talent theories argue that expertise is the result of a good fit between the innate abilities of a person and the activity they are engaged in performing (Sternberg, 2006). While this theory does include the domain or area as an important factor, the specific capabilities of the person are seen as very important, perhaps paramount. It should be noted that the conceptualization of expertise based upon innate talent has evolved significantly over time, specifically including the match to domain to explain specific domain abilities.

Early ideas about the influence of genetics upon a person's capabilities were heavily influenced by Galton's "Heredity" (1869), a comprehensive look at the recognized people of note in many different fields. Galton looked at the relatives of these noted individuals and saw indications that their offspring could also be expected to be notable. He specified that both capacity and disposition were important and that a person possessing both would be certain to succeed. Bramwell (1948) later examined this work and found some factual errors but continued to support the idea that eminence could be at least partially predicted by heredity. Ceci and Liker (1986) later examined the handicapping ability of gamblers to find the source of their talent and found that, while measures of IQ did not reliably predict performance, measures of cognitive complexity were more reliable predictors. Even so, while the innate talent view of expertise has at its root the assumption that performance levels are constrained by some trait or constant of the person, they also acknowledge that practice is often what determines to what extent that ideal is reached. In rebuttal, Ericsson and Lehmann argued that the "belief that most anatomical and physiological characteristics are unmodifiable and thus reflect innate talent is not valid for expert performance acquired through at least a decade of intense practice" (1996, p. 279). Still others examined the effect of innate ability as time and practice increased and found that, while ability plays a strong role in initial stages of learning, the influence lessens as experience and practice grow (Ackerman, 1988; Fleishman, 1972).

Information processing theories maintain that experience is the key that builds knowledge and skills, leading to expertise (Ericsson & Charness, 1994). This expertise is based upon the particular domain or area of training, leading to the use of domain expertise as a descriptive term, postulating that expertise can be seen as a form of skill acquisition. Within these research communities, domain expertise has been defined as “the ability, acquired by practice, to perform qualitatively well in a particular task domain” (Frensch & Sternberg, 1989, p. 160). Glaser (1987) theorized that expertise developed over time and experience, that experts organized and represented information differently than novices, and that experts develop an ability to see patterns in information. Hoffman (1996) agreed, arguing that expert knowledge differed from novice knowledge in both extent and in organization. Hart (1986) equated expertise with effectiveness, efficiency, and awareness of limitations. For Solomon, domain experts use well-rehearsed strategies to enhance recall and process knowledge, giving them an “enhanced ability to recall the appropriate scripts or schema of their field of expertise” (1992, p. 163). Experts also store more information than novices and organize that information into “more structurally and hierarchically meaningful patterns” (LaFrance, 1989, p. 7).

Ericsson and Lehmann (1996) examined relationships between expertise, ability, and training, conducting a series of experiments and looking for correlations between them. They found that expertise often could not be expected to extend into other domains, but did not find clear evidence for either training or innate ability as the root of expertise. In one such experiment involving musicians, they asked teachers to divide students based upon their likelihood of career path, testing the assumption that the most gifted students would be placed within the group destined for great success. Instead, they found that the difference in the groups was simply in how many hours they trained each week, with the students who trained more seen by their teachers as more likely to succeed.

In another experiment, Ericsson and Lehmann (1996) found that college students given 50 to 200 hours of practice at memorizing numbers, names, or pictures would perform significantly better at recall after the training. Similarly, others found that topic knowledge can affect both comprehension and recall of narratives (Chiese, Spilich, & Voss, 1979) as well as writing about a topic (Voss, Vesonder, & Spilich, 1980). But other researchers note that experience over time and casual or leisure-based experiences often stall after achieving a basic level of competence, with further improvements unpredictable and somewhat arbitrary (Ericsson & Lehmann, 1996). It is rather the accumulation of specific, deliberate practice that is often the hallmark of superior performance in many fields, constrained by amount of effort, availability of resources, and motivation. Ericsson, Krampe, and Tesche-Romer (1993) believed that experts in domains with especially difficult advancement seek out experiences or activities especially designed for certain skills or personalized to their needs. They examined violinists and pianists for evidence of the effects of deliberate practice, using journals to examine their habits and schedules over time. While much of the data was specific to individuals, they found patterns of sustained deliberate practice as the hallmark of the most talented musicians.

Even though in many domains training or extended experience improves the performance of experts, some studies have shown that there are domains where this is not the case, where experts perform no better than those with less training. Dawes (1994) examined the state of the profession of clinical psychology, primarily to see how licensing and division of that profession into medical and non-medical practitioners was affecting care to patients. Dawes based the definition of expertise upon the type of degree or certification held by the practitioner, reasoning that those with more advanced or rigorous degrees had more training and therefore would have better results. The finding that there were few differences in clinical outcomes based solely on experience was considered surprising considering the extant belief in degree or certification as a benchmark for expertise. Similarly, Camerer and Johnson (1991) asserted that while experts might have more training or exposure to domain knowledge, they often use configurable rules with only a subset of the variables involved to make decisions, which can then lead to poor outcomes. This idea is particularly interesting when examining expertise in domains such as searching, where expertise has often been associated with formal training in search or where status as a search intermediary was considered to make one an expert (Fenichel, 1981; Hsieh-Yee, 1993; Turner, Kaske, & Baker, 1990; Marchionini, Dwiggins, Katz, & Lin, 1993). This again raises the question of whether training does in fact lead to better, observable outcomes and could complicate studies that separate users based upon those outcomes.

More recently, Simonton (2000) specifically examined classical composers to determine whether domain experience or innate talent was the key to creative development. After longitudinal examination of classical composers, Simonton concluded that creative expertise did not reliably follow the predicted developmental trends and that success in this creative field did not seem to be predicated upon either experience or perceived talent. Cross (2004) agreed, examining expertise in design and concluding that it seemed significantly different than expertise in other fields. Clearly, the extent of the influence of talent and experience has not yet been fully determined. Additionally, with many of those learning a profession or domain improving only up to a certain level, or with unpredictable improvement based upon experience (Ericsson & Lehmann, 1996), other individual variables, like talent or cognition, must be considered.

2.1.2 The Cognitive Viewpoint

Much of the modern study of expertise came from the emergence of cognitive science, which in turn came from interest in building artificial intelligence systems and expert knowledge systems. Hoffman (1996) noted that the challenge for cognitive science was not only to agree upon a definition for expertise, but to operationalize its development, knowledge structures, and reasoning processes so that experts could be identified. He also noted several aspects of expertise, stating that the "development of expertise involves a progression from a superficial and literal understanding of problems (a qualitative mark of the cognition of novices) to an articulated, conceptual, and principled understanding (a qualitative mark of the cognition of experts)" (Hoffman, 1996, p. 83). He maintained that expertise had distinct levels and that progression through those levels was generally predictable. Levels would be skipped only rarely and only a lack of practice would result in a regression to a prior level. Hoffman categorized novice problem representations as concrete or superficial, compared to the expert use of knowledge or deep understanding to create abstract representations. He also noted that practice could cause a skill to take on the quality of an automatic reaction rather than a conscious one. These ideas not only specified that the thought processes of experts and novices were inherently different in some way, perhaps because of their specific experiences, but also that expertise contained the ability to solve problems within a domain, using the tools of that domain.

Other studies of expert behaviors noted that experts generally excel at organizing information, recalling information, and applying that knowledge to tasks within a specific domain (Feltovitch, Prietula, & Ericsson, 2006). The critical aspect of experts' working memory is not the amount of information stored, per se, but rather how the information is stored and indexed in long term memory. Hatano and Inagaki (1986) called expertise adaptive, arising from both rote learning and experimentation and consisting of two dimensions, efficiency and innovation. Burgman, Fidler, McBride, Walshe, and Wintle, (2006) believed that decisions and judgments were based upon our memories of what we know. If experts have an advantage in recalling information based upon specific organizations of information, it follows that their decisions would correspondingly be better than those of novices, even novices with similar prior exposure to knowledge. While IQ or other basic measures of capacity do not serve to differentiate the top artists or scientists (Taylor, 1975; Ericsson & Lehmann, 1996), experts with extended experience in a field are likely to have acquired complex patterns of thought that they can use to manipulate information and solve problems.

But it is difficult to know what subjects might be thinking at any given time, or what mental models they might be using to structure knowledge (Ericsson & Charness, 1994). To complicate matters, Ericsson and Simon (1993) found that having subjects simply verbalizing or stating aloud what actions they were taking did not introduce any cognitive changes, but that asking them to explain their cognitive processes did result in changes to those processes. Additionally, Feldon (2006) later found that free recall of strategies introduced errors and omissions not present in more structured approaches. As expertise progresses, the expert also often loses their awareness of what they know and what knowledge is needed for the expertise they demonstrate (Hoffman, 1996), implying that the processes that need to be examined in experts are the very processes that are altered by examination.

Other cognitive processes might impact novices and experts differently, complicating comparisons between them, especially processes involved with effort and difficulty. Tverdeski and Kahneman (1974) examined cognitive processes and the use of heuristics and biases in experts and novices, and they concluded that both groups can be affected by bias, albeit that the actual heuristic in play could be different for the two groups. Chi (2006) agreed and noted a number of cognitive reasons why experts might fail to perform in comparison with non-experts, including over-confidence, bias, and inflexibility of thought. Similarly, the decision processes in satisficing (Simon, 1979) could potentially affect both groups, although again likely in different ways. Individual actions might be affected by a “Principle of Least Effort” (Zipf, 1949) causing a user to take actions based upon how much effort they must expend. Information Foraging Theory (Pirolli & Card, 1995) similarly posits that users evaluate their perceived cost of acquiring information with their perception of its value to determine whether to engage in the activity to gain the information. Wilson (2006) also asserts that users will adopt very simple search strategies in seeking information, perhaps causing both experts and novices to behave in more unpredictable fashion. Smith (2014) studied search behaviors of searchers who were formally trained in the use of Dialog, specifically examining DISE (domain independent search expertise) and found similarities in how people monitored the search space as well as progressed through the search task. She proposed that gaining this procedural knowledge allowed trained searchers to focus their attention and guide shifts of attention during a search.

Potentially, these and other cognitive processes might apply differently as expertise increases. Research indicates that increased experience in a domain can influence users to prematurely end information gathering more often than less experienced users (Eva & Cunnington, 2006). Additionally, as knowledge structures grow, solution strategies are subconsciously proceduralized and overall flexibility can lessen (Frensch & Sternberg, 1989). For this reason, less-experienced scientists are also widely believed to have a better chance of radical discoveries than do more experienced scientists (Kuhn, 1970). Clearly the cognitive aspect to expertise is complicated, and many researchers therefore focused on bounded, well-defined domains to help keep other variables in check.

2.2 Expertise Within Domains

The study of expertise has included not only observation of its effects but also how it might be understood and taught in specific domains. This focus on learning specific domains assumed that expertise was attainable by every novice and that expertise could be quantified by comparisons between experts and novices. Expertise was therefore viewed as an attainable skill that could be, and should be, understood to facilitate the maturation of novices into experts (Chi, 2011). Educators also applied these ideas of expertise to their own profession, separating it into domain knowledge and pedagogy, the practice of teaching, also acknowledging that these two aspects are innately tied together within the community of practice (Kinchin, Cabot, & Hay, 2008). Essentially, in this theoretical construct, expertise is something that is practiced rather than something that is described; it is prescriptive rather than descriptive, with aspects including skills acquisition, decision making, and problem solving (Kennedy, 1987).

As noted earlier, Chi (2006) detailed the stages of expertise as Novice, Initiate, Apprentice, Journeyman, Expert, and Master – stages that often take years of study or training.

Finding a way to shorten this training to reduce costs and solve problems faster has therefore been a central focus of expertise research in both education and in the creation of expert systems. Within education, expertise is often developmental, meaning that third graders are assumed to be novices when compared to sixth graders. This focus on development explains the focus within education on effective training of novices into experts.

But researchers quickly learned that the real problem they faced was not in circumventing some bottleneck in acquisition of knowledge, but rather a problem of cognition, with research suggesting that the most promising methods simulated tasks that were already familiar to the learner or instilled familiarity with difficult cases (Hoffman, 1996). Complications also arose when research showed differences in comprehension and memory (Chiese, Spilich, & Voss, 1979) and writing ability related to a domain (Voss, Vesonder, & Spilich, 1980). Researchers were forced to face the fundamental question of how to teach the cognitive processes involved in advanced representation of problems in that domain.

Chi, Glaser, and Rees (1982) performed a series of studies to investigate the differences in how novices and experts might organize and represent physics problems. They found that novices did not have trouble identifying relevant keywords, but that those keywords did not help them understand the underlying principles. While experts used the keywords to make inferences about the problem and the overall principles involved, novices focused on the primary clues of keywords and diagrams. They concluded that it is not clear how to teach this method of association or deeper understanding, and that individual differences make it difficult to study the phenomena.

Others, like Logan (1990), applied already existing instruments specifically to the training of novices into experts. Using an instrument designed by Kolb (1973) that was already used to measure learning preferences, Logan looked for evidence that particular environments based upon these learning styles might give an advantage to particular users doing searching tasks. His results showed some differences in methods based upon their learning style classification, but was forced to conclude that experience would lead to adaptability and difficulty in prediction. This conclusion illustrates the difficulty in determining the success or failure of particular methods based upon individual characteristics of users.

Similar difficulties arose in attempting to quantify expertise. Lajoie (2003) used CTA (Cognitive Task Analysis) to propose a structure for researching and fostering expert development. He called for the creation of individualized trajectories with milestones that showed dynamic assessment, but did not specify details beyond urging to use a structured, documented methodology. Shanteau, Weiss, Thomas, Pounds, & Hall (2003) created a ratio based upon discrimination and consistency to measure domain expertise, but acknowledged that there were issues with its use. They did apply it to several prior studies with promising results when using it to differentiate expertise and evaluating results sets.

Alexander (2003) proposed a combined model of expertise called the MDL (Model of Domain Learning), based upon real-world experiences in schools. The MDL focuses on three aspects of expertise: knowledge, strategic processing, and interest. The authors differentiate it from prior efforts by stating that it focuses on academic domains, includes motivational and affective components, includes social factors, and focuses on the journey rather than the end states. Interestingly, the model also includes both domain expertise and topic expertise. Its validation in multiple academic domains and its integrated model make it a potentially valuable tool in both academia and other areas.

Still, other researchers made progress in their conceptualizations of expertise within particular domains and with the goal of expedited training. Meyer and Booker (1990) separated what they called substantive expertise, consisting of training, experience, and knowledge of a particular field, from normative expertise, which is the social aspect of being able to communicate within the field using its conventions and jargon. They argued that both skills were critical to be an expert in a domain, but needed different types of training. Walton (1997) also asserted that the expert's relationship to other experts in that domain was important, as well as their prior opinions. Collins and Evans stated that "expertise is, therefore, a social process – a matter of socialization into the practices of an expert group" (2007, p. 3). Hoffman (1996) agreed, stating that knowledge resided within social groups rather than as an isolated concept. More recently, Hashem, Chi, and Friedman (2003) studied how expert physicians diagnosed patients in multiple specialties, including their own. They found that within their own specialty they listed more cues in their diagnoses than when writing a diagnosis outside their specialty. Interestingly, they also saw what they interpreted as a bias in these specialists, who pulled cases towards their specialty. They speculated that training could be accelerated by teaching the physicians the specific cues used by specialists in other areas, assuming that they already knew the cues themselves from their training. Perhaps focusing on training novices in the "way things are done" is the shortest path to expertise. But educators often do not agree on identification, quantification, and transfer of expertise within teaching itself, much less other domains (Lampert & Clark, 1990).

2.2.1 Expertise in Chess

Early researchers in expertise looked for well-defined and bounded domains to study that included recognizable and demonstrable levels of skill. One of the areas that yielded interesting results was in the study and play of chess. While each game followed the same rules and used the same pieces, the play of the game was different each time and required use of more than memory to succeed. In fact, much of what we know of expertise is a direct result of the study of chess and chess masters. De Groot (1946), a chess master himself, is widely considered to have been a pioneer in studying and quantifying aspects to mastery in chess. He demonstrated that asking participants to choose the next move when presented with random chess configurations was an excellent way to allow for predicting levels of expertise. He further found that asking expert and world-class players to think aloud while considering their next move discovered interesting differences in their ability to recognize promising potential moves. Further, even after only a brief exposure to unfamiliar board setups, the best players were also able to reproduce almost exactly the position of every piece, compared to much less recall from the players with lower levels of skill. Interestingly, he also noted no real difference in speed of thought processes or function of their general memory, confirming the results of earlier research. However, he did determine that experienced chess masters had a greater ability to recall entire boards of chess positions. This demonstrated ability was the impetus for several theories of the cognitive processes involved in domain expertise, as noted earlier.

Chase and Simon (1973) duplicated de Groot's experiments but added the aspect of random, illegal chess positions to further demonstrate that experts did not have innate photographic memory or an edge in recall in those situations. Recall of these positions was poor from all participants regardless of skill. They originally theorized that superior performance by experts on legal configurations was due to the experts' exposure to or knowledge of patterns of pieces, allowing them to use fewer resources to remember them. They theorized that experts were able to chunk these known patterns of information that were organized in familiar ways to get around their short-term memory limitations of about seven chunks (Miller, 1956). This finding has been very influential in studies of expertise within several domains, with an elegant solution explaining the way in which the experts outperformed those with less skill.

Gobet (1998) examined four major theories of expertise, all related to chess, with the goal of determining which best fit the observed data. He detailed Chunking Theory as well as SEEK Theory, Long-Term Working Memory Theory, and Template Theory, concluding that each theoretical framework had explanatory gaps but that Template Theory provided the best explanation for the data. Template Theory extends Chunking Theory with the idea that repeated exposure to specific types of situations causes the expert to develop sophisticated templates that serve to inform subsequent encounters. Later, Gobet (2009) examined intuition and concluded that the intuition of experts could also be explained using the Template Theory framework, linking the templates not only to cognitive processes but to affective ones as well. While the study of chess and chess masters has been informative in conceptualizing expertise, it provided few answers on the way in which expertise might be taught or in how experiences might be designed to increase expertise.

2.2.2 Domain Expertise and Information Retrieval

Domain expertise has played an important role in the study of information retrieval, due to a need to distinguish the “knowledge of a subject area (i.e., domain) that is the focus or topic of the search,” (Wildemuth, 2004, p. 246) and the “knowledge of searching techniques” (p. 247) when discussing the abilities of searchers to find the content they sought. Like Kennedy (1987), Solomon (1992) saw both domain and search expertise as arising from a process by which individuals change over time, each with their own particular strengths and limitations. Using this separation of searching expertise from domain expertise, researchers studied effects upon search term selection (Hembrooke, Granka, Gay, & Liddy, 2005), search tactics (Hsieh-Yee, 1993), search tactic formulation (Wildemuth, 2004), and knowledge acquisition (LaFrance, 1989).

Unfortunately, the tools used within information retrieval have not remained static, which has made it difficult to build research into a body of knowledge over time. Researchers additionally have disagreed on the exact nature of domain expertise, using frameworks like knowledge acquisition, problem-solving strategies, working memory, and automaticity to understand the differences between novices and experts (Feldon, 2006). Other complications arise when comparing research examining specific aspects of information retrieval like search tactics, where researchers have used inconsistent definitions of search moves, often leading to contradictory results (Wildemuth, 2004). Much of the research also has focused on the dual novice-expert state rather than the continuum between the two extremes. This focus can be useful for dividing participants into two groups of low and high expertise, but it is less useful when trying to describe actual skill levels compared to one another. This focus led Solomon (1992) to call for the use of four data points in novice/expert comparisons to gain a richer understanding of the novice/expert distinction. Additionally, some research in domain expertise and information retrieval has primarily examined novice/expert differences with an eye towards assisting novices to perform more like experts or to actually create expert systems to accomplish this goal. Logan (1990) noted that experts developed particular methods to increase their search effectiveness and noted that online systems might make use of those methods to assist novices during their searches, but also cautioned that these very methods might confound research in this area.

Borgman (1984, 1986a, 1989) examined individual differences of users of experimental retrieval systems and found that many of the individual characteristics, including domain knowledge, were interrelated. Borgman extended these experiments, in part, to try to explain why some users succeeded in the initial experiments and some did not, concluding that technical attributes of the users had a greater impact upon results than did personality differences. Conversely, Hsieh-Yee (1993) compared search strategies between novice searchers and expert (professional) searchers as they interacted with familiar and non-familiar topics. Hsieh-Yee theorized that expert searchers knew methods to cope with their reduced knowledge while novice searchers were poor enough at searching that domain knowledge did not assist them in formulating tactics. Marchionini et al., (1993) also compared domain experts with search experts and found differences in both their mental models of the search problem and in their search methods. In similar work, Kiestra, Stokmans, and Kamphuis (1994) found little difference between domain experts and novices using an online search catalog. Chadwick-Dias, Tedesco and Tullis (2004) examined expertise and age but found inconclusive results indicating relationships between all of their variables. Other studies (Vibert, Ros, Le Bigot, Ramond, Gatefin, & Rouet, 2009) showed no significant advantage to domain knowledge when searching PUBMed.

Zhang, Anghelescu, and Yuan (2005) measured domain expertise using familiarity with domain-specific terms, and then examined search behaviors, including number of searches, terms per search, and domain-specific terms. The study specifically looked for evidence that the level of domain knowledge affected the users' search behaviors and their search effectiveness. Zhang et al., found that as domain knowledge increased, so did the number of queries and the number of terms, but the results were not statistically significant. Search effectiveness remained the same for all users. The study speculated that the difference in domain knowledge between the groups was not large enough, perhaps explaining the lack of significant differences. Similarly, Duggan and Payne (2008) used a questionnaire and trivia topics and found that topic familiarity improved both search time and search performance.

White, Dumais, and Teevan (2008) examined log files, identifying medical experts by their use of PubMed, and found that domain experts used more domain-specific vocabulary as well as longer queries when searching in their domain of expertise. Later, they examined search behaviors in medicine, finance, law, and computer science, again using log files (White, Dumais, & Teevan, 2009). For this study, they continued using particular site usage as determinants for expertise and primarily used their results as a basis for predicting expertise through log files. While it is interesting to note that they did see some differences based upon grouping searchers solely by their use of particular sites in their log files, studies like this are limited because they are unable to determine the nature of the searchers or their specific information needs. Their conclusion noted that online systems could use their analysis to aggregate searchers into groups and personalize their results based upon the results of other searchers in their groups, or perhaps use the results from searchers defined as experts by these methods to supplement the results of searchers defined as novices. Again, this work relied upon access of a particular site to determine domain expertise and would be of limited use in domains with less obvious specific locations, but, potentially in some domains, aspects of behavior like this could be used to distinguish types of users in order to provide individual services. However, as discussed above, domain expertise also has a well-defined cognitive aspect apart from behavior, indicating that measures based solely upon behavior will be limited in usefulness and scope. In this particular domain, the interaction of search expertise and domain expertise introduced more complexity, with predictably inconclusive research results.

2.2.3 Discussion

Domain expertise has been widely studied in different fields using different methodologies, approaches, theoretical underpinnings, and focus. While early studies focused on acquisition of knowledge as a hallmark of expertise, later studies examined motivation and problem solving. Early research primarily focused upon defining expertise, examining the differences between novices and experts (Norman, Eva, Brooks, & Hamstra, 2006), or upon the generalizability of expertise (Ericsson, Charness, Feltovich, & Hoffman, 2006), while later research sought to measure expertise or provide an inclusive model to represent it.

Bricker and Bell (2008) emphasize the importance of expertise with regard to understanding learning, stating that:

> “Learning is therefore deeply bound up in an account of expertise development because one must learn what expertise means within the confines of the groups to which he/she belongs, learn what practices and other, possibly tacit, understandings are associated with that expertise, and learn which networks of people and resources are best able to socialize one into these practices and understandings.” (p. 208)

Unfortunately, the construct of domain expertise is complicated, as are the models and methods used to examine it, leading to inconsistent experimental results. Finding a consistent way to examine and measure domain expertise is critical to increasing any understanding of this concept. Nowhere is this more apparent than in the study of search expertise, which could be conceptualized as both the substantive part of expertise, consisting of the topic of task, and the normative part of expertise, especially related to how to use the tools and conventions of search.

2.3 Expertise in Information Seeking

The size and complexity of the Web make successful searching online a critical need for many, yet most agree that online searching remains difficult to study. The sheer amount of information available makes the task of searching particularly a significant, non-trivial task (Liaw & Huang, 2006), and the ever-changing nature of both the information online and the typical Web user make this even more challenging (Hsieh-Yee, 2001). Many users treat search on the Web as if they were consulting an encyclopedia (Aula & Nordhausen, 2006) or use it solely to find simple information about a topic (Rose & Levinson, 2004). But defining good searching or good searchers has also proven to be difficult. Past research has considered the user's background, personality, environment, and skill as possible variables affecting search outcomes. Yet online search expertise continues to be a difficult concept to define or measure, often equated to system experience, web experience, or computing experience. This is due in part to the fast-changing nature of the Internet as well as the dearth of measures of Internet skills (Hargittai & Hsieh, 2012). Research suggests that experience is a key factor in expertise, but the exact role of experience has remained elusive.

If experience plays a key role in expertise, then it is particularly important in online search expertise, where differences in experience of the searchers could have significant impact on their results and the information that is available to them. Searchers do not always experience searches the same (Kelly, 2009), and different levels or types of experiences could affect the accuracy or completeness of the user's mental model of the system, leading to experienced users with non-homogeneous skillsets (Taylor & Tversky, 1992). Borgman (1986b) and Kim and Hirtle (1995) studied prior experience with a particular electronic system and concluded that experience could indeed create a framework or structure for a user's mental model for that system. But experience, while a key concept in online search expertise, is not a simple construct that can be easily measured or developed. The unfortunate consequences of this complexity have been inconsistent definitions and operationalizations of both search experience and search expertise within the literature of Information Science (Vakkari, 1997).

The prevalence of inconsistent measures of search expertise as an independent variable in information seeking research has all too often led to result sets that cannot be compared (Vakkari, 1997). In fact, search experience and search expertise are often used interchangeably when separating experts from novices, or are even used without definition at all. Clearly, experience plays a role in search expertise, but other factors must also be considered, possibly including familiarity with computers, environment, cognitive style, analytical abilities, and structured learning. With the ubiquity of the Internet and searching, search expertise is a key concept in information use that should be used and measured consistently in future research.

2.3.1 Early Concepts in Search Expertise

Early research in search expertise necessarily took place around database systems, especially the new online catalogs that were being used by many libraries. This change occurred in a time when few believed that end users could do their own searching (Tenopir, 2008). The focus of much of this research was therefore examining the system experience held by researchers and learning how to help or train the end user to use the system more effectively. Expert searchers in these systems were often compared to inexperienced searchers to find specific skills that could be taught to the novice. Implied in this research was the concept that search expertise is based upon experience (Fenichel, 1981) and that experience could be quantified and taught effectively. Search expertise was therefore often defined in terms of system experience (see Table 2). It should also be noted that being a good searcher was rarely discussed other than operationally. This focus on the process of search rather than its conceptualization could have been due to the rapid changes taking place in online systems or the focus of many in the training of end users of search systems. Much of the research in this period also relied heavily upon comparisons of trained searchers or librarians with novices, and did not explore search expertise much beyond that dual distinction. Grounding the research in this way was perhaps inevitable, with new online catalog systems and shrinking library budgets as strong forces in the field. Lack of agreement of how to conceptualize search expertise combined with the focus on observable search skills led to operational definitions when it was used in research.

Even so, some researchers were expanding the concept of search expertise to include other factors. Marchionini and others (Marchionini, Lin, & Dwiggins, 1990) examined the interaction between domain and search expertise in a series of experiments using primarily hypertext databases. They compared three groups of searchers: domain experts without search training, search intermediaries without domain expertise, and novices with neither expertise. This study and a subsequent study (Marchionini et al., 1993) found that, while the two groups had similar results, they obtained those results through different methods. Domain experts favored conceptualist approaches while search experts favored operationalist approaches. Later, Hsieh-Yee (1993) used her results to argue that any online system designed using the model of the professional searcher would not adequately address the needs of a novice searcher.

Interestingly, one of the earliest researchers, Bates (1979), explored experience as a special type of skill based upon problem solving and prior experience with similar problems. This idea of competence born out of experience would influence much of the later work in search expertise. Similarly, Fenichel (1981) noted that the search process was sensitive to factors other than the searcher's skill and the difficulty or nature of the task, and also grounded these ideas into specific experience with specific systems. Some, like Vigil (1983), theorized that it was the quality of interaction with the system that showed search expertise rather than the time spent using it. Bellardo (1985) theorized that search expertise was a quality of the mind or personality traits of the expert, and Borgman (1986) tied both system experience and inherent talent into a single idea of search expertise that included both. Dervin and Nilan (1986) cited a need for researchers to focus on the individual aspects of the searcher instead of the system. Many of these concepts were extended or explored by later research.

Table 2: Early Search Expertise Definitions

Date	Researchers	Definition
1979a	Bates	"the specifically human, psychological processes involved in searching" (p. 205)
1981	Fenichel	"underlying assumption was that skill is strongly related to experience" (p. 24) "working, online search analysts…regular users of DIALOG" (p. 24)
1983	Vigil	"…it is the simultaneous cognitive processes that bring together the individual parts of a search into an amalgamated and cohesive whole." (p. 281)
1984	Harter	"problem-solving, conceptual skills" (p. 250)
1985	Bellardo	"best searchers must possess…high creativity…forceful, but helpful personality…high intelligence" (p. 242)
1986a	Borgman	"people can use the system better if they have a correct mental model" (p. 48)
1989	Marchionini	"performance in applying principles or tools is dependent on dynamic internal representations of those principles or tools called mental models." (p. 56)
1990	Allen	"experienced in using all of the CD-ROM databases available" (p. 70)
1990	Marchionini, Lin, and Dwiggins	"We consider expertise to be dependent on well-developed mental models…Thus experts understand the concepts and relationships specific to a domain and are able to apply this knowledge to solve problems." (p. 129)
1990	Turner, Kaske, and Baker	"experienced searchers would have established a repertoire of cognitive structures to use in identifying critical information" (p. 36)
1991	King	"experience with the PaperChase system" (p. 361)
1993	Hsieh-Yee	"professional searchers who have at least one year of search experience and have either taken course(s) on online searching or attended workshops provided by system vendors" (p. 163)
1993	Pao, Grefsheim, Barclay, Woolliscroft, and Shipman	"total number of online sessions" with Medline, or "number of topics searched…number of successful searches conducted…number of online hours accrued." (p.545)
1993	Qiu	"amount of prior experience subjects have with computerized information retrieval" (p. 414)

2.3.2 Early Measures Used for Search Expertise

The early emphasis on experience, especially database experience, as a reasonable substitute for search expertise also heavily influenced the measures used in early research (see Table 3). Unfortunately, these measures were not consistent across research efforts. While many researchers discussed the difference between novices and experts, many did not specifically state the criteria that they used to distinguish these groups. Those that did state their criteria often selected it ad hoc or without formal process. In some cases, the comparison of experienced or trained searchers to end users or novice searchers was a critical part of the research, but specifics were not given on how the groups were defined. Many of the measures were based wholly upon some aspect of experience: time spent searching, number of sessions, or number of systems.

Even though much of the work in this period relied upon experience with databases as a yardstick for search expertise, many noted that this measure in and of itself was not adequate. Fenichel (1981) used prior experience with ERIC as a basis for search expertise, but also noted that there was considerable variation in individual search approaches and that even experienced searchers still had a lot of room for improvement. Borgman (1986) tried to combine concepts of inherent individual differences with training in systems use and argued that individual differences in system users should be assessed and used in system design and training. She listed important variables as experience with computers, experience in task domain, technical aptitude, age, sex, and affect or personality. Fidel (1984) noted that early results showing no association between search experience and search outcomes could be due to small sample sizes or inadequate dependent variables and also pointed out that the assumption that greater interaction with a system was desirable or better was not necessarily true (Fidel, 1991).

Table 3: Early Search Expertise Operationalizations

Date	Researchers	Operationalization
1979a	Bates	Classification of search moves into overall strategies as well as specific tactics.
1981	Fenichel	Number of searches performed on ERIC and number of searches in the last 6 months. Specific guidelines were not given, but moderate experts had on average performed between 50 and 500 searches, with about 20 searches in the past 6 months. Very experienced users had more than 500 searches on average and around 100 searches in the past 6 months.
1983	Vigil	Use of the NOT function as an interaction with the system.
1984	Harter	Experience (0-2 years, 3-4 years, more than 4 years)
1985	Bellardo	GRE scores to measure intelligence, Interpersonal Disposition Inventory scores to measure personality traits, and surveys to measure creativity.
1986a	Borgman	Experience with computers, experience in task domain, technical aptitude, age, sex, and affect or personality
1989	Marchionini	Primarily based upon age of children.
1990	Allen	Number of database systems used
1990	Marchionini, Lin, and Dwiggins	Experts regularly conduct searches, are familiar with many sources or systems and can apply varied strategies.
1990	Turner, Kaske, and Baker	Experts had an advanced course in searching and/or extensive experience with online catalogs.
1991	King	MEDLINE novice less than 10 prior searches, intermediate 11-20, advanced 20 or more.
1993	Hsieh-Yee	Professional searchers with at least one year of search experience and training through a course or workshops.
1993	Marchionini, et al	Self-identified or identified by employment as search intermediary.
1993	Pao, Grefsheim, Barclay, Woolliscroft, and Shipman	Based upon number of sessions. Beginner less than 20 sessions over 30 months. Intermediate 20-40; Advanced 40 or more.
1993	Qiu	Self-reported perception of experience, divided into high and low groups.

Bates (1979a, 1979b) went so far as to define search strategies and tactics that could be measured as moves during a search session and used to quantify the difference between expert and novice searchers. Vigil (1983) specifically tested training users in the use of the NOT command on DIALOG systems and concluded that users must be specifically trained to solve specific retrieval problems. Bellardo (1985) examined search expertise as success in search and sought to determine and measure the cognitive or personality traits that led to it. She collected information on each participant including GRE scores to measure intelligence, Interpersonal Disposition Inventory scores to measure personality traits, and surveys to measure creativity. Unfortunately, her results showed no clear indication that cognitive or personality traits could be used to predict search success.

The lack of comparable independent variables for search expertise made it difficult to build the existing research into a coherent body of work. Similarly, many researchers have used the idea that users become more systematic as they become more experienced, but this is also operationalized only loosely as greater use of Boolean connectors or longer search strings (Cothey, 2002). The assumption of a connection between increased systematic searching and expertise needed further study, including the way in which it was operationized. To complicate matters, the environment being studied began to change with the meteoric rise of the Internet and the birth of search engines. Clearly, examining search within the confines of online databases was no longer sufficient.

2.3.3 Search Expertise on the Internet

The early examinations of search expertise were clearly tied to online catalogs and their use by patrons rather than the trained searchers who had previously used them. For some, focus on libraries and the limited usefulness of early search engines extended their interest in database or catalog experience as an indicator of search expertise. Table 4 at the end of this section shows a sample of studies using definitions of search experience or search expertise that explicitly focus on database or online catalog experience to separate novices from experts. Some compared Boolean and hypertext systems (Wolfram & Dimitroff, 1998), while others like Kim (2001) examined how experts in online databases used the new Altavista search engine. Much of this research found limited differences between their defined experts and novices (Meadow et al., 1995; Wolfram & Dimitroff, 1998; Vakkari, Pennanen, & Serola, 2003), found only differences in time spent on searches (Dillon & Song, 1997; Kim, 2001), or found limited indications of the influence of cognitive styles (Kim, 2000; Palmquist & Kim, 2000; Kim, 2001). Clearly, defining expertise based upon database experience was of limited usefulness.

Others extended this definition slightly to base search expertise upon general computer literacy or experience, including training in computer applications like databases but also including email. Table 5 at the end of this section shows a sample of studies that focus on overall computer literacy to separate novices from experts, although database experience is also a part of these studies. This research was also characterized by the lack of significant results throughout when comparing defined experts with novices (Fang & Salvendy, 2000; Zhang & Chignell, 2001; Koshman, 2004). Like database experience, it is clear that computer literacy by itself was not a useful basis for search expertise.

Additionally, one of the common ways in which computer literacy was measured was by asking the users to report it themselves. Typically, users would answer questions based upon their length of time online, their frequency searching online, or even their own perception of their skill level in searching. This self-reporting of their own abilities is based upon Bandura's Social Cognitive Theory (1977) and referred to as self-efficacy. Bandura posited that a person's beliefs about their own abilities were based upon their judgment of their ability to perform and that this perception was based upon the influence of both their personal characteristics and their environment. The theory focuses on specific sources for efficacy, including accomplishments from past performance, prior feedback, and changes in emotional state or arousal based upon those prior experiences. The theory also indicates that self-efficacy can be a self-fulfilling prophecy (Gecas, 1982), where users choose behaviors that support their initial beliefs. This general idea of self-efficacy was used by Compeau and Higgens (1995) to create a computer self-efficacy scale, or a measure of a user's belief in their ability to perform tasks using computers.

The idea of a self-efficacy scale was then used by Debowski, Wood, and Bandura (2001) to create a search self-efficacy scale, using concepts from library science. This scale was later tested and modified by Kelly (2010), and then tested again by Brennan, Kelly, and Zhang (2016). Their results indicated that the scale was not yet sensitive enough to discriminate between different levels of search expertise. In fact, criticism of self-efficacy theory notes that the link between self-efficacy ratings and observed behaviors has not been fully established (Biglan, 1987) and that other factors in the environment could also affect observed behavior. Additionally, self-efficacy judgments can be initially overconfident concerning cognitively complex tasks without feedback (Stone, 1994). This supported Taylor and Brown (1988) in their argument that positive self-evaluations are relatively common in human cognition, as well as indicating the importance of feedback on results (Bandura & Jourden, 1991).

Others (Tsai, Chuang, Liang, & Tsai, 2011) note that relatively few empirical studies have been conducted to test the initial concept of self-efficacy. Tsai et al., also noted that search tasks were the most common task used to research Internet-Based Learning and that the studies that were conducted resulted in inconsistent findings, although there were indications of a correlation between self-efficacy and learning outcomes as well as attitudes about learning. They also note that most measures of self-efficacy used a questionnaire or survey to gather data and suggested that other methods might be more useful. However, often high levels of self-efficacy do not correlate with better outcomes. For many, it seems, experience and the self-efficacy that comes from it do not always lead to expertise.

The assumption that experience leads to expertise has been rejected by many as a flawed conceptualization (Shanteau et al., 2002). Fisher (1991) noted that novice users were frequently equated with naive users, and that there were distinct differences between a lack of experience and a lack of ability. He defined two axes to describe users – novice to experienced and naive to expert. Cothey (2002) agreed, stating that, although the general idea of systematic growth in experience leads to expertise is an appealing one, the reality is more elusive and more difficult to define. Some researchers have even asserted that the division of users into novice and expert groups has been arbitrary (Fisher, 1991). This leads to the conclusion that studies using experience as the only measure of expertise are at great risk of mislabeling individuals as experts erroneously. The assumption that a more experienced user is also more proficient in searching is inherent in operationalizations using experience to represent expertise, but potentially could be addressed by examining behavior as well.

Some researchers have in fact conceptualized search expertise behaviorally, with observable abilities. Table 6 at the end of this section shows studies that not only used measures of experience to distinguish users from experts, but also focused on their actual behaviors, although often not comparing the groups directly. Sternberg (2006) argued that expert abilities can be measured to show the different levels of expertise, including time spent to solve problems, accuracy in solving problems, use of strategies to solve problems, and creation of schemas to represent problems. The absence of these abilities is his definition of a novice. Since the typical query to a search engine is a series of words separated by spaces with an implied Boolean AND between them, some researchers posited that use of any other syntax displayed a higher level of search expertise (White & Morris, 2007). In fact, in summarizing end user searching, Markey (2007a, 2007b) lists generally accepted and demonstrated qualities of the end-user searcher:

- End-user searches bear few queries
- End-user search statements bear few terms
- Few end-user searches use BOOLEAN operators or quotes
- End-users usually accept system defaults
- Few end-users scan past the second page of results
- Most end-users are satisfied with their search results.

However, few of these researchers used behavior to separate and compare their users, choosing instead to simply infer or identify experts based upon their actions (White & Iivonen, 1999; Hargittai, 2002; Zhang et al., 2005; Macdonald & Ounis, 2007). Additionally, defining search expertise behaviorally does not address cognitive and affective processes within the user, although it does address the conceptual problem inherent in substituting experience for expertise.

As previously noted, online search expertise is a complex concept with many factors to consider both conceptually and in measurement. Conceptualizing search expertise as a kind of media competence could be seen as an attempt to find a middle ground between behaviorism and experience. This concept was put forward by Hölscher and Strube (2000) as “the knowledge and skills necessary to utilize the World Wide Web and other Internet resources successfully to solve information problems” (p. 338). Although this conceptualization is more for basic levels of competency rather than overall expertise, it is still useful as a starting point. Indeed, examination of research shows that many researchers have coalesced around this idea, as shown in Table 7 at the end of this section. Common ideas for establishing search expertise in this group include years of experience online, knowledge of how search engines work, number of sources used, frequency using the web, proficiency at Internet tasks, experience browsing, experience with query manipulation, and frequency of use. While none of these studies combines all of these concepts into a coherent summation of search expertise, clearly they are attempting to extend the measuring of that expertise into different areas.

What is particularly interesting is to note where results were seen within this body of research and then also note the way in which search expertise was defined for those studies. As noted, Hölscher and Strube (2000) defined web expertise as a type of media competence involving both knowledge and skill and argued that frequent use of search engines would lead to development of expert knowledge related to mastering those resources. In their research, they built a model of expert behaviors and examined the query log of the German search engine Fireball. They found that experts used more terms than the average number found in the search log (3.64 words vs 1.66 words) and that experts were more inclined to use advanced search features like Boolean operators. They found that their experts used more query formatting tools than novices (87% to 47%) and also selected more target documents for inspection (35% vs. 25%).

Bilal (2000) used general Internet experience, experience using Web search engines, use of the Yahooligans! search engine being studied, and prior knowledge of some of the features of the Yahooligans! system to separate experts from novices. During the study, individual moves made by the participants were scored relevant, semi-relevant, or non-relevant. She found that the children in the study frequently shifted between activities while interacting with the system – keyword searching, visiting sites, browsing subject categories, and searching by keyword in a particular subject category, perhaps indicating the importance of experience with those tools. She concluded that system design and the children's prior experience both influenced how the children interacted with the system.

Similarly, Chen (2000) used experience searching on the Web, experience with point and click interfaces, and experience with online catalogs to separate experts from novices. Results indicated that experts performed better on text-based interfaces. Saito and Miwa (2001) used similar measures and found differences in time used and selection of sources. Slone (2002) also used a range of experience to compare experts and novices, finding that experts used more varied approaches than did novices.

Aula and Nordhausen (2006) noted that, although many researchers had used Web experience as a measure to separate novices from experts, it had been an ambiguous and inconsistent measure that prevented the results to be compared between studies. For their study, they made a point of choosing general Web experience over computer or search experience, using both length and frequency of use. They also argued that search success consisted of both efficiency, measured by completion time, and effectiveness, measured by number of tasks completed. They defined success as a measure they called task completion speed (TCS) that included both completion time and effectiveness and found differences between their experts and novices in the more complex or broader tasks. They speculated that their results confirmed the link between experience and expertise, although they also state that many of their results are inconclusive.

These studies all share similar methods to differentiate experts from novices, using experience as a factor, but including other factors as well. Some of these were simply examining experience in a broader way, or using several different kinds of experience. Others added in frequency of use or other online skills to differentiate their users. Others, like Cothey (2002) used a within subject method over time to infer growth of expertise during a longitudinal study. The study found that users actually used the Internet less often and more sporadically as their experience grew and that participants used more passive browsing and link clicking behaviors rather than searching. Unfortunately, the method did not allow examination of the tasks performed by the users to see if they remained constant, nor did it allow for an examination of the users themselves.

Other researchers did not find clear differences when comparing their experts to novices. Navarro-Prieto, Scaife, and Rogers (1999) selected their experts based upon college major, years of experience using the Web, and knowledge of how search engines worked. They noticed that their experts sometimes used more specific queries or structured approaches than their novices and concluded that novices could be more influenced by the external representations presented to them, perhaps indicating the effects of cognitive load. Lazonder, Biemans, and Wopereis (2000) used prior Internet experience and proficiency on 12 Internet tasks, finding that their expert users sometimes, but not always, performed faster than their novices. Specifically, their experts performed the web site location tasks faster but not the tasks involving finding information on a web site. Sutcliffe, Ennis, and Hu (2000) and Ford, Miller, and Moss (2001) used similar measures of general experience online, experience searching online, and experience searching databases with similar unclear results. Jenkins, Corritore, and Weidenbeck (2003), also used computer use and online experience and found that search expertise interacted with subject knowledge but the actual interaction was unclear.

Chevalier and Kicka (2006) also used time spent online and overall experience online as a basis for comparison, but identified three distinct groups of users: novices, experienced users, and web designers. They examined cognitive load using ergonomic and non-ergonomic websites, finding some differences in number of links or steps needed for tasks as well as time needed to complete the task These differences, however, were inconsistent between groups, and no clear difference was found in their measure of cognitive load. Thatcher (2008) used similar measures but defined them as continuous variables rather than discreet ones as in prior studies. He asked participants questions related to their frequency of use, location of use, tasks performed, training, length of use, current use in hours per week, and a self-rating. He found few differences in measurable search outcomes, but noted that the method by which those outcomes were obtained was different based upon experience. This result implies that the tasks examined in research might not be discriminatory enough to measure the effect of search expertise on search success.

More recently, Ishita, Miyata, Ueda, and Kurata (2017) examined information retrieval skills, dividing them into formal Internet skills, operational skills, assessment skills, and search strategy skills. These categories were based primarily upon similar categories from van Deursen, van Dijk, and Peters (2011). Their research used a large group of participants in Japan who were required to complete their online survey. The results were then examined using factor analysis and structural equation modelling. They reported that critical thinking ability and self-efficacy positively influenced the participant's skill level of information retrieval. Unfortunately, the construct of critical thinking suffers from many of the same issues discussed here for online search expertise. While interesting, the lack of conceptual and operational definitions of critical thinking ability limits the usefulness in applying it to online search ability. The authors do note the need for additional work.

Unfortunately, the criteria for measuring search expertise and search experience have varied widely between individual studies (Aula & Nordhausen, 2006; Moore, Erdelez, & He, 2007), even those studies sharing similar conceptualizations, making it difficult to compare results between them. The users defined as experts in one study could be defined as novices in another study. This lack of consistency prevents the comparison of the results from different studies in any meaningful way. It also leads to uncertainty when evaluating results that might seem contradictory between studies. This inconsistency again points to the use of operationalisms of online search expertise rather than conceptual models and is perhaps due to the idea mentioned above that it is an active ability. Although it is clear that researchers are starting to come together conceptually regarding search expertise, this has not yet been translated into specific measures that can be used and compared.

Many researchers have also examined the differences between domain expertise and search expertise to determine which was more beneficial. Allen (1991b) found differences between searchers with different levels of topic knowledge using an online library catalog system, primarily in search terms and number of search expressions, as well as recall. The measure of topic knowledge used was familiarity with vocabulary words related to the Voyager 2 exploration of Neptune, the topic for the study. Other differences were also noted, including the fact that high-knowledge searchers used more search expressions and more terms not in the topic descriptions. The researcher concluded that these indicated cognitive differences as well as the measured vocabulary differences.

Other research examined particular aspects of search behaviors with respect to expertise. Wildemuth (2004) examined the tactics used by searchers in an effort to understand how they formulate and reformulate search strategies, examining differences based on domain knowledge. She found that her participants moved through cognitive models at greater frequency when their domain knowledge was low, a result she attributed to the number of changes needed by students to retrieve appropriate records. She also noted that the sequence of moves changed as domain knowledge changed, although increased familiarity with the interface may have impacted those results. Hembrooke et al., (2005) also explored differences between domain experts and novices in generating search terms both with and without feedback. The study measured the presence or absence of search strategies, indicators of complexity, and time per trial. The results indicated that novices engaged in fewer effective strategic search behaviors and that domain experts used elaboration more frequently and employed more complex and unique terms.

Table 4: Search Expertise operationalized as Database Experience

Operationalized As	Study	Use in Research	Results
Formal experience or training in database search.	Meadow, Wang, and Yuan, 1995	Differences between trained Librarians and novices in use of DIALOG.	Inconclusive results.
Prior online search experience with databases or training. Novices had less than one year online experience.	Dillon and Song, 1997	Examined differences in text and graphic interface.	Novices were slower.
Experience with Quicklaw database, by hours online self-reported. Divided into groups: no experience, initial training, prior usage.	Yuan, 1997	Examined use of tools and search in Quicklaw to perform tasks.	Experienced users employed more tools and features.
Experience with searching information systems, self-assessed. Placed into expert and novice groups.	Wolfram and Dimitroff, 1998	Compared groups use of hypertext and Boolean systems.	Differences seen in time and choice of system.
Experience in OPAC in last 12 months, self-assessed. Once a week usage was considered to be expert.	Vakkari, Pennanen, and Serola, 2003	Compared performance using PsychInfo.	Slight differences noted in use of facets.
Expertise in online database use, unspecified.	Kim, 2000	Compared impact of experience and cognitive style.	Some interaction between experience and cognitive style.
Experience with databases, self-reported.	Palmquist and Kim, 2000	Examined interaction of expertise and cognitive style.	Results indicate that cognitive style can influence the effect of expertise.
Expertise defined as frequent use of online database over a long period of time. Novices had no prior online database experience. Self-assessed and divided into 2 equal groups.	Kim, 2001	Compared information seeking on Alta Vista.	Novices took more time. Some interaction with cognitive style, especially for novices.
Self-reported experience with systems like DIALOG and BRS.	Larson, 2001	Compared two TREC systems.	Significant positive correlation with Recall.

Table 5: Search Expertise operationalized as Computer Literacy

Operationalized As	Study	Use in Research	Results
Regular use of computers	Pollock and Hockley, 1997	Examined Internet novices doing searches online.	Searches were a process, not an event.
Computer experience, Library search experience, web search experience, all measured in time, self-reported.	Fang and Salvendy, 2000	Primarily examining use of keywords.	No differences seen.
Trained to understand database structure, fields, indexing, and search strategies.	Debowski, 2001	Examined novice behavior using ERIC	Searches were effortful but poorly constructed and not planned.
Self-reported experience in computer applications like database management and electronic mail, specific ranges not given. Divided into High, Medium, and Low.	Zhang and Chignell, 2001	Effects of experience on mental models	Weak effect noted for experience.
Experience with computers and with DIALOG/VIBE. Experts had minimum of 3 years online experience.	Koshman, 2004	Tested use of prototype visualization information system.	No significant differences seen.
Categories of formal Internet skills, operational skills, assessment skills, and search strategy skills.	Ishita, Miyata, Ueda, and Kurata, 2017	Structural equation modeling to examine factors in information retrieval skills.	Results indicated positive influence of critical thinking ability and self-efficacy.

Table 6: Search Expertise operationalized as the Use of Experience

Experts "possess substantial knowledge related to the factors of information seeking, have developed distinct patterns of searching, and use a variety of strategies, tactics, and moves." (Marchionini, 1997).

Operationalized As	Study	Use in Research	Results
Comparing Pausal Behaviors	Huang, 2003	Dialog searches over a semester.	Pauses decreased over time.
Time spent searching, frequency of search, and knowledge and use of search tactics.	White and Iivonen, 1999	Not used for comparison.	None.
Task-oriented. Knowledge of Internet terms, prior use of browser features.	Hargittai, 2002	Not used for comparison.	None.
Experts identified as students in Library and Information Science. Novices were students of Psychology.	Madjid, Stephane, and Daniel, 2003	Examining web search and domain expertise.	Web experts performed better on searches.
Self-assessed by frequency of use and searching of databases, use of searching and browsing on the Internet, and use of advanced features.	Zhang et al., 2005	Primarily interested in domain knowledge.	Not shown.
Time spent to solve problems, accuracy in solving problems, use of strategies to solve problems, and creation of schemas to represent problems.	Sternberg, 2006	N/A	N/A
Observed use of operators or advanced syntax.	White and Morris, 2007	Used of advanced query syntax to identify expertise.	Experts showed more search success.
Retrieval performance on test system	Macdonald and Ounis, 2007	Used to identify experts for consultation.	None.
Observed use of operators and Boolean logic	Chu and Law, 2008	Development of expertise in ERIC database.	Changes in source ratings over time.

Table 7: Search Expertise operationalized as Media Competence

"the knowledge and skills necessary to utilize the WWW and other Internet resources successfully in solving information problems" (Hölscher & Strube, 2000).

Operationalized As	Study	Use in Research	Results
By major, computer science vs psychology. By years of experience using the web, determined in an interview. By knowledge of how search engines work, by interview.	Navarro-Prieto et al., 1999	Compared novice and expert searchers performing a variety of tasks.	Some strategic differences noted.
Exploratory study used sources, number of sources, time and frequency using the web, and informal evaluations.	Choo, Detlor, and Turnbull, 1998	Not used as basis for comparison.	None.
3 years of experience, daily use of the Internet, assessed by interview and pre-test (unspecified)	Hölscher and Strube, 2000	Compared Internet experts and novices on search tasks.	Some differences seen in tactics and task completion.
Novices defined as having less than 10 hours of experience on the Internet and self-identified as proficient in 4 or fewer of the 12 Internet tasks on the initial questionnaire. Experts defined as having 50 or more hours of experience and proficiency in 8 or more of the 12 tasks.	Lazonder et al., 2000	Compared experts and novices in search and browsing tasks.	Speed differences noted for experts in search tasks but not for browsing tasks.
Experience with the Internet (less than one month, 1-6 months, over 12 months), use of Web search engines (never, used one or more, used Yahooligans!), and knowledge of Yahooligans! features.	Bilal, 2000	Studying both design and experience.	Experience influenced system use.
Experience with point and click interfaces, with searching on the Web, and with online catalogs. Self-assessed.	Chen, 2000	Examining performance in spatial enviroments.	Experts performed better using textual interface.

Table 7 (cont.): Search Expertise operationalized as Media Competence

Operationalized As	Study	Use in Research	Results
Experience with browsing and searching in databases and online as well as general online experience.	Sutcliffe et al., 2000	Compared use of visual system. Experience primarily used as descriptor.	Unclear.
Experience with web search engines, Alta Vista, and Boolean search, self-assessed.	Ford et al., 2001	Examined whether experience correlated to search effectiveness.	No correlation found.
Search success, efficiency, accuracy, relevancy, starting and anchoring points, initial search terms, reformulation, number of cycles, and search time	Hsieh-Yee, 2001	Interaction of search expertise and subject knowledge on DIALOG.	Both influenced the tactics used. Experts also influenced by Subject knowledge.
Experience self-reported, based upon daily Web use and knowledge of search engines. Selected experts and novices based upon top 5 and bottom 5 scores. One expert removed as atypical.	Saito and Miwa, 2001	Compared searches of experts and novices.	Differences in time and selection of sources.
Experience assumed over time in longitudinal study	Cothey, 2002	Examined changes in query rate and web activity rate.	Noted less use of the Web and fewer queries over time.
Examined range of experience rather than depth of experience, including use of search engines, email, browsing, and url's.	Slone, 2002	Looking at patterns of search behavior.	More approaches used by those with broader experience.
Both computer use (5 years) and online experience (4.5 years).	Jenkins et al., 2003	Interaction of search expertise and subject knowledge.	Differences in groups noted, interaction between the two.
Hours of Internet use, Hours of Web searching, typical search tasks	Rieh, 2003	Not used to compare.	None.

Table 7 (cont.): Search Expertise operationalized as Media Competence

Operationalized As	Study	Use in Research	Results
Experience based upon age, use of search engines, browsing experience, use of email and chat.	Sloan, 2003	Primarily examining effects of age.	More study needed.
Search engine experience on a 7-point Likert scale using self-assessment.	Liaw and Huang, 2006	Studied attitudes towards search engines.	Experienced searchers had more positive attitudes.
Self-assessed using time spent online daily (1 hour or more) and overall experience online.	Chevalier and Kicka, 2006	Studied effects of site design (cognitive load) and experience using 3 groups – novices, experts, and web designers.	Differences noted but difficult to interpret. Some indication that design influences recall and experience influences number of steps to solve problem.
Search expertise variable had two levels (daily and less than daily). Self evaluation of search skills, skilled (ratings 4 and 5) and unskilled (ratings 1–3).	Aula and Nordhausen, 2006	Tested measure called TCS, using experience to divide groups.	Found link between experience and expertise.
Continuous variable translated to a 5-point Likert scale using length of Web use, hours per week, and self-assessment.	Thatcher, 2008	Effects of experience on performance measures and cognitive behaviors.	No real differences in outcomes, but some indication of differences cognitively.
Daily use of the web to search.	Duggan and Payne, 2008	Primarily looking at topic expertise.	None.

2.4 Information Literacy

While psychologists studied the cognitive and behavioral aspects of expertise, researchers in education were more interested in its development through training. This was in great part due to the publication of “A Nation at Risk” (The US Department of Education, 1983), a report that asserted that current curricula lacked the content necessary for students to succeed in a modern world and defined specific information skills needed for success. Information skills were loosely defined by this report, but were later defined by The American Library Association as information literacy, and stated that those who possess it "know how knowledge is organized, how to find information, and how to use information in such a way that others can learn from them" (American Library Association, 1989). Various models of information literacy exist, each with a different focus or in the context of different domains, but the most well-known are the Big 6 Skill model from Eisenberg and Berkowitz (1990) and the Society of College, National, and University Libraries' (SCONUL) Seven Pillars Model (1999). Unfortunately, many of the details of these programs are not available, so it is difficult to judge and compare the effectiveness of programs, much less the models they are based upon. However, these models do share the goal of first teaching information skills and then measuring them through testing.

Much like expertise, three major pedagogical approaches arose in information literacy: behaviorism, constructivism, and relational (Bruce, 1997). The behaviorist approach used rewards and punishments and manipulation of stimuli to change behavior in a learner. The constructivist focused on cognitive models and mental processes, theorizing that new knowledge is built as it is encountered and is based upon existing knowledge. The relational approach focused on the relationship between the learner and the information object. An additional pedagogy, situated or social learning, parallels the ideas in adaptive expertise by focusing on how users model behaviors based upon prior experiences.

Shapiro and Hughes (1996) proposed structuring information literacy into tool literacy, resource literacy, social-structural literacy, research literacy, publishing literacy, emerging technology literacy, and critical literacy. These categorizations are of particular interest with regard to search expertise in that it is clear that some level of familiarity with the tools, the format and location, the social situation, and the research practices would all play a part in measuring that construct. Langford (1998) asserted that information literacy was independent of tool and should be conceptualized as simply the means to solve information problems using learned behaviors, skills, and techniques. Conversely, Plotnick (1999) argued that there was empirical support to indicate that use of technology as a tool also increased abilities in managing information and communication. He argued that a willingness to embrace current and future technologies would be a key component of information literacy. Campbell (2004) argued that while existing definitions of information literacy were designed to be broad and inclusive, they still remained focused on educational settings. Sedera and Dey (2013) argued that measures cannot be all-purpose or they would risk losing functionality, making them much less useful. van Deurseb, van Dijk, and Peters (2011) categorized Internet skills into four types, operational skills based upon technical competence and proficiency, formal skills related to navigation of the Internet, content skills related to fulfilling information needs, and strategic skills related to goals and decision making. They discovered that educational attainment and Internet experience both had positive influence on operational and formal skills but less influence on content and strategic skills. Their work underscored the difference between technical skills and information-related content skills.

Many of these observations and lessons learned are useful when designing a measure of online search expertise. The different types of information literacy proposed by Shapiro and Hughes (1996) inform some of the categories used in the model in Chapter 3. The debate over the usefulness of tool literacy as a measure of information literacy echoes similar debates on the usefulness of database expertise as part of online search expertise. But it still remains unclear which tools or technologies are suitable for examination and use in measuring online search expertise.

Pomerantz (2006) argued that the widespread use of search engines has created a de facto competency that should be assumed and librarians should focus on higher-level skills. Ward (2006) similarly argued that information literacy is a fundamental part of our lives and experiences and we interact with it “individually and collectively, subjectively, objectively, emotionally, and analytically” (p. 396). Perhaps in the end we are, as Ward (2006) argues, just fish constantly swimming in a sea of information, unable to separate ourselves from it. This has important implications for measuring online search expertise, since in many ways search engines have become our de facto way of swimming and as long as we do not drown, we believe we are doing okay.

2.5 Summary and Discussion of Literature Review

The lack of a tested and validated measure of search expertise has hampered both research and practice. But the creation of such a measure is complicated, especially when many of the items currently used to measure search expertise were conceived when card catalogs and databases were the primary methods of finding information. Many of the items previously used by researchers were also used on an ad hoc basis rather than part of an overall model or conceptualization.

The overall summation of the use of search expertise in Information Retrieval literature both underlines the perceived importance of different types of experience as well as pointing out the inconsistent ways in which these experiences were actually used. The shift into measuring both experience and behavior shows that online search expertise is something that is expressed, rather than something that is possessed, a kind of *deliberate practice* (Ericcson et al., 1993).

Finally, the limited and conflicting results from the research comparing their identified novices to identified experts indicates that more remains to be included.

How we search, when we search, and why we search are more complex concepts than ever, so it is not a surprise that search expertise is also a more complex concept to conceptualize and measure. Experts can no longer be clearly defined by their experience with complex database retrieval systems, and searching experience is much more widespread than when many search expertise measures were developed, illustrating that search expertise cannot necessarily be equated with experience. Even formerly useful markers of search expertise like having an ILS degree are less useful when attempting to measure a continuum rather than simply sort participants into buckets named search experts and search novices. A clearer, more consistent and usable measure is needed. But that measure must also be guided by a clear conceptualization and definition of online search expertise that includes factors based upon current search systems rather than those of the past.

CHAPTER 3: Conceptual Framework and Methodological Approach

This chapter presents the conceptual framework for this dissertation, including a proposed model for online search expertise and a methodological approach. The first section details the way in which the preceding literature review was used to create a working definition for online search expertise. This is followed by a presentation of a proposed model for online search expertise. The definition and model presented in this section are based upon the results of the literature review. Both the definition and the model are updated in later chapters. The last section discusses the methodological approach that was used when creating a new measure and how that methodology was used in this research.

3.1 Defining Online Search Expertise

Conceptualizations of expertise itself have incorporated many different factors, including natural talent (Sternberg, 2006), skill acquisition (Ericsson & Charness, 1994), ability to communicate within a field (Meyer & Booker, 1990), training (Ericsson & Lehmann, 1996), efficiency (Hart, 1986), enhanced recall (Solomon, 1992), and cognitive development (Hoffman, 1996). Search expertise has been defined through psychological processes (Bates, 1979a; Marchionini, 1989; Turner, Kaske, & Baker, 1990), general search experience (Harter, 1984; Allen, 1990; Fang & Salvendy, 2000; Zhang & Chignell, 2001), database expertise (Yuan, 1997; Kim, 2000; Larson, 2001), actual use of their experience (Hargittai, 2002; Chu & Law, 2008), media competence (Hölscher & Strube, 2000), cognitive abilities (Ericsson & Lehmann, 1996; Hoffman, 1996; Feldon, 2006), and personality (Bellardo, 1985; O’Brien & Toms, 2008).

Thus, any conceptualization of search expertise must incorporate experience as well as cognitive, affective, behavioral, and situational aspects related to the searcher. It must also represent actual abilities to find solutions or, in short, be considered a kind of media competence that includes experiences online, proficiency at using online tools, and understanding of the Web and how search engines work, a concept put forward by Hölscher and Strube as "the knowledge and skills necessary to utilize the World Wide Web and other Internet resources successfully to solve information problems" (2000, p. 338). It must also include the actual use of the mental models and knowledge to solve problems (Marchionini et al., 1990).

Therefore, online search expertise is defined as a practical ability, a *deliberate practice* (Ericsson et al., 1993), something that must be used to have any meaning. As an ability, it includes both innate talents and learned skills, and individuals might exhibit different levels of ability over time. It includes aspects of experience, including domain knowledge and social adaptation, tool or platform use, vocabulary, and specific task familiarity (see Table 8, presented in the next section). It can be modified by both cognitive (see Table 9, presented in the next section) and affective state (see Table 10, presented in the next section) when it is being used. Formally, the proposed definition used during the initial stages of this research was as follows:

> *Online search expertise is an ability based upon skills learned from past search experiences, past experiences with platforms or tools, past experiences with corpuses or topics, past experiences working in domains, vocabulary, and other learned skills. It is also an active ability that must be used to be meaningful, and so that baseline ability is modified in the moment by both cognitive and affective factors like logical abilities, problem solving skills,*

cognitive load, personality type, concentration, motivation and engagement, and current emotions.

3.2 Modeling Online Search Expertise

This section outlines the development of the proposed conceptual model for online search expertise. The proposed conceptual model for online search expertise was based upon how it has been previously described and used in research, including the aspects noted above in experience, cognitive abilities, and affective state. The model here is presented not as an end result but rather as a starting point from which to examine online search expertise. It was expected that this model would change and grow as this research continued.

As prior research has shown, many of the factors comprising online search expertise are interconnected and difficult to separate into discrete categories. Sedera and Dey (2013) called expertise formative, multidimensional, and reflective, and suggested that attempting to describe it in a single model for all users would divorce it from important situational aspects. Indeed, even large scale divisions used in the past to structure online search expertise like domain expertise and search expertise have been shown to be very interactive (Jenkins et al., 2003). The proposed model must therefore use categories as a means by which to be inclusive of different skills or experience while understanding that these categories are loose groupings rather than exclusive and discrete.

Still, the selection of specific category labels remains important, even with the knowledge that they are not intended to represent specific discrete groupings. Shapiro and Hughes (1996) proposed using tool literacy, resource literacy, social-structural literacy, research literacy, publishing literacy, emerging technology literacy, and critical literacy as reasonable ways to structure information literacy, a related concept. This provides support for using some level of familiarity with the tools, the format and location, the social situation, and the research practices when measuring online search expertise. All of these factors might be loosely grouped into what can be called prior experience. Other specific factors for experience previously seen in research include social/domain experience, vocabulary, experience with the platform and tool, experience with the corpus, and specific experiences (see Table 8). Also listed in Table 8 are the researchers who examined or discussed these factors as they related to search expertise. It is clear that many aspects of experience must be included within any model of online search expertise.

Prior experience is not the only important aspect of online search expertise. Sedera and Dey (2013) included cognitive competence and motivation as well as skill-based constructs and years of experience in their model of expertise. Just as seen with categories of prior experience, aspects of cognition and affect are very intertwined and difficult to separate. Additionally, these factors can also be called conative, meaning the expression of cognitive and affective processes or the actual will or volition to perform an action that expresses those processes (Kolbe, 1990) rather than the actual processes themselves. For the purposes of this discussion, however, the factors will be grouped into primarily cognitive and primarily affective sets with the understanding that the actual expression of those states properly belongs to the conative realm (Bagozzi, 1992).

Table 8: Factors of Experience, with Definitions and Prior Research

Factor	Definition	Prior Researchers
Social/Domain Experience	The prior exposure to and participation in a domain, including exposure to the resources, methods, and traditions, called normative domain expertise by Meyer and Booker (1990).	Frensch and Sternberg, 1989 Meyer and Booker, 1990 Walton, 1997 Wildemuth, 2004 Collins and Evans, 2007 Bricker and Bell, 2008 Kinchin et al., 2008
Vocabulary	Defined by Merriam-Webster online as all of the words known and used by a person.	Chi et al., 1982 Hembrooke, Granka, Gay, and Liddy, 2005 Zhang et al., 2005 Elmborg, 2006 White et al., 2008
Experience with Platform and Tool	Defined by Shapiro and Hughes (1996) as the ability to understand and use a particular information technology, for example a particular search platform, such as a phone, or a specific search tool, such as a search engine.	Fenichel, 1981 Borgman, 1986b Allen, 1990 King, 1991 Pao et al., 1993 Qiu, 1993 Kim and Hirtle, 1995 Tyner, 1998 Wolfram and Dimitroff, 1998 Plotnick, 1999 Chen, 2000
Experience with Corpus/Topic	Defined by Shapiro and Hughes (1996) as Resource Literacy, or the searcher's prior exposure to the collected information being searched, as well as its structure and organization.	Chiese et al., 1979 Voss et al., 1980 Borgman, 1984, 1986b, 1989 Allen, 1991b Ericsson and Charness, 1994 Hashem et al., 2003 Wildemuth, 2004 Duggan and Payne, 2008
Specific Experiences	These are the actual information seeking problems and events the searcher has encountered in the past, called substantive expertise by Meyer and Booker (1990).	Fleishman, 1972 Glaser, 1987 Ackerman, 1988 Ericsson et al., 1993 Ericsson and Lehmann, 1996 Hoffman, 1996

Additionally, since expertise is defined above as *deliberate practice* (Ericsson et al., 1993) or something that must be used to have any meaning, the cognitive and affective aspects must be examined at their time of use so that aspects of situation and context are included. Again, these could be discussed as conative processes as well. Cognitive state then would consist of several factors, including cognitive structures, logical abilities, problem-solving skills, and cognitive load (see Table 9).

Table 9: Factors of Cognitive State, with Definitions and Prior Research

Factor	Definition	Researchers
Cognitive Structures	Defined by Piaget (1952) as the basic building blocks of intelligent behavior, they are patterns of physical or mental action that underlie specific acts of intelligence.	Borgman, 1986a Ceci and Liker, 1986 Glaser, 1987 Marchionini, 1989 Marchionini et al., 1993 LaFrance, 1989 Turner, Kaske and Baker, 1990 Solomon, 1992 Dufrense et al., 1992 Ericsson and Charness, 1994
Logical Abilities	Reasoning, including deductive, inductive, and abductive reasoning skills.	Burgman et al., 2006 Feltovitch et al., 2006 Sternberg, 2006
Problem Solving Skills	Defined by Mayer and Wittrock as "cognitive processing directed at achieving a goal when no solution method is obvious to the problem solver" (2006, p. 287).	Taylor, 1975 Bates, 1979a Kennedy, 1987 Camerer and Johnson, 1991 Ericsson and Lehmann, 1996 Hoffman, 1996 Feldon, 2006
Cognitive Load	Defined by Sweller (1988) as the total mental requirements imposed upon working memory, which is limited in both capacity and duration.	Kim and Hirtle, 1995 Palmquist and Kim, 2000 Bergman et al., 2012

Affective state would then include factors such as personality type, concentration, motivation, engagement, self-efficacy and self-concept, and the current emotional state itself (see

Table 10). Affective state arguably has profound consequences upon many kinds of abilities, but is also arguably the least consistent aspect when it comes to measurement. It should also be noted that many of these factors are interrelated and difficult to distinguish from one another.

Table 10: Factors of Affective State, with Definitions and Prior Research

Factor	Definition	Researchers
Personality Type	A general summation of how people view and approach the world, defined by Jung as psychological types and grouped by functions and attitudes (Jung, 1971).	Bellardo, 1985 Armstrong et al., 1997 Marchionini, 1997 Kim, 2000, 2001 Palmquist and Kim, 2000
Concentration	Defined by Merriam-Webster online as the ability to give your attention or thought to a single object or activity.	Kanfer and Akerman, 1989
Motivation	Defined by Nevid (2013) as the needs or wants that activate and direct behavior.	Huneke et al., 2004 Weiler, 2005
Engagement	Defined by O'Brien (2008) as sustaining the attention and interest during system interaction.	O'Brien, 2008
Self-Concept/ Self-Efficacy	Self-Efficacy is defined by Bandura (1977) as confidence in one's own ability to perform a certain task. Self-Concept is a related, but broader concept that asks for an estimate of overall competence in that task.	Debowski et al., 2001 Tsai and Tsai, 2003
Affect/Experience of Emotion	Panksepp (2000) differentiates Affect from Emotion, calling it the conscious experience of an emotion.	Kuhlthau, 1988, 1991 Ward, 2006

Therefore, from the tables above and the formal definition, the factors that influence online search expertise are many and difficult to measure, including personality type, cognitive abilities, logical abilities, problem-solving skills, concentration, affective state, social/domain experience, vocabulary, experience with the platform and the tool, and experience with the corpus. It should be noted that any specific factors mentioned are selected based upon the likelihood they have an effect on the information seeking process. Each of these factors potentially interacts with the other factors throughout the process. These interactions create a complex process difficult both to model and to represent within one model.

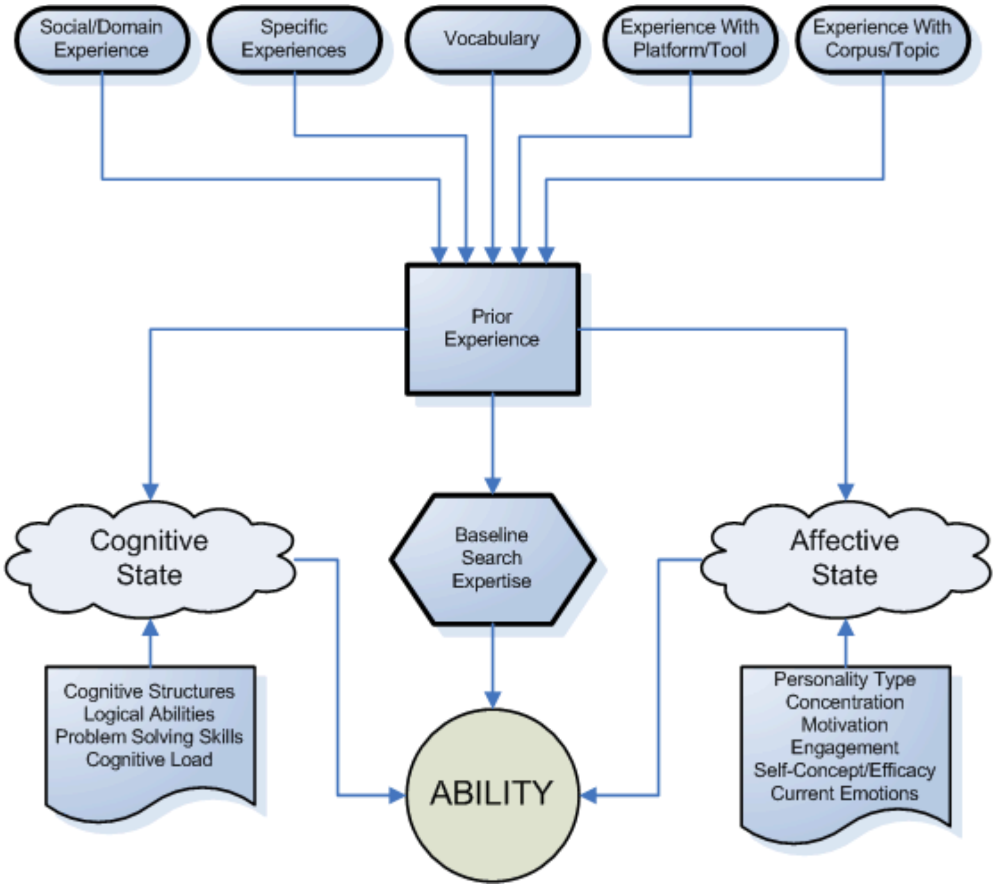
Past researchers have examined these aspects and proposed theories, frameworks, and models to help understand how these aspects might fit together. These include Taylor's four levels of information needs (1968), Belkin's anomalous states of knowledge (1980), Dervin's sense-making (1983), Ellis' model of information-seeking behavior (1989), Bates' berrypicking model (1989), Kuhlthau's information search process (1991), Vakkari's ideas on task in information retrieval (2001), and Ingwersen and Järvelin's integrated information seeking and retrieval (2005). While these models address the process of information seeking rather than the impact of expertise on that seeking, they can still be helpful in this examination, especially Taylor's (1968) four levels of information need.

Borrowing from Taylor's (1968) levels of information need as the central piece of a complex interrelated map, online search expertise can be viewed as a constantly evolving process. Around this process are the varied factors that could impact each step as the searcher experiences it. The interplay between these factors is complicated and potentially influences the process at multiple levels. Some factors might play a role throughout this process, while others are more prevalent in later stages. For example, self-efficacy could directly affect the process during the early stages and could also arguably affect a person's cognitive structures, which in turn could affect their logical and problem-solving abilities. Self-efficacy could also affect concentration and affective state. It could also change how the searcher internalized or used specific experiences. Examining online search expertise using this model emphasizes the practical nature of this ability and the way in which it can change based on many different factors. Clearly the context is important when describing and modeling online search experience.

Xie (2007) developed a model of situational factors in information retrieval that she titled the Planned-Situational Interactive IR Model. In this model, Xie specifically focuses on searcher goals and tasks, as well as the relationships between them. Xie specifically included social context, levels of goals, levels of tasks, intentions, retrieval tactics, domain and system knowledge, and situation. She noted that prior research had examined information seeking at different levels: specific tactics, overall strategies, and patterns based upon demographics like occupation. Her model attempted to integrate and include all of those levels. It is the attempted integration of all these frameworks and models into one coherent whole that makes the Planned-Situational Interactive IR Model interesting. It attempts to use situation as an overall organizing structure to include the factors of context, domain, interaction, goals, and tasks. While it can be argued that situation is of great importance when it comes to information retrieval, many of the factors it includes are based upon the searcher, suggesting that the searcher should be the primary form of organization rather than the situation.

Sedera and Dey (2013) built a model of user expertise with systems that includes many of the same aspects of expertise considered in this research. In their model, they identified cognitive and affective components as well as experience and skill. They consider expertise to be a formative index with multiple dimensions that is context specific. While interesting, much of their research focused upon measuring experience with time rather than the specific types of experience discussed here. Their research concentrates on measuring the factors and specific experiences that build online search expertise, with the anticipation that measures for these factors would be included in the final instrument. The specific factors of social/domain experience, specific or substantive experiences, vocabulary, experience with platform/tool, and experience with corpus/topic are separately shown as contributing to prior experience. All of these past experiences are combined into an overall set of prior experiences. These prior experiences form a baseline search expertise ability, a potential that is then modified at a particular point in time by the searcher's current cognitive and affective states, which combine to produce the searcher's actual ability at a particular point in time (see Figure 1).

Figure 1: Online Search Expertise Model



It should be noted that the different factors contributing to online search expertise do interact, but those interactions are too complex to properly display in the model. This model is directly based upon the definition developed above and specifically separates the baseline ability from the conative effects of situation and context. This model can also be easily updated with additional factors that might be important in specific applications or domains.

3.3 Methodological Approach

This section describes the overall methodological approach that was taken in this research and discusses the specific approaches and techniques employed therein. The purpose of this research was to create and test an instrument to measure online search expertise, an instrument that could then be further tested and modified as it was used in other research. The methodology used in this research was motivated both by these goals and also by the limitations observed in prior research concerning both the conceptualization and the operationalization of online search expertise.

As previously stated, online search expertise has often been used in research but rarely specifically described except in operational terms. Often researchers simply used simple operationalisms with the goal of sorting participants into high and low ability buckets rather than any real theoretical definition or investigation. Certainly, this was in part due to the quickly changing online landscape (Hargittai & Hsieh, 2012), as well as changes in the online searchers themselves (Hargittai, 2009). Additionally, much of the existing research is solely based upon searchers' perceptions of their skills, in part due to the need to use surveys in order to get adequate sample sizes (Hargittai, 2005), rather than any test of their skill or ability.

3.3.1 Standards in Measurement

The instrument developed here must follow standards in measurement to increase validity and reliability as well as give a basis for evaluation. It is particularly important in this research because online search expertise has not been consistently measured in past research. Measurement in research includes both an understanding of the terminology used as well as understanding the rules and frameworks used to allow for statistical interpretation of research results. Measurement itself is often defined as the "assignment of numerals to objects or events according to rules" (Stevens, 1946, p. 677) or the “rules for assigning numbers to objects in such a way as to represent qualities of attributes” (Nunnally, 1978, p. 3). It is also concerned with the different degrees of those qualities or properties rather than simply their presence or absence (Duncan, 1984). The use of rules to assign these numbers indicates that standards should be used to assign values. The use of standardized measures promotes objectivity, communication, efficiency, and generalizability (Nunnally, 1978). A measure must also be internally consistent and comprised of the minimum number of items necessary to assess the underlying constructs reliably (Hinkin, de Raad, & Goldberg, 1997).

Stevens (1946) proposed that all items could be placed into four categories ordered by the types of analytical operations that they supported: nominal, ordinal, interval, and ratio. This hierarchical nature of the types of scale items is often referred to as the levels of measurement. Each level in turn allows for the use of more and more statistical tools for analysis, while also supporting the levels of analysis of the levels below them. Nunnally (1978) believed that most scale items used in the social sciences could be treated as interval items and analyzed with that level of statistical analysis without harm. In the past, nominal and ordinal measures have primarily been used to measure search expertise, often simply to group them into categories. This research seeks to create continuous, interval-level measures for online search expertise to allow for greater understanding and statistical analysis.

The instrument developed in this research must be flexible enough to grow and adapt as the online environment changes. Constant changes in both technology and in the users of that technology (Hargittai, 2009) have made prior work difficult to use in the current environment, and so the development process must be ongoing. It is also important, however, to ground the instrument, evaluating what has been used in the past for its applicability in the current environment. Flexibility also must include different kinds of data whenever needed so as to capture the different aspects of online search expertise discussed earlier.

In past research, categorical values like possession of an LIS degree and ordinal values like specific time periods spent using a database were used as ways of sorting participants into high and low search ability groups. It is still important to include these measures and investigate their usefulness in the current environment. Additionally, as shown in the model in Figure 1, online search expertise contains various types of experience. These types of experience can be measured using demographic or observable data and are important to include both for grouping participants and for connecting the results to prior research.

Online search expertise is defined as an active ability, so the instrument must also contain test or skill items where the participant uses whatever expertise they possess. These items are important as they can be easily updated as technology changes. In the past, participants have been asked to rate their own skills, using a self-efficacy kind of model (Kelly, 2010), and that kind of data should also be collected in order to establish how useful it might be in the current environment. These types of items are often referred to as self-ratings and have specific guidelines in their use. Additionally, these two types of items can be compared for similarities and differences.

Aspects of personality, including cognitive and affective states are also included in the proposed model. While the use of demographic or observable items to measure search expertise is well documented in Chapter 2 of this dissertation, the use of items measuring aspects of cognition or affect are rarer, perhaps because they are difficult to observe and measure. In measurement, items that cannot be directly observed, like those involving mental processes are called latent characteristics or factors. Latent factors are the most complex in terms of data collection because they are not readily observable. Psychometrics is the area of psychology that specializes in assigning numbers to observations in a way that allows for them to be summarized and studied (Nunnally, 1978). Measurement instruments developed in this way are vital to training, practice, and research in the social sciences (Cizek, Bowen, & Church, 2010; Cizek, 2012). Creating a single instrument to measure demographic, observable, skill-based, self-rated, and latent items is challenging. Each of these types of data must be measured according to standards of practice that will be discussed in more detail in the following sections.

3.3.2 Demographic or Observable Items

Some data is measured simply through use of an item that simply asks the participant to select a response that is factually accurate. These items are often demographic in nature, but can also be descriptive where the participant chooses the answer that best fits with their experiences. Items of this type are often descriptive or observable and are often used to describe the data or to group or compare participants. In the past, these types of items have often been used to group participants into high and low ability.

Items that measure demographic or observable data must first be concerned with the structure and language used to elicit the data from participants. This type of information is often collected directly from the participants using self-reported items, but can also be directly measured by researchers or obtained through records. The primary concern in creating self-reported items is to be clear in meaning and to provide an appropriate list of choices from which the participant can select (Wildemuth, 2009). This list of choices should be complete, containing all of the responses needed by the participant, but should also not provide unnecessary responses. Often standard items are used for collecting this type of data because they are familiar to the participants and will therefore require less time and effort.

Typically, demographic or observable data is measured by categorical or ordinal variables, although other types of variables might be used in some cases. Categorical variables like ethnicity are often used simply to describe the participants or to group them for further examination, although overlapping categories in these types of variables can complicate their measure. Ordinal variables can also be used to describe participants, and both can be used to examine the participants overall for any demographic deficits that might impact the results, such as missing age groups or ethnicities.

3.3.3 Skill Items

Skill items ask the participant for a correct answer and use the responses to judge their performance. Like the previous items, items testing performance related to skills must primarily be clear and concise, but must also use wording that is neutral, specific, and asking a single question (Wildemuth, 2009). The instructions for the item should make it clear what the participant is being asked to do and how they might accomplish it. Skill items might be scored individually or aggregated across items based on number of correct answers, number of incorrect answers, or some combination of the two methods. Skill items scored as a single continuous score offer additional methods of analysis.

Items of this type are typically examined through univariate analysis using distribution counts, ranges, and measures such as mean, median, or mode (Babbie, 2007). Statistical tests of items of this type often include the Chi-Squared Test for Independence (Babbie, 2007), which is used to determine whether a categorical or demographic variable like having an LIS degree has a measurable effect upon another variable, in this case perhaps performance on a skill-based search-related item. In cases where the categorical variable has multiple values, such as educational level, and the skill scores are aggregated together, a similar statistical test called the Analysis of Variance (ANOVA) is used to determine what, if any, influence the independent categorical variable had upon the scores of the dependent continuous variable.

3.3.4 Self-Rated Items

These items ask the participant to rate their ability on some task using some type of scale, typically a Likert (1932) scale consisting of various levels of familiarity or ability. The resulting data can then be examined in much the same way as the skill items, using the categorical or demographic items to check for their effects on the self-rated scores. It should be noted that self-rated abilities, while conceptually similar to self-efficacy, are more specific and typically involve specific abilities or tasks (Brown, Lent, & Gore, 2000). Self-efficacy overall is a more general measure of self-confidence and will be included in the latent measures. These types of items should be clear in what particular skill or ability they are asking the participant to rate and in particular should take care not to include multiple, confounding items. Self-rated items using Likert scales should be examined statistically like the latent items in the next section.

3.3.5 Latent Ability Items

Because latent characteristics, traits, abilities, and so on cannot be directly observed, they must be studied indirectly using instruments specifically developed to measure them. The method by which latent characteristics are often measured is through use of a set of related items that together represent a theoretical variable that cannot easily be observed or measured directly (DeVellis, 2012). This theoretical variable is often referred to as a latent variable or emergent variable. A latent variable will have a value determined by the set of items used to represent it, but this value is expected to be different from the actual, or true, value of that characteristic due to the difficulty in measuring it. While this difference is important, it is expected to be small in cases where the set of items adequately represent the characteristic.

The individual items in the set representing a latent variable are often measured using five- or seven- point Lickert (1932) scales in order to provide discriminatory power between participants (Hinkin et al., 1997). These scales typically ask the participant to assess their agreement with a statement or to rate their skill or ability. The latent variables will be examined using Classical Test Theory, detailed in the next section. Classic test theory focuses on establishing the reliability and validity of a set of items measuring a latent characteristic.

3.3.6 Classical Test Theory

The measurement of psychological and social phenomena is called psychometrics (DeVellis, 2012). The most prevalent of these theories are Classical Test Theory (CTT), also known as True Score Theory. The CTT model assumes a certain level of error in measuring a latent variable, but also assumes that the error is simply random rather than a systematic problem (Borsboom, 2005). These random errors are also expected to cancel out each other over repeated measurements of the latent variable. Using this theory is important, in that it allows for standardized testing for both reliability and validity (DeVellis, 2012). The focus in CTT is to create a group of items or scale that all represent the underlying latent variable similarly.

Since the latent variable cannot be actually measured, there must be standard methods by which to assess how well the group of items represent the latent variable. In CTT, this is done by assessing the validity and reliability of the group of items, also called a scale. The scale is considered reliable when it is internally consistent, and it is considered valid when it measures what it was designed to measure (DeVellis, 2012). Both reliability and validity are examined in a number of ways depending on the situation.

Reliability, defined as consistency in the scores or values of the latent variable (DeVellis, 2012), can be examined using internal consistency, consistency over time, and consistency over different forms or versions (Nunnally, 1978). Internal consistency is a measure of how similar the scores are for the individual items for the same participant, and it is usually measured using a statistic called Cronbach's alpha (Wildemuth, 2009). A high value for Cronbach's alpha indicates that the scores of the individual items in the set are generally about the same for each participant. Cronbach's alpha ranges from 0 to 1 and is generally considered to be sufficient at a value of 0.8, although in some circumstances a value of 0.7 can be sufficient (Nunnally, 1978).

Internal consistency is the most often used test of reliability (Wildemuth, 2009) and is the method used in this research. Other tests for reliability include tests over time, or test-retest, and tests based upon alternate forms of the items (Nunnally, 1978). In scale development, the items are expected to change over time as data is acquired, so this type of validity is more appropriate once the instrument is in more of a final form. A similar argument can be made that alternate forms of the instrument are best left to when the instrument is in a more advanced stage. These types of reliability can be assessed during later stages of the instrument development cycle.

Validity in CTT is defined as the extent that the scores on the group of items actually do represent the latent variable that they are supposed to represent (DeVellis, 2012). Reliability of these items is a necessary condition for validity to be considered, but it does not guarantee validity (DeVellis, 2012). Validity is often assessed by expert judgment, called content validity; comparisons to established measures, called criterion-related validity; and how well the individual items together represent a latent variable and only that variable, called construct validity. For this research, validity was assessed using all three of these methods, although in modified format.

Both reliability and validity are important concepts in the development of instruments that include items representing latent variables. One method by which to maximize the likelihood of both reliability and validity and to reduce any possible error due to bias is to follow standards in development for psychometric scales. It is important to note that 'scale' is used to denote an instrument that collects data from multiple items that together represent a latent variable. The instrument developed for this research contains multiple types of items that cannot be grouped together into an overall score representing a latent variable. Even so, following standards in psychometric scale development helps insure that the final instrument will be free of systematic bias and allows any latent variables to be examined using psychometric procedures.

3.3.7 Development Standards for Psychometric Scales

Borsboom (2005) notes that a scale is "a mathematical representation of empirically observable relations between the people measured" (p. 4). The use of multiple items in a scale allows for more consistent results, greater precision, and greater ability to measure broad concepts in a less restrictive way (Spector, 1992). When generating items, care must be taken to keep the items at similar levels of specificity so that they can be combined into a meaningful scale (DeVellis, 2012). It is considered good practice to have more items than will actually be included in the final scale and that some of those items might even be similar, since the process of testing should remove the weaker items. Likert (1932) scales are common and familiar to many respondents and work well with strongly worded items, but there are some differences of opinion of the use of the neutral middle point (Lynn, 2013). Statements on Likert scales should be in present tense, clear, short, avoid using universals, and avoid negatives. Five to seven choices are often used to express varying degrees of agreement with the statement given.

The design of a scale to measure a latent variable can be difficult and ultimately bias understanding of that variable (DeVellis, 2012). Each design decision must be made using a clear, specific concept of what the scale is being designed to measure, as well as a structured approach to creating the scale. Steps in this process typically can include domain identification, item generation, content validity testing, pilot tests, field tests, and often factor analysis (Lynn, 2013). DeVellis (2012) goes more into detail on the process, reorganizing it into six stages with more specific tasks:

1. Determine clearly what you want to measure.
2. Generate item pool.
3. Determine format for measuring.
4. Have initial pool reviewed by experts.
5. Consider inclusion of validation items.
6. Administer to development sample.

Wildemuth and Choemprayong condensed this process into four practical steps: (1) Defining the construct; (2) Developing the items; (3) Creating an inventory from the set of items; (4) Pilot testing the inventory, including reliability and validity evaluation (2009, p. 281). These steps were followed for the development of this instrument, with additional guidance from DeVellis

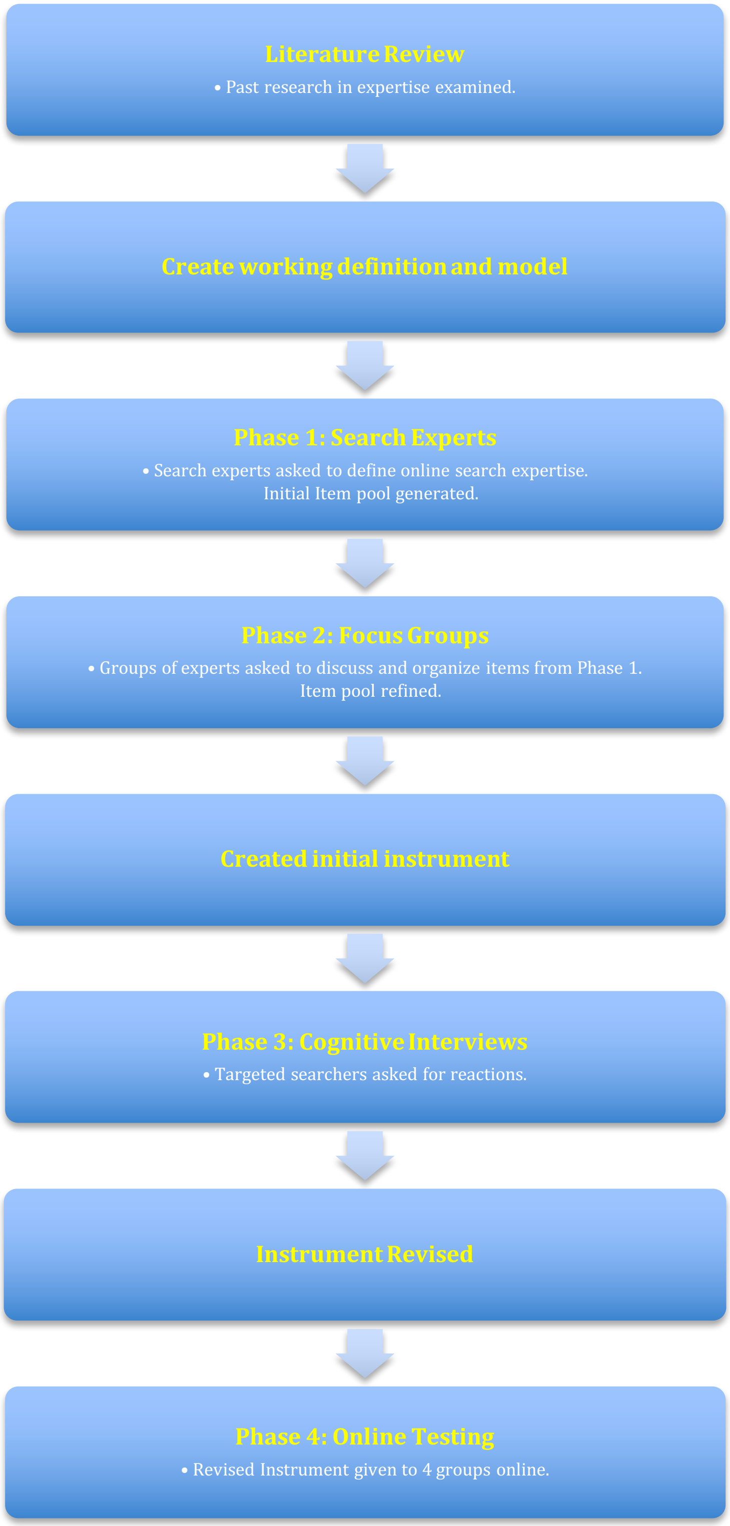
(2012). Again, it is important to note that the instrument for measuring online search expertise cannot be called a scale because it makes use of non-psychometric items, but the procedure for scale development was followed in order to maximize reliability of the psychometric items.

3.4 Overview of Methodology

As noted previously, the instrument used in this research will contain both selected response items assessing demographic and historical data as well as psychometric items assessing latent variables. Unfortunately, while some existing instruments examine specific kinds of expertise within certain domains, their application to a more general instrument is doubtful. Also, instruments used to measure the similar concept of information literacy are primarily used in educational settings and often too long for use in general research. While items related to cognitive and affective abilities have a large body of research available, many of the instruments used to measure these traits are proprietary or licensed. Finally, the items used in past research to measure search expertise are often outdated or used inconsistently. This led to a strategy of starting with no pre-selected basis for the instrument to be developed. Since the instrument was expected to contain psychometric items, the suggested steps for scale development were followed (Wildemuth & Choemprayong, 2009; DeVellis, 2012).

The procedure followed can be seen in Figure 2. In the first two phases, prior research was examined and search expert opinions were consulted to create a definition and model of online search expertise as well as generate a list of potential items for the instrument. The items were then examined by targeted participants to verify their usefulness and clarity. The instrument was then edited based upon those searchers. This edited instrument was then administered to four specific groups of online users in order to test reliability and validity. It should be noted that this process is iterative rather than singular and so is expected to continue into the future.

Figure 2: Flowchart of Research Steps



3.4.1 Literature Review

Prior research in Psychology, Education, Sociology, Information Literacy, and Information Science was examined for both conceptual discussions and models of search, but also for how search expertise had been used to categorize past participants. The results were then examined and grouped based upon similarity of concept. The results of this step are reported in Chapters 2 and 3.

3.4.2 Create Working Definition and Model

The concepts from prior research were used to create both a working definition and a working model of online search expertise. The results from this step are reported in Chapter 3.

3.4.3 Phase 1: Search Experts

Search experts were then asked for their thoughts regarding online search expertise, including its definition and use. Each expert was interviewed individually and the results of those interviews were recorded. Concepts were gathered from those interviews and compared to the concepts and groups from prior research to obtain a starting list of concepts for development into items. This process is more fully documented in Chapter 4.

3.4.4 Phase 2: Focus Groups

The nine search experts from the first phase were gathered into groups of three for focus groups to discuss the items generated from their interviews. Each focus group examined a set of index cards, each card containing one of the concepts mentioned in one of their three interviews. All items were from the three search experts in that focus group. They were asked to categorize and organize the cards based upon meaning and were allowed to discard cards or add new cards as desired. The results from these focus groups were compared to the proposed model and added to the list of concepts from the literature review to create a starting item pool. This process is more fully documented in Chapter 4.

3.4.5 Created Initial Instrument

The list of concepts was examined for the feasibility of creating items for measuring them. Existing items from research were examined and updated where possible. Some items were borrowed from open source Information Literacy tests used by state governments. Other items were created by combining related concepts from the search experts, such as grouping together certain types of experience or certain sources into items.

For the psychometric items, the subscales used to measure latent psychological traits were taken from the International Personality Item Pool (IPIP). The International Personality Item Pool (http://ipip.ori.org/ipip/) is a scientific collaboratory for the development of advanced measures of personality. It contains public domain broad-bandwidth items that were specifically developed for general use in research.

Measurement for non-psychometric items was based upon similar items from existing research. The International Personality Item Pool (IPIP) gave structure to the items requiring a Likert scale as well as guidelines in how to label the points on that scale. Details of this process are more fully documented in Chapter 5.

3.4.6 Phase 3: Cognitive Interviews

This step was expanded in this research process to include both experts and non-experts since this instrument needed to be accessible and meaningful to both groups. Search experts were given the initial draft of the instrument informally to gather design feedback. Cognitive interviews were then performed with deliberate samples of the population to evaluate the face validity of the instrument, detailed in Chapter 5. This phase deliberately included self-identified experts and non-experts because the online environment has changed so much since many of the studies of search expertise were conducted, making it possible that the environment was no longer as understood previously. Including multiple levels of expertise allowed the items to be examined for multiple levels of ability, including places where items might perform well for one set of searchers, but not as well for another set.

3.4.7 Instrument Revised

The initial instrument was revised based upon both the data from the cognitive interviews and also upon the answers from the participants on the initial draft instrument. Each item was evaluated for its clarity and specificity, as well as its discriminatory power. The results and changes to the instrument are detailed in Chapter 5.

3.4.8 Phase 4: Online Testing

The revised instrument was implemented on the UNC Qualtrics site and made available to four different subgroups: Amazon Mechanical Turk users, members of the UNC Faculty and Staff list, members of the RUSA list, and members of the ASIS&T list. Results from this administration can be seen in Chapter 6. The data from this phase was examined using various statistical methods, depending on the type of item. The demographic and categorical items were first examined using descriptive methods. They were then used to group participants to examine the skill items, self-rated items, and latent variables. The self-rated items and latent variable items were examined using exploratory factor analysis.

Evidence for content-related validity came from the use of expert searchers in initial phases. The use of experts in this way to examine items proposed for an instrument is common in research and often referred to as face validity (Wildemuth, 2009). Additional evidence for was gathered during the focus groups, when the search experts were asked to examine the proposed items and discard any that they believed to be not relevant to online search expertise. Changes in both technology and the online environment indicate that evidence for content-related validity should be gathered throughout the development of this instrument.

Evidence for criterion-related validity is normally assessed by using an existing measure that is related to the latent variable being examined (Wildemuth, 2009), with the idea that the scores should be similar on both the established measure and the measure under investigation. For this research, no existing measure exists for online search expertise by which to formally assess criterion-related validity. However, the research was designed to contain cohorts of participants containing known experts in search. The first such cohort, the Reference and User Services Association (RUSA) is an association whose mission states their commitment to providing reference and information services and their core purpose of connecting people to information services (http://www.ala.org/rusa/about). Their membership includes trained reference librarians with experience searching using multiple online systems. Their training and experience would allow for them to score highly on a measure of online search expertise if such a measure existed. Therefore, their scores on this measure can be viewed as evidence in favor of criterion-related validity.

Similarly, the Association for Information Science and Technology (ASIS&T) cohort focuses on research into techniques, theories, and technologies to improve information access (https://www.asist.org/about/). Their membership is more diverse than the RUSA cohort, including librarians, information scientists, and others conducting research in information, but are still trained in and focused on information use. Like the RUSA cohort, the ASIS&T cohort would score highly on a measure of online search expertise and their scores can therefore be used as evidence in favor of criterion-related validity.

This method of collecting evidence for criterion-related validity is not ideal, but is necessary due to the lack of established instruments to measure online search expertise. While not ideal, any evidence related to validity is important in the early stages of instrument development. Continuously collecting this evidence with additional participants will serve to provide more context and a richer understanding of the underlying construct. Rather than using the standard correlation between the experimental measure and the established measure, this research must instead examine the frequency of correct classification of known search experts from these two cohorts.

Construct validity is usually examined through statistical tests using factor analysis, which can be exploratory to examine new items, or confirmatory to examine known items. Exploratory factor analysis is often used in instrument development to determine the underlying relationships between measured variables (Costello & Osborne, 2005), although it has few absolute guidelines in its use. While strict rules for sample sizes needed for exploratory factor analysis do not exist, DeVellis (2012) states that a sample size of 300 is sufficient for most applications. For this research, exploratory factor analysis was used to examine the set of items used to measure the self-reported skill items. Confirmatory factor analysis was used to examine the pre-existing scales for the personality variables. Results of factor analysis allow suspect items to be removed for future versions of the instrument.

3.6 Chapter Summary

Designing an instrument to operationalize a construct like online search expertise is difficult. It should first be based upon a clear definition and also acknowledge that the developing an instrument is an iterative process (Wildemuth, 2009). It should follow the standard process by which a scale is developed even though it may contain non-psychometric items of interest, in order to reduce bias and increase both reliability and validity. As an iterative process, the findings from each research phase must also be used to inform the development of the instrument for the next phase.

CHAPTER 4: Consulting Search Experts

Prior literature was examined during the process of creating the model shown in Figure 1. This examination suggests that online search expertise is composed of aspects of prior experience which are then modified in the moment by cognitive and affective factors. However, much of that research was done before the current online environment and should be examined for validity in more contemporary environments. Thus, this research began by examining these concepts further through interviews and focus groups with known search experts.

4.1 Phase 1: Interviews with Search Experts

The first phase of this research sought to update both the conceptualization and the operationalization of online search expertise. With much of the existing research treating search expertise as a known concept without an agreed-upon formal definition, it was important to employ data rich qualitative methods to fully examine its current meaning. Since it is known that experts sometimes lose their awareness of what they know (Hoffman, 1996), the method employed had to include both planned and unplanned questions. For this reason, semi-structured interviews were selected as the method by which to elicit the experts' thoughts and opinions regarding online search expertise. The goals of these interviews were:

- To understand how search experts view online search expertise.
- To examine and update the conceptual model from Chapter 3.

- To build a list of concepts and operationalizations for use in creating an instrument to measure online search expertise.

4.1.1 Participants

Nine participants were recruited using snowball sampling. Several of the participants were referred by a research librarian not included in the study. The remainder were direct referrals from other participants. Each participant was given an honorarium of a ten-dollar gift certificate to a local coffee shop after completing the interview, using the Carnegie Grant from the UNC School of Information and Library Science. The interviews were held from May 2015 through August 2015.

Participants were professional librarians with MLS or MLIS degrees currently working in a university environment. All participants held positions where they searched on a regular basis: four in medical research, two in humanities research, two in archival research and metadata, and one in economics research. Three participants had more than 20 years of experience in positions using search regularly. The remaining participants varied in experience with some currently working as research librarians and some working in research support positions, but all had five or more years of experience working in positions using online search regularly. Participants were also published authors in their fields of study. Eight of the nine participants were female. All participants expressed an interest in the topic and a desire to see the results.

The decision to use trained librarians as search experts was made based upon both their availability and also upon the difficulty in identifying other types of search experts during the early stages of this research. The concept of search expertise arose from the abilities of research librarians to locate information, so the use of those participants is supported, but it must also be noted that search expertise has changed and grown to incorporate other kinds of search experts.

Use of these trained librarians gives a basis for this research but also limits understanding of online search expertise to their particular environment. Still, even with those limits, study of online search expertise must begin somewhere, and the use of research librarians firmly ties it in prior research.

4.1.2 Interview Protocol

The method used in phase 1 was semi-structured interviews with known search experts who were asked to consider online search expertise before coming to the interview (see Appendix A). Interviews lasted from 49 minutes to 62 minutes. During the interview, they were asked to consider the meaning of online search expertise, including both general ideas and specific items, but were not given a list of dimensions. The interviews were held in private offices and meeting rooms and were audio recorded. This research was reviewed and approved by the University of North Carolina Office of Human Research Ethics (IRB#14-3179).

Each interview began with an open-ended question about what it meant to be an expert searcher. The interview questions were designed to elicit the participants' thoughts regarding online search expertise. The same set of base questions was used for all participants; however, probing questions were also used to encourage participants to elaborate upon their answers. The questions are listed in the following sections.

Section 1: Defining the Expert Searcher

This section of the interview was used to encourage the participant to elaborate on any qualities they associated with a person they considered to be an expert searcher (see Figure 3).

Figure 3: Phase 1 Section 1 Questions

Main Question: What do you think it means to be an expert searcher?

- Clarifiers Used when/if these concepts have been mentioned
  - Is that based upon a particular system?
  - Does the type of search matter? How?
  - Does the topic matter? How?
- Clarifier: What other factors might go into being an expert searcher?
  - Why is that important?
  - If a searcher did not have that, could they still be an expert searcher?
  - If a searcher did not have that, then what would be second best?
- Clarifier: Do you consider yourself to be an expert searcher?
  - Why or why not?
  - Are expert searchers always expert searchers?

Depending on their answers, they were then asked probing questions. Throughout the interview, the participants were also given short summaries of what they had mentioned in order to prompt more reactions. At the end of this section, they were asked to personalize their thoughts by asking if they considered themselves to be an expert searcher and why or why not.

Section 2: Defining Search Expertise

This section of the interview changed the viewpoint to discussing the ability rather than the person in order to tease out more of the participants' thoughts on online search expertise (see Figure 4). Probing questions were asked in order to encourage the participant to elaborate on their thoughts. At the end of this section, participants were specifically asked what changes, if any, they had noticed in their thoughts regarding online search expertise.

Figure 4: Phase 1 Section 2 Questions

Main Question: So considering this expert searcher, let's move on to the actual ability of search expertise that they have. Can you tell me what search expertise means to you?

- Clarifier: By meaning, talk about how you would describe search expertise.
    - Is it one thing or multiple things?
    - Is it consistent or does it change?
- Clarifier: Is search expertise important? Why or why not?
    - What specific aspects of search expertise do you think are important?
    - Why is that aspect important?
    - Are any more or less important than others? Which?
    - Are any of the aspects you mentioned optional?
    - Are there any aspects that are external to the searcher?
- Clarifier: Imagine that researchers had announced that they had figured out search expertise. What would the newspaper headline about search expertise say?
- Clarifier: have your thoughts on search expertise changed?
    - What changed?
    - Why did that change?

Section 3: Measuring Search Expertise

In this section, the participants were asked to focus on concrete ways to measure the aspects of online search expertise that they had mentioned in the previous two sections (see Figure 5). Participants who suggested methods of measurement were then asked probing questions about the specifics they would recommend. They were also asked whether the idea of measuring these aspects had changed their views on their relative importance.

Figure 5: Phase 1 Section 3 Questions

Main Question: Considering your thoughts on what search expertise means and what an expert searcher means, can you tell me some specific ways you would measure search expertise?

- Clarifier: Let’s go back to the aspects of search expertise you mentioned. How would you measure those aspects?
    - Would you measure them individually or as a group?
    - What units would you use?
    - What kind of scale would you use?
- Clarifier: Are there aspects that you don’t feel could or should be measured?
- Clarifier: Does measuring these aspects change your feeling on relative importance?
- Clarifier: Have you seen any of these aspects measured before?
    - Were the measurements reasonable?
    - Were there places where the measurements seemed inappropriate?

Section 4: Specific Measures of Search Expertise

The questions in this section were asked only after the participant had completed sharing their own thoughts regarding online search expertise (see Figure 6). They were selected based upon the categories in the suggested model in Chapter 3. Participants were also asked clarifying questions based upon their answers. The interview was then concluded by thanking the participant.

Figure 6: Phase 1 Section 4 Questions

Main Question: I am now going to ask you about some specific concepts that might be related to search expertise. For each one, please tell me if and how you think it might be related, as well as how important it is. Finally, how would you measure it?

- Do you think that familiarity with a search system is a part of search expertise?
- What about the type of computer system you are using?
- What about practicing a profession?
- What about what you already know about something?
- What about any specific kinds of searching you may have done already?
- What about how long you have been online?

4.1.3 Data Analysis

The recordings for these interviews were reviewed using both the audio recordings and written transcripts in order to capture and record concepts, measures, or items related to search that were mentioned by the participants. All the concepts mentioned by each participant were simply listed without regard to order. No attempts were made to judge relative importance of the concepts and no coding of these items was done. The researcher made an effort not to record the exact concept more than once for each participant, although some duplications were later discovered and eliminated. Other than listing the concepts, no additional coding was done. After the lists were complete, the transcripts of the recordings were again examined for emergent quotes from the participants that communicated their thoughts. Again, these were selected as illustrating the thoughts of the participant rather than their support of any particular idea. These quotes were then examined for potential interest in illuminating discussion of the findings.

4.1.4 Results

The participants demonstrated that they had prepared for the interviews as instructed in the email that was sent to them, with one participant bringing written notes to the interview. The participants began with a fairly small and bounded set of concepts but later added others when they were asked for clarifications and elaborations on their thoughts. Many of the items identified by participants during the individual interviews were common through all participants. The lists of individual concepts can be found in Appendix B. All items mentioned by the participants have also been loosely categorized in preliminary topics in Table 11 in order to report some of the specific quotations from the participants. At the beginning of the interviews, participants often focused on skills or the practical application of them, especially related to search environments involving databases. This focus on practical experience and the ability to apply it dominated much of the interviews, ranging through items related to domain experience, experience with tools and platforms, experience with databases, topic or subject, and controlled vocabularies.

Participants also stressed being able to use experience and understand the limitations of the tools they employed as well as what results they might give.

> *P1-2: "I think to be an expert searcher, it's important to be able to understand something about what's going on behind the search box. So I think to be an expert searcher, it really involves having enough knowledge of the technology or the database or whatever it is to understand what you're searching when you type in words, how the search box interprets your responses on the back end, and then how the results that come out reflect the words that you've typed in."*

> *P2-3: "So expert searcher…someone who understands the structure of the database. The way in which the search engine searches the contents, how language is used in storage and searching…"*

Table 11: Common Topics in Expert Searcher Interviews

Topic	Examples of Category From Participant
Databases	*P1-2: "I think to be an expert searcher it really involves having enough knowledge of the technology or the database"* *P2-3: "So expert searcher, I think it's someone who understands the structure of the database."* *P3-2: "To me what it means is that you are able to search the various databases and you know kinda like the tricks"*
Controlled Vocabularies	*P1-3: "I think understanding controlled vocabularies is important"*
Bibliographic/Catalog	*P1-1: "you may be able to find things, usually bibliographically"*
Searching for Others	*P1-1: "find things…that your patrons are unable to find"* *P3-2: "you were able to translate a question that a researcher has into a concept that he can search"*
Subject/Topic	*P2-1: "An expert searcher is familiar enough with the subject matter and the sources of information from which that topic can be best examined"* *P2-3: "I think, to a certain extent, it helps to have expertise in the subject field that you're searching"*
Updating Skills	*P2-1: "An expert searcher involves keeping up to date with the sources, they change frequently, so as to be able to continue to use them effectively"*
Manipulating Results	*P2-2: "deliberately being able to combine terms in a way that anyone can see a meaningful result. …expert searchers think a lot more about sensitivity, specificity of their search. Thinking about the end result"* *P3-1: "I think first of all, an effective searcher needs to be able to define or succinctly state what they're searching for…what information do I need"* *P3-3: "they understand what the search results are and why they are ordered the way that they are, what that means as far as the relevance to their initial query."*

Other practical aspects that were mentioned by participants in initial statements were keeping up to date on search skills, understanding questions, especially questions from others, and focusing on both the process of searching as an interaction and also the end result needed.

> *P1-1: "…it is very much, I feel an interactive process…"*
>
> *P2-2: "…so being able to think about in terms you're searching for what each term actually means, how to combine them in ways that's not just guessing or not letting the tool guess for you but deliberately being able to combine terms in a way that anyone can see a meaningful result."*
>
> *P2-2: "I think it is a combination of experience, knowledge of the tool, knowledge of the subject... teamwork. ... knowing how to get help, knowing where to go, knowing where to look outside yourself..."*

After their initial thoughts, participants were encouraged to add other aspects of online search expertise that seemed important to them. Here, participants referred to personal characteristics of the searcher, including persistence or tenacity, curiosity, patience, confidence, intuition, and analytic ability. Interestingly, while these aspects were not usually mentioned at the start of the discussion, they were often described later as being very important.

> *P2-3: "…analytic ability, patience and persistence in terms of kind of innate traits, curiosity."*
> *P2-3: "I do think that the analytic ability, the ability to do something and look at what happened and figure out why it happened, in my mind, is the most important."*

While these traits of the searcher were mentioned after their ideas on tools and databases and other practical ideas, when they were asked to consider the most important part of online search expertise, participants selected these traits rather than practical experiences.

> *P3-1: "I could teach somebody to do that. I can't really teach somebody patience and flexibility. ...sometimes people are sort of innately good at more or less innately able to analyze a situation, state the information need and to be able to plan and prepare."*

Participants often seemed hesitant to state unequivocally that any particular experience with a tool or database would create search expertise. On the other hand, for traits of the person, they were more certain.

> *P2-3: "No I think, I mean, certainly, they're more likely to be an expert searcher if you spend a lot of time searching one database, you'll usually try to understand why it does what it does and if you also have the ability to transfer that knowledge and use it as a tool when you go someplace else and some people do and some people don't. If you don't, they'll know you're not an expert searcher in my opinion, you may be an expert ex-database searcher…"*
>
> *P2-3: "…curiosity is a big key because you can't create it, either someone has it or they don't. If they don't have it, they're not going to be a good librarian let alone an expert searcher."*

Participants were also asked how they might measure online search expertise without resorting to using a specific task.

> *P3-1: "Wow, what would I ask somebody without ever referring to a search or a search question or an information need?"*

Their responses to this question once again showed their focus on the practice of search; generally, participants had a difficult time identifying methods for measuring search expertise.

At the end of the interview, participants were asked whether their ideas on search expertise had changed after talking about it. Their answers here focused on both the ongoing nature of expertise as well as the traits of the searcher.

> *P3-3: "So this idea of expertise I would say that it's certainly a combination of different traits and different skills absolutely."*
>
> *P3-3: "So expertise is…ongoing and…one part of fluidity is this willingness to learn and to grow and sort of a curiosity maybe that makes an expert searcher and sort of willingness to … fail and to consider alternatives."*

As noted above, the interview data was reviewed and examined for mention of concepts, measures, or items related to online search expertise by each participant. The individual items thus obtained from each participant were then used in the next phase of this research.

4.1.5 Summary and Discussion of Interviews

This phase found that many of the concepts that were mentioned by current search experts as important to online search expertise aligned with the model proposed in Chapter 3. Experts also focused on very practical aspects of online search expertise. This focus on the practical skills and process of search supports the idea of *deliberate practice* in expertise research (Ericcson et al., 1993). It also parallels Hölscher & Strube (2000) and the practical idea of media competence being at the root of search expertise. However, participants also seemed hesitant to suggest that any one particular practical skill might make one an expert in online search. This stood in contrast to their willingness to state that certain personality skills were vital for that expertise. Additionally, while many of the items seemed to fit the proposed model, some of the individual items were more difficult to group together into overall concepts.

4.2 Phase 2: Focus Groups with Search Experts

The second phase of this research continued collecting qualitative data from the same search experts that were interviewed in the first phase. This phase was designed to create further discussion about online search expertise through the use of small focus groups. Use of focus groups in this manner allows participants to compare their views with the views of others, thus allowing the researcher to observe similarities and differences of opinion rather than having to infer them (Wildemuth & Jordan, 2009). The goals of this phase of the research were:

- To elicit groupings, eliminate redundancies, eliminate non-relevant items, and establish content validity for included items
- To examine the groupings created by the experts and compare those to the concepts in the suggested model.

- To create an initial instrument to measure online search expertise using the finalized items and groupings along with the suggested model.

4.2.1 Participants

For this phase of the research, the same nine search experts from the individual interviews were gathered in focus groups of three members each. Focus groups were formed on a convenience basis and were performed concurrently with the interview phase. The focus groups were held in May, June, and September in 2015. Each focus group consisted of exactly three experts. All nine participants completed both phases. Each participant was given an additional honorarium of a ten-dollar gift certificate to a local coffee shop after completing the focus group, using the Carnegie Grant from the UNC School of Information and Library Science.

4.2.2 Focus Group Protocol

The lists of items generated for each participant taking part in a specific focus group were merged together and sorted alphabetically. Exact matches were removed, although similar items were not discarded. This resulted in a list of items unique for each focus group that had been generated by the three members of that group. This list of items was sent through email to the participants two days before the scheduled focus group with the request for the participant to look over the list before attending.

The decision to include only the items unique to each focus group's participants was made for both practical and conceptual reasons. Conceptually, one of the goals of the focus groups was to allow for independent discussion and grouping which could then be compared to the proposed model. Practically, the search experts were recruited slowly over months through snowball sampling. The focus groups were scheduled as soon as three experts had completed phase one so that their initial discussion would be fresh in their minds. With the first group having only access to their own items, the process was then kept the same for the later groups.

This method has both advantages and limitations. Having the participant on hand who suggested each item allows for items to be further explained or even championed in the event of disagreements. This also allows for a wider range of items to be discussed with the potential for including more unique viewpoints. However, this method does have limitations as well. Since not all the expert participants saw all of the items, they were not given the opportunity to specifically comment on or even reject items from the other groups. This could have also led them to encounter even common items differently based upon context.

The items were then written on individual index cards, which were shuffled together for random ordering. Some additional duplicates were discovered during this process and discarded. The focus groups began with 79 individual items for Focus Group 1, 123 items for Focus Group 2, and 78 items for Focus Group 3 (see Appendix B). The number of items per group was a function of the items identified by group participants during the one-on-one interviews.

The focus groups were held in a private conference room on the campus of the University of North Carolina at Chapel Hill and were attended by all participants. Focus groups lasted from 90 minutes to 110 minutes. Participants were instructed aloud that they were to discuss the items related to search expertise, including both good and not-so-good reactions. They were also instructed that the role of the researcher was to observe their discussion only. The focus group guide can be found in Appendix C.

Participants were given blank index cards, writing utensils, rubber bands, and paper clips to use for all the exercises. For the first exercise, they were given a stack of index cards with each card containing one item written on it, along with the instructions (see Appendix C) to work as a group to sort the cards into categories and to name those categories using the blank index cards provided. This was an open sort with no predetermined categories. Cards with items that they viewed as representing the same idea were clipped together. Participants also added cards for missing concepts and removed cards for items they considered unimportant or irrelevant.

For the second exercise, participants went through the cards in each group and assigned numbers to them to represent their importance in search expertise. They were shown a printed version of the ratings to assist with these ratings. The ratings were as follows:

- Essential to Search Expertise
- Somewhat Important to Search Expertise
- Related or Less Important to Search Expertise
- Not at all Important to Search Expertise

For the third exercise, participants were instructed to consider ways in which each concept marked as Essential or Somewhat Important might be measured as well as what scale might be used to measure it. Due to time constraints, this exercise was only given to one of the three focus groups. That group determined together that they would recommend individual interviews to determine the capabilities noted in the items.

4.2.3 Data Analysis

After the focus groups, the item groupings used by the experts were noted, as well as the items listed in each grouping and the concepts determined by the participants to be similar. These groupings and items were then compared across focus groups for similarities and differences. The groupings were also compared to the proposed model for online search expertise.

4.2.4 Results

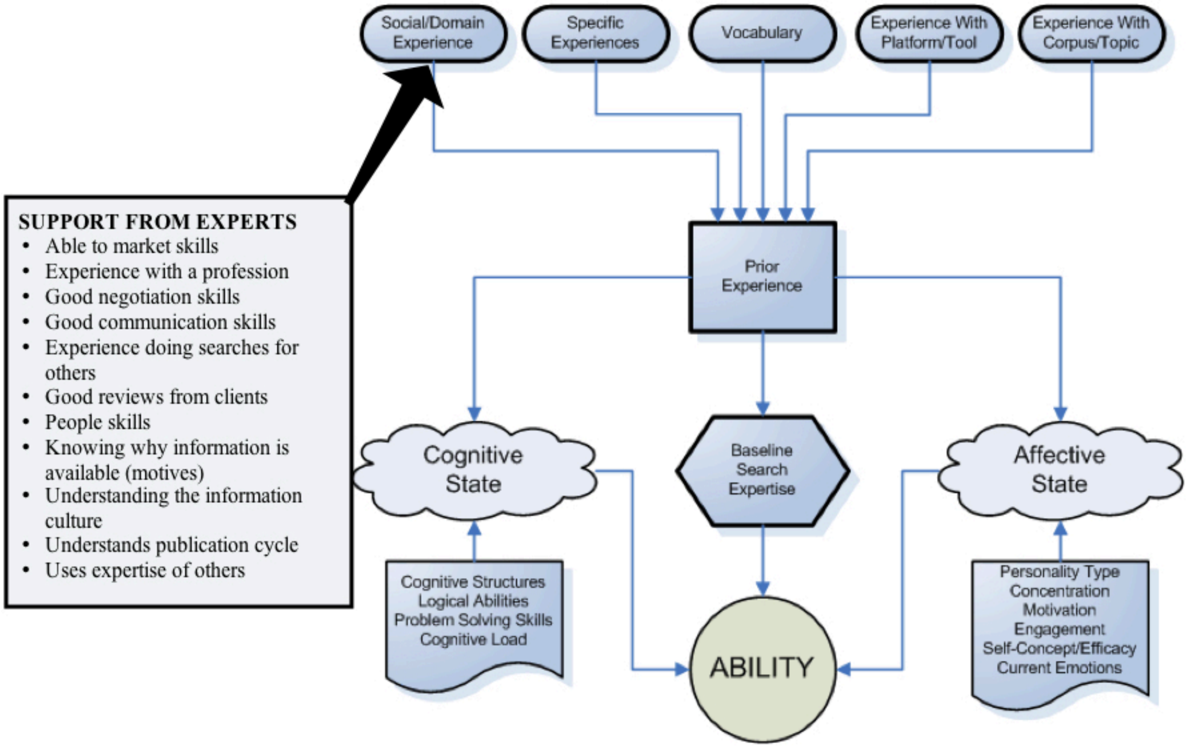
Exercise 1 consumed most of the time allotted for the focus group for all three groups. The participants initially displayed hesitation in sorting the items, with much discussion about how and why to sort them in different ways. Each focus group also re-sorted items in the middle of the exercise after coming across additional items. Often these re-sortings created more groups, but in several instances the participants actually collapsed several groups into larger groups. When doing this, it seemed that the links between related items often made it difficult for participants to decide where to split them into groups. Creating a larger group seemed to solve this problem for them. The card sorting was most often done with one person picking up a card and stating their opinion about how to sort that item. One participant, however, took a stack of cards and sorted them without consulting the other two participants. This led to a second sorting once all the cards had been sorted once.

After the groups sorted the cards, Focus Group 1 had 10 categories and 78 individual items; Focus Group 2 had 13 categories and 113 individual items; and Focus Group 3 had 7 categories and 58 individual items (see Appendix D). Not all of the listed concepts were used by the focus groups. Focus Group 1 discarded the most items, the majority of which were specific kinds of experience that they considered unimportant, such as experience with bibliographies, professions, academic sources, bibliographic tools, specific platforms, and reference. These discards were not echoed by the other two focus groups, each of which discarded only one item that they deemed unimportant. All groups combined items that they considered similar.

The item lists that were used for each focus group were combined into a single list and pruned of duplicates. Any items discarded by the participants were also deleted. Items that were grouped together by the participants as meaning the same thing were also deleted unless specifically included in another group's listing. The 148 remaining individual items were then compared to the proposed model and sorted into the categories shown in the model. This sorting was done to verify support for the categories shown in the model and to identify items that did not seem to fit any category. Of the 148 total items, 117 supported categories in the proposed model, with a majority of 85 items supporting the categories contributing to prior experience.

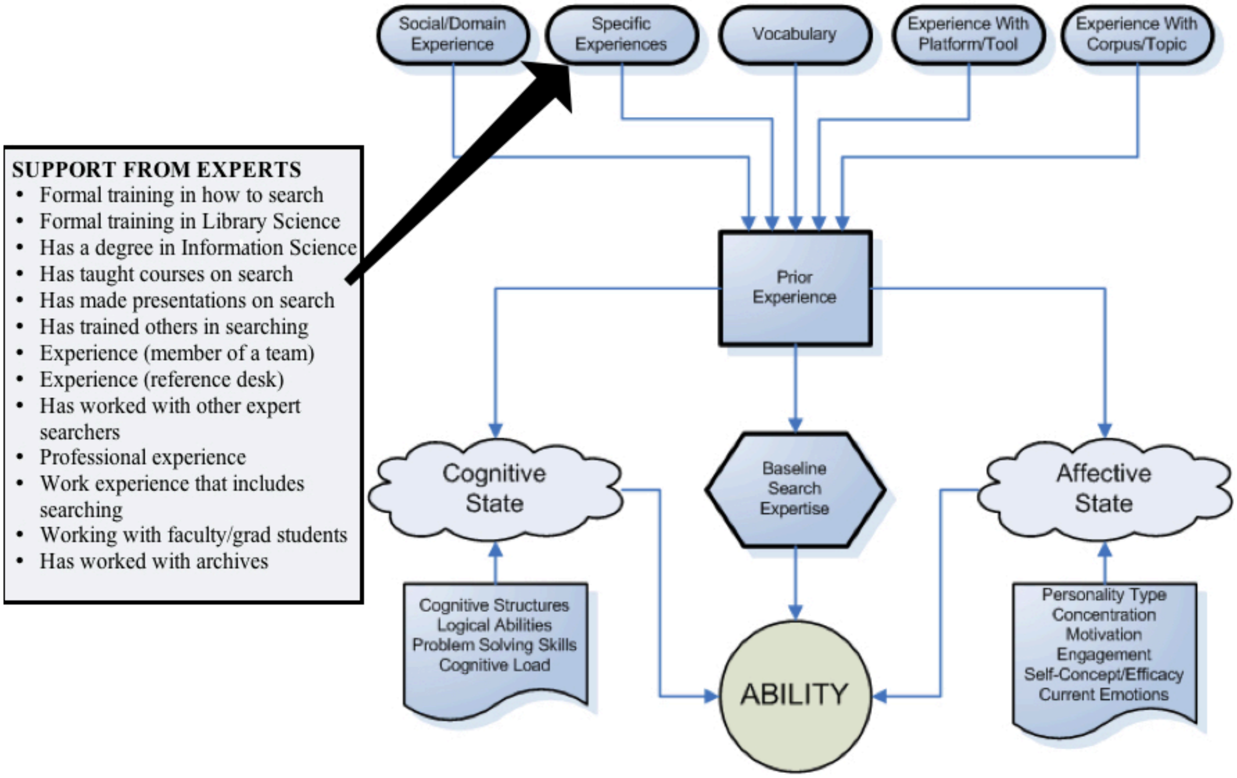
Eleven of the items from the combined lists supported the category of Social/Domain Experience from the proposed model (see Figure 7). These items primarily centered around working with others, communication skills, and understanding what information might be available. It is interesting to note that these skills could also be listed as skills for a professional librarian and that the search experts had all been trained as librarians. This could have limited the inclusion of other types of skills and will be discussed in the limitations below.

Figure 7: Items from Experts Supporting Social/Domain Experience



Items in Figures 8 and 9 supported the Specific Experiences category from the proposed model. This category was strongly supported with 31 items, sorted into items related to formal education and work experiences in Figure 8 and items related to specific personal search history shown in Figure 9. The group of items related to formal education and work history includes training received as well as training others, along with specific kinds of work environments. The prior category listing contained the item ‘Experience with a Profession’ (in Figure 7) and this category listing contains an item ‘Professional experience’ (in Figure 8). While these two items appear quite similar, the participants discussed them differently, with the former item focused on the social aspects of working in a profession and the latter focused on the technical aspects. Throughout these listings, the words that were used by the experts were retained, even in examples like this where their discussion is needed to provide more context on their meaning.

Figure 8: Items from Experts Supporting Specific Education and Work Experiences

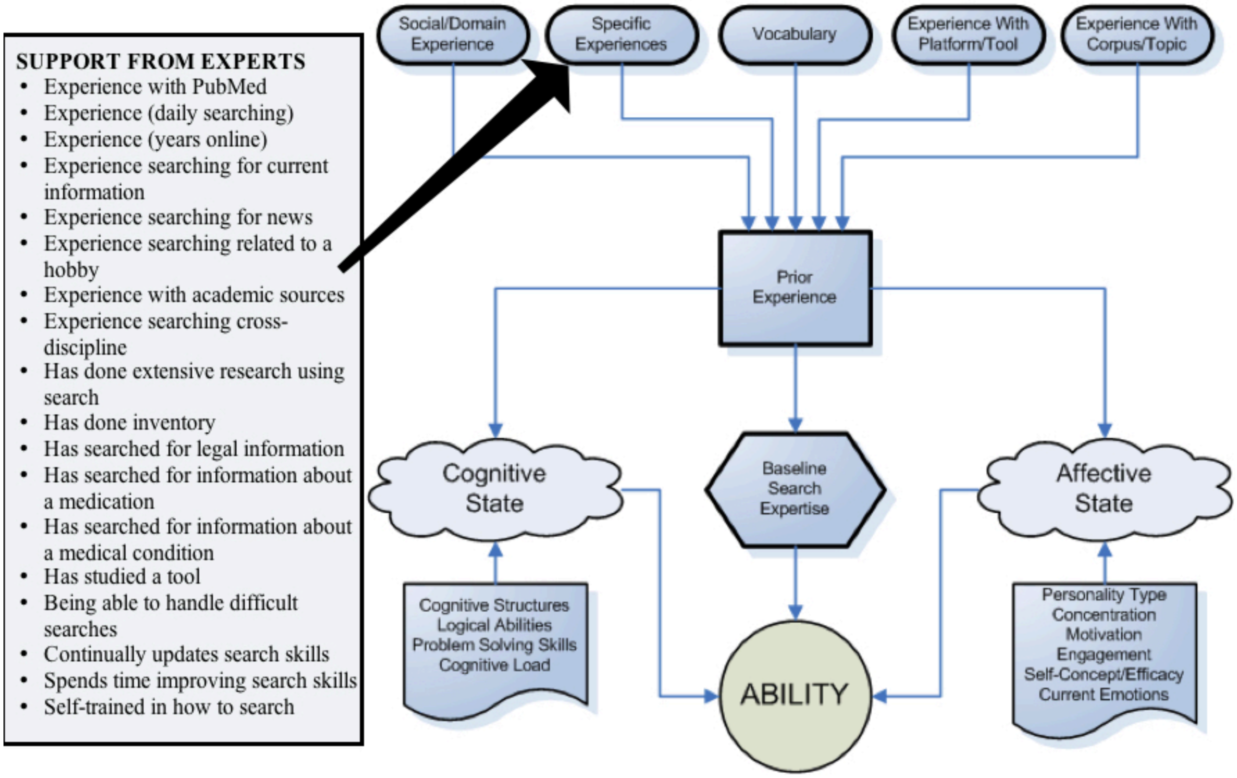


SUPPORT FROM EXPERTS

- Formal training in how to search
- Formal training in Library Science
- Has a degree in Information Science
- Has taught courses on search
- Has made presentations on search
- Has trained others in searching
- Experience (member of a team)
- Experience (reference desk)
- Has worked with other expert searchers
- Professional experience
- Work experience that includes searching
- Working with faculty/grad students
- Has worked with archives

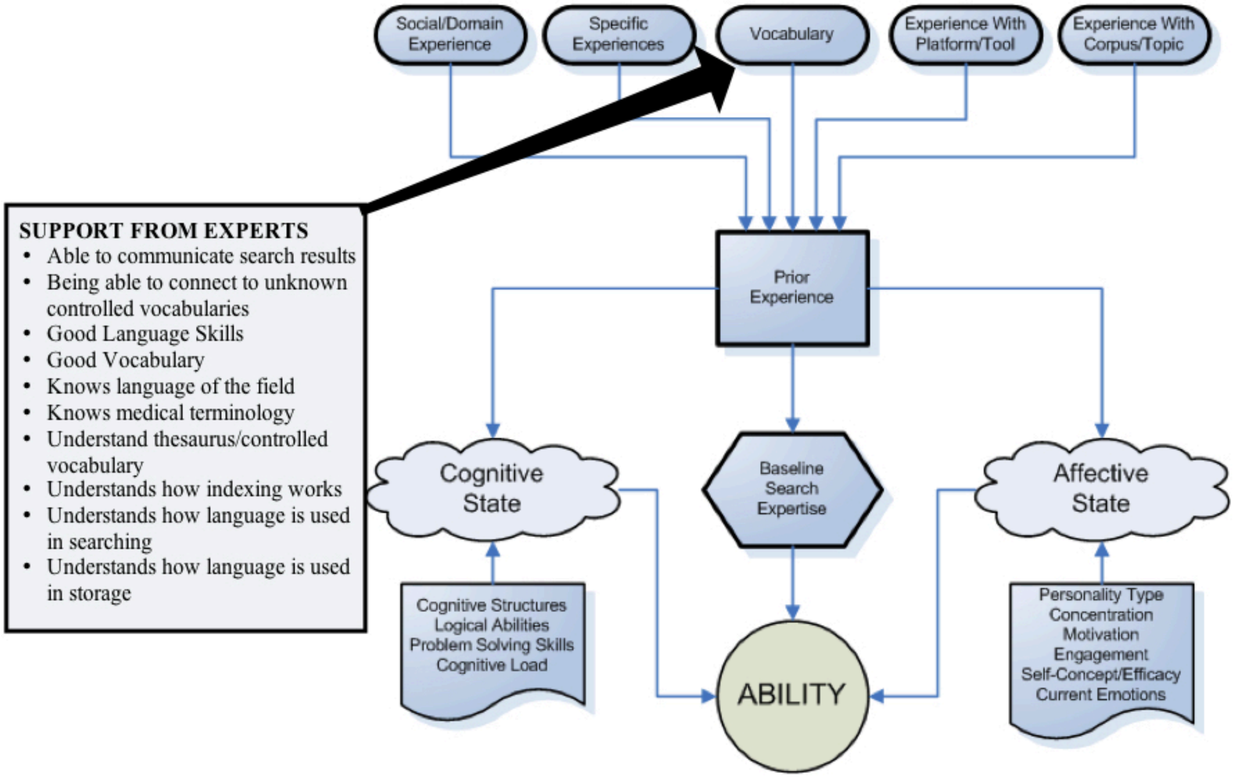
The second group of items (see Figure 9) is more diverse, including a wide range of experiences, specific types of searches, and working with specific databases or archives. These items all have in common the experience of performing certain kinds of searches outside of formal training.

Figure 9: Items from Experts Supporting Other Specific Experiences



A total of 10 individual items supported the Vocabulary category from the proposed model. These items center around both the ability to use language to communicate, and the ability to understand how language is processed and used by search systems and in the storage of information (see Figure 10).

Figure 10: Items from Experts Supporting Vocabulary

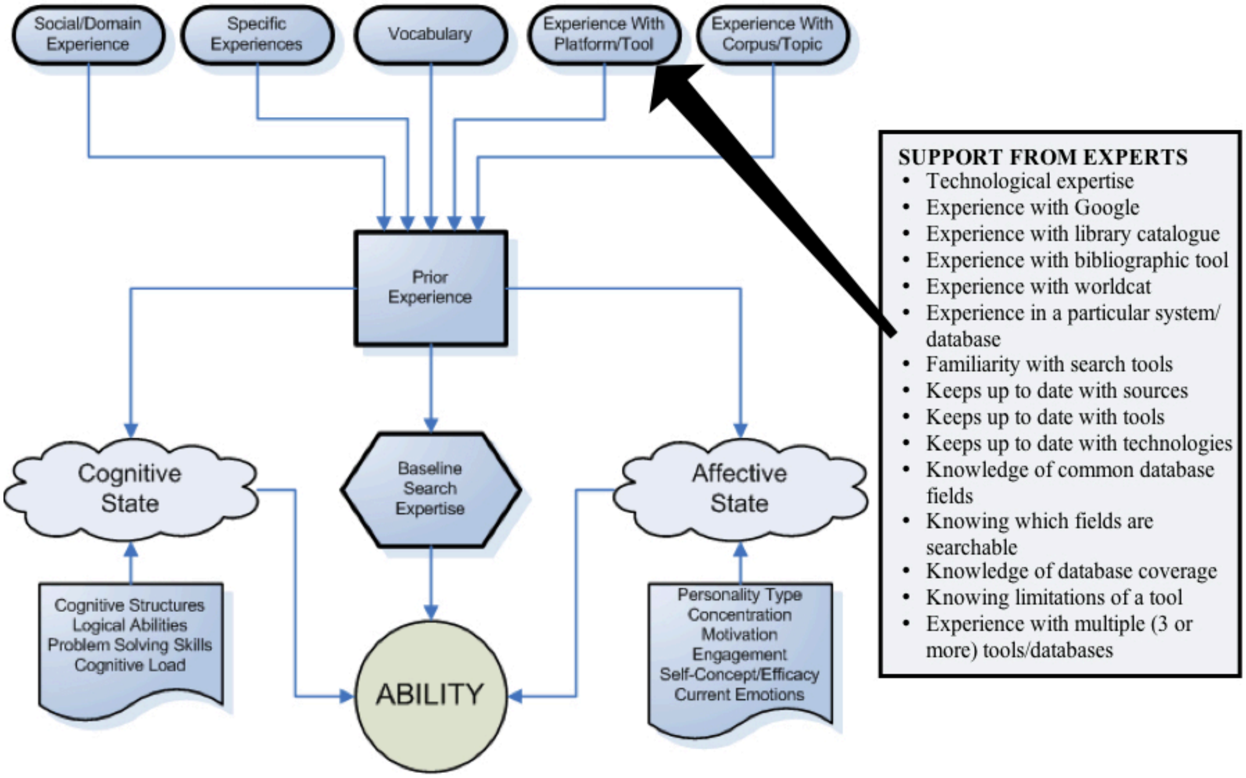


SUPPORT FROM EXPERTS

- Able to communicate search results
- Being able to connect to unknown controlled vocabularies
- Good Language Skills
- Good Vocabulary
- Knows language of the field
- Knows medical terminology
- Understand thesaurus/controlled vocabulary
- Understands how indexing works
- Understands how language is used in searching
- Understands how language is used in storage

The Platform/Tool category was extensively supported with 27 individual items from the search experts. Many of these items mentioned specific tools, web sites, and techniques or effective use of tools and are grouped together in a loose ‘Technologies’ category (see Figure 11). It is interesting to place these into a group because of the fleeting nature of most technological competencies. The participants specifically mentioned keeping up to date on tools, sources, and technologies here.

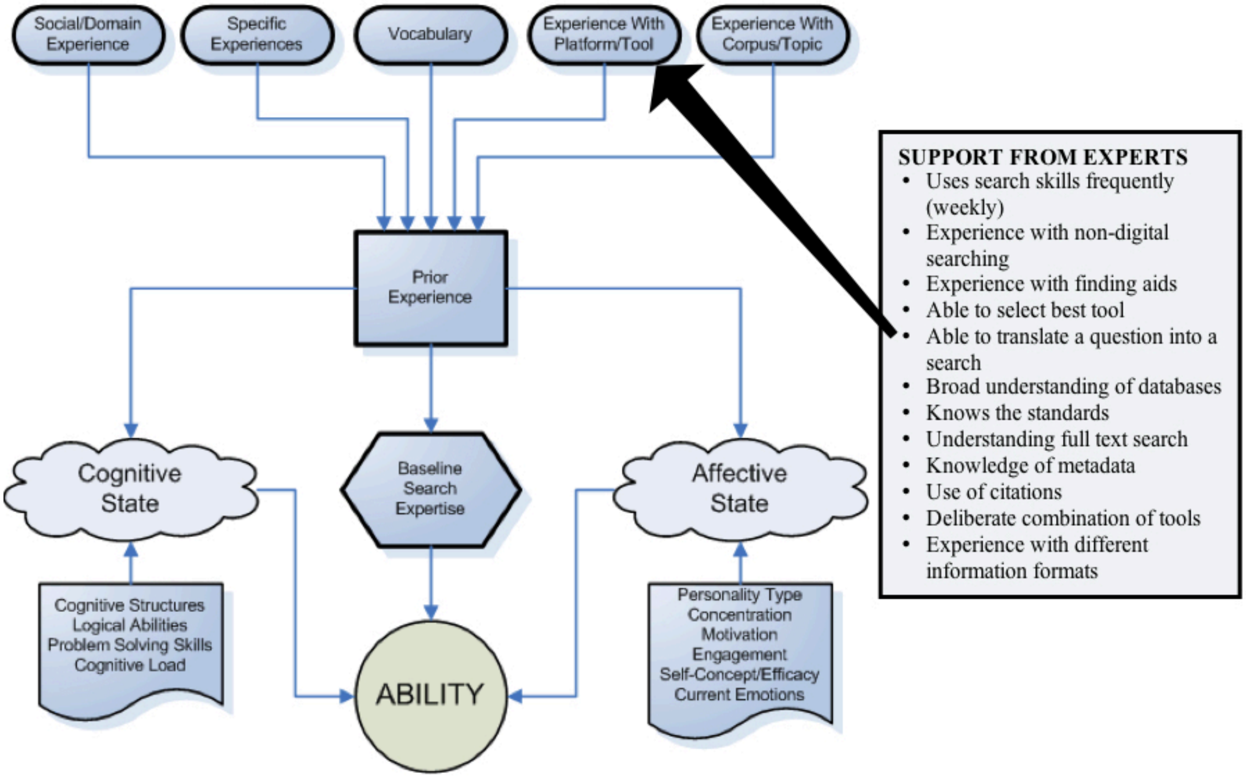
Figure 11: Items from Experts Supporting Experience with Platform/Tool: Technologies



SUPPORT FROM EXPERTS
- Technological expertise
- Experience with Google
- Experience with library catalogue
- Experience with bibliographic tool
- Experience with worldcat
- Experience in a particular system/ database
- Familiarity with search tools
- Keeps up to date with sources
- Keeps up to date with tools
- Keeps up to date with technologies
- Knowledge of common database fields
- Knowing which fields are searchable
- Knowledge of database coverage
- Knowing limitations of a tool
- Experience with multiple (3 or more) tools/databases

Other items focused on skills that impact the use of tools and technologies, but are more focused on the understanding of how best to use them. Participants placed emphasis on this aspect of tool use in addition to simply knowing the specific tools (see Figure 12). Once again, some items could be placed in additional categories, but were placed here based upon how the experts discussed them. Specifically, familiarity with databases was most often discussed as familiarity with their structure and methods rather than the topic they covered.

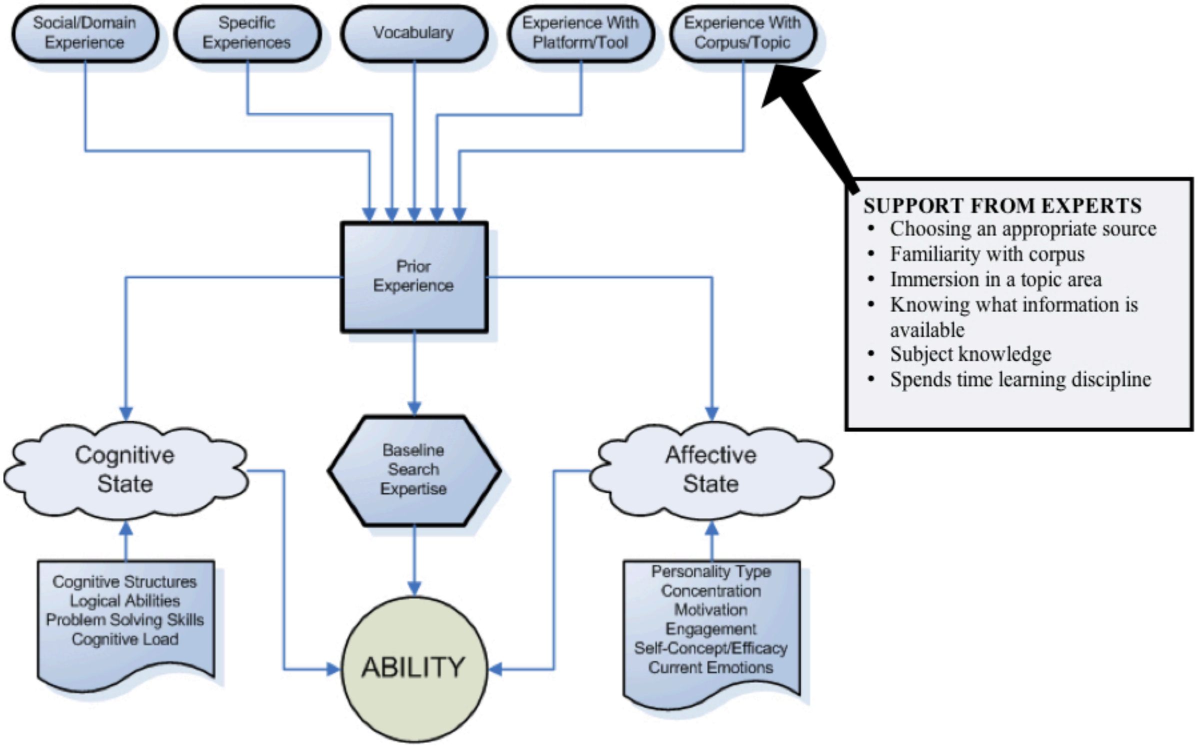
Figure 12: Items from Experts Supporting Experience with Platform/Tool



SUPPORT FROM EXPERTS
- Uses search skills frequently (weekly)
- Experience with non-digital searching
- Experience with finding aids
- Able to select best tool
- Able to translate a question into a search
- Broad understanding of databases
- Knows the standards
- Understanding full text search
- Knowledge of metadata
- Use of citations
- Deliberate combination of tools
- Experience with different information formats

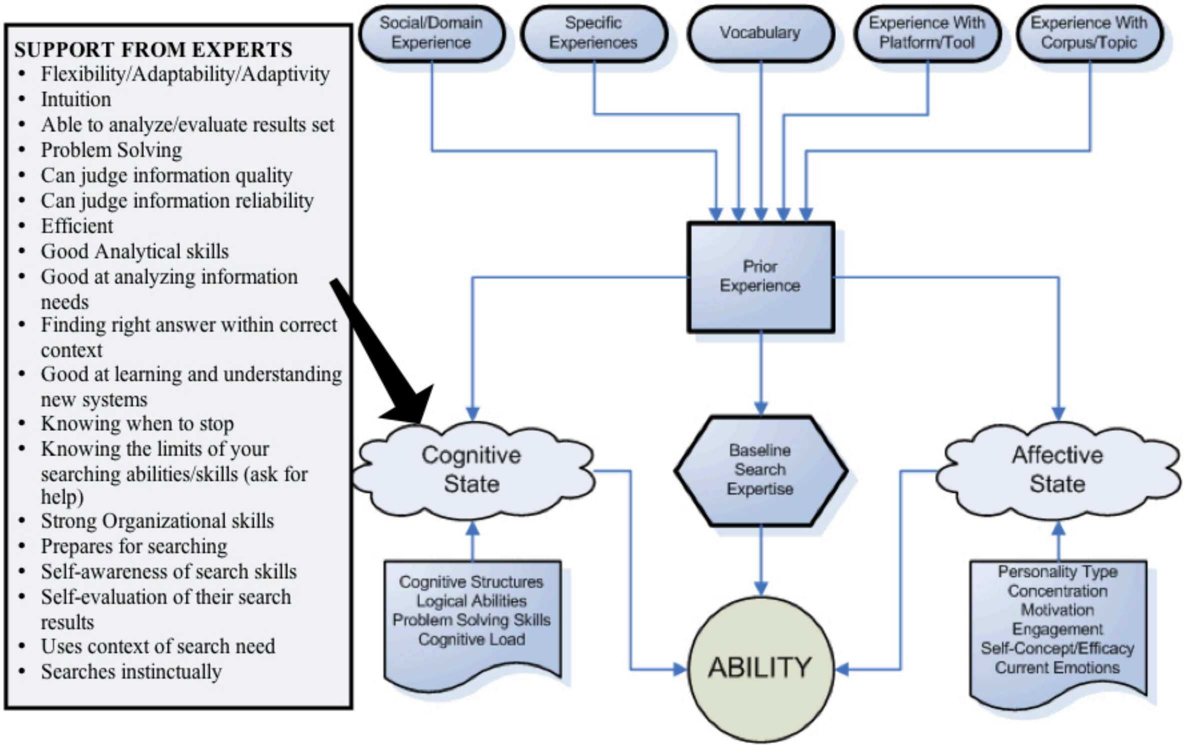
A total of 6 individual items supported the Corpus/Topic category of the proposed model (see Figure 13). The experts mentioned knowledge of a topic area or corpus, but did not focus on these skills. This is possibly due to the division between domain skills and search skills that was created by earlier research and the placement of reference librarians in the search skills category.

Figure 13: Items from Experts Supporting Experience with Corpus/Topic



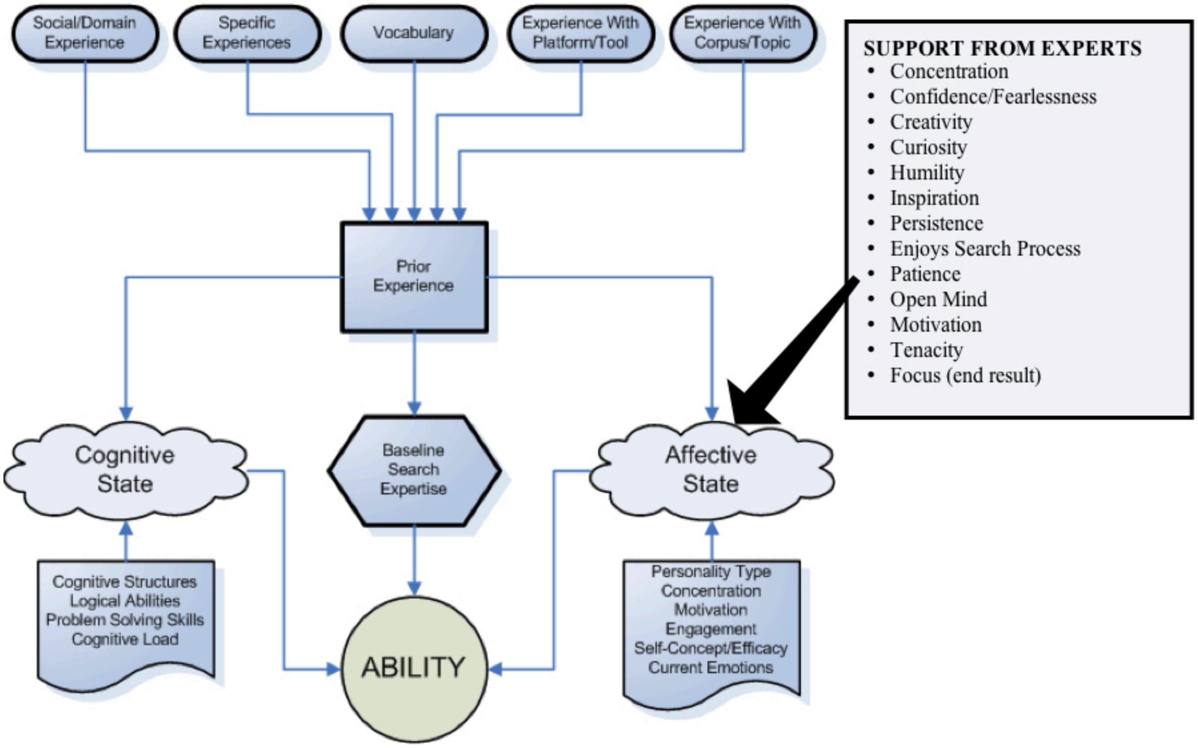
The category of Cognitive State in the proposed model was supported by 19 individual items from the experts (see Figure 14), although some refer to more enduring characteristics. Some of the items listed here and under the remaining category, Affective State, could be listed under either category or both of them. In all cases, items were listed using the context of the experts' discussions. The list of items supporting Cognitive State included aspects of personality like flexibility and organization, analytical ability, problem solving, and evaluation abilities. It should be noted that the items listed here were discussed by the experts as traits that a good searcher would possess rather than as states that a searcher might experience while conducting a search.

Figure 14: Items from Experts Supporting Cognitive State



A total of 13 items supported the Affective State category from the proposed model (see Figure 15). This list of items included aspects of personality like creativity and curiosity but are included here rather than the prior category for their aspects related to motivation. Confidence and fearlessness were also mentioned as important by the experts.

Figure 15: Items from Experts Supporting Affective State



Some of the items mentioned by the experts were not specifically included in the model, although they could be considered Experience in Platform/Tool. These items all generally focus on manipulating the search results and were specifically grouped together to reflect the emphasis given to them by the participants (see Table 12). While many of these items could be placed in Platform/Tool Experience or Specific Experiences, participants gathered them into groupings of evaluating and understanding results, an indication that they considered these skills to be a specific subset of the online search expertise ability. In fact, many of these skills rely not only on knowledge of how to do them, but also an analytical ability to use them effectively, making them bridge the gap between Prior Experience and Cognitive Abilities. This category could also be tied to critical thinking and reinforces the *deliberate practice* (Ericcson et al., 1993) idea of online search expertise.

Table 12: Items Supporting Results Manipulation

- Knowing when information need is fulfilled or unable to be fulfilled
- Knowing what can’t be found
- Iterative searches
- Knowing/evaluating results
- Knowledge of what is being searched
- Able to conduct systematic searches
- Able to get consistent results
- Understands Relevance
- Knowing when the answer you found isn’t good enough
- Good at fine tuning results
- Knowing Boolean
- Has realistic expectations
- Thoughtfully trying more than one approach
- Understanding connection between search terms and results
- Thinking about end result
- Knowing when/how to limit previous search
- Understanding how system will respond to request
- Knowing when/how to broaden previous search
- Sensitivity/Specificity
- Knowing truncation
- Knowing quotes
- Understanding Google’s personalization
- Understanding how Google works
- Knowing Google’s advanced features
- Understanding implications of search results
- Able to predict search results
- Understands limiting search sets by source
- Understands limiting search sets by time
- Understands limiting search sets by type of information
- Uses Table of Content Searching

These skills are particularly interesting when considered alongside of the precision-focused way in which searching was done by professional searchers on catalogue and database systems – the idea of the ‘perfect search’ (Bates, 1984). These items instead indicate a more general fishing-type query that is then followed by further queries to refine the results. Again, it supports the idea of *deliberate practice* (Ericcson et al., 1993) being at the center of the online search expertise ability. These ideas also support analytical abilities and critical thinking as important parts of online search expertise. Adding the results manipulation category to the model and also including these abilities within personality would include both the learned skills and the cognitive abilities aspects of critical thinking.

Interestingly, while many of the individual items easily sorted to provide support for the categories in the proposed model, the groupings were not so similar. All three groups sorted items related to experience differently than the model, but used many of the same dimensions (see Table 13).

Table 13: Comparing Model to Focus Groups

Model	Group 1 Sorted Groups	Group 2 Sorted Groups	Group 3 Sorted Groups
Specific Experiences	Search Technology/Database Structure General Search Experience	Experience in Searching Specific Subjects Non-Search Related Experience Formal & Informal Training	Training Experience
Experience with Platform/Tool	Interacting With A Search System Evaluating Results Finding Right Answer in Context Use of Search Strategies	Knowledge of Specific Databases Knowledge of a Variety of Databases Able to Manipulate Search Using Features Maintaining/Improving Search Skills	Indexing/Controlled Vocabulary Understanding Results Understanding Tools
Experience with Corpus/Topic	Subject Knowledge Knowledge of Sources	Acquiring Subject Knowledge Understanding the Body of Literature	
Social/Domain Experience		Interpersonal Skills	
Vocabulary		Language Skills in Searching	
Cognitive State Affective State	Knowing Limitations Personal Characteristics	Personal Characteristics Analytical Skills	Personality Planning

Some of the groupings used by the focus groups could map to one or two of those used by the model. Some of these cases used a title that indicated the use of two or more related concepts. In those cases, the first concept listed was used to choose the mapping. All three groups sorted items into a category related to personal characteristics or personality rather than specifically Cognitive or Affective states.

Experience groupings varied widely between the three focus groups, both in how they were grouped and in the specificity of the groupings. This difference reflects the re-sorting done by the three focus groups as new items were encountered. While Focus Groups 1 and 2 split groups more by types of knowledge or experience, Focus Group 3 created a large group for all experience.

- Focus Group 1 split experience into: General Search Experience, containing basic online experience; Interacting with Search Systems, containing tool and controlled vocabulary experience; Knowledge of Sources, including corpus and culture; and Subject Knowledge.
- Focus Group 2 used groupings of Experience in Searching Specific Subjects, Knowledge of Specific Databases, Non-Search Related Experience, Knowledge of a Variety of Databases, Acquiring Subject Knowledge, and Maintaining/Improving Search Skill.
- Focus Group 3 used a more general Experience category along with Training and Understanding Tools.

All three groups included items related to Social/Domain Experience, Vocabulary, Experience with Platform/Tool, and Experience with Corpus/Topic. All three focus groups also considered updating skills to be an important part of search expertise. Training was also mentioned as important by two of the focus groups. As noted above, all three groups also focused on specific ways in which tools could be manipulated to enhance results, including Boolean, iteration, quotes, and synonyms.

None of the focus groups differentiated Cognitive State from Affective State, instead combining the two into a category they named Personality or Personal Characteristics. Within those categories for all three focus groups the most explicit items were items related to Motivation and Engagement, using terms like: Passion for Searching, Enjoys Search Process, and Curiosity. Aspects of Cognitive State were represented by specific items including Creativity, Adaptability, Self-awareness, Analytical and Problem Solving skills, and Organizational Skills. Focus Group 2 grouped items like these into Analytical Skills, although that grouping also contained items related to evaluation of results. Evaluation of Results was a concept seen in all three groups, with multiple items including judging search results, judging information quality, analyzing results, understanding relevance, and fine-tuning results.

All three focus groups also touched upon another area related to dealing with others, either specific experience searching for others or more general people skills. For two of the focus groups, these skills were placed into Personality, but Focus Group 2 separated them into a distinct group, including skills in negotiation, communication, teamwork, marketing, and training.

4.3 Summary and Discussion

The listing of items provides support for the categories shown in the model and past literature, although the focus groups did not always use the same labels for their categories. The very different ways in which items were sorted by the three focus groups suggests that many of these concepts are intertwined and that the individual items might be of more interest than the exact way in which those items are arranged. It could also suggest that the categories used in the model, especially in the Prior Experience section, might be merely convenience in sorting rather than clearly defined with sharp borders. The difference in the number of groups is also interesting in that it could indicate differences in experience or viewpoint of the participants or even something as simple as perceived time limits, as those in a hurry tend to create fewer groups (Hudson, 2012).

The differences in how items were sorted into groups was not an unexpected outcome, since all participants will have different histories and motivations. The qualitative value of these results is in examining the topic area from the perspective of the participants (Hudson, 2012), rather than in finding a one to one correspondence between the groups. Still, it is important to note where the categories are unique, such as the focus on manipulation of results using various tools or techniques. This focus shifts the emphasis from knowledge of tools, such as shown in the proposed model, to a more practical application to manipulate the results lists. This shift suggests an analytical or problem-solving ability rather than one of experience, or perhaps some hybrid of the two categories.

It is also interesting that the items do not break down evenly between these groups, but skew heavily to Platform/Tool experience and Specific Experiences. Certainly, some of the items gathered into the Platform/Tool category relate to experience with specific systems or specific databases, but the items also reflect an emphasis on knowing the coverage and limitations of those tools, as well as continuous training and improvement. The items gathered under Specific Experiences reflect a number of types of searches that might have been previously performed as important. This category also includes specific training or educational experiences. This, combined with the items in the Platform/Tool category, could indicate that the model should include a specific category for training, education, and improvement. This category can easily be added as another factor in Prior Experience.

It is also interesting that the Corpus/Topic category contains very few items compared to the other categories. It is perhaps not surprising that professional librarians place less emphasis on what is often called domain knowledge in the research literature. The items here also focus on knowing what is available rather than general domain knowledge itself. This finding is interesting in light of the amount of research reported in Chapter 2 dealing with specific domains of knowledge and how much of the research regarding expertise is based upon specific domains. It is possible, however, that the experts might have considered more aspects of this category had it been specifically mentioned in the interviews. With this in mind, it is anticipated that this instrument could and should be supplemented with specific domain-related items in order to create a more specific measure.

Similarly, the Social/Domain category, meant to represent knowledge about how information is stored and transmitted in a field of study, displays the perspective of the participants. Most of the items in this category focus on working with clients, a key skill in their profession, and the social skills necessary for that work. This perspective is also seen in the Vocabulary category, where most of the items relate to indexing and controlled vocabulary rather than jargon or technical vocabulary.

It is also interesting to note where the experts mentioned skills or concepts that were not prevalent in prior research on search expertise. One large grouping of items focused on social aspects, including the ability to communicate search results, the ability to market their skills, experience as a member of a team, communication skills, language skills, negotiation skills, good reviews from clients, people skills, using the expertise of others, and working with faculty or graduate students. While many of these do fit in the Social/Domain experience category, others could fit partly in experience and partly in personality traits.

The most significant finding in this phase was the way in which the experts discussed personality traits. Many personality traits were mentioned by the experts, including concentration, efficiency, passion for searching, flexibility, adaptability, analytical skills, humility, inspiration, intuition, open mindedness, and patience, but all of these were discussed as core traits of the searcher rather than being cognitive states experienced in the moment as shown in the proposed model. While prior research has certainly examined personality, cognitive traits, and affective traits, and their effect on search ability, the actual traits mentioned by the experts have not previously been used in measures of search expertise. The emphasis placed upon traits by the experts clearly indicates a need to measure the traits in the instrument. Additionally, the experts' attention to these traits indicates that the model needs to explicitly include them. This is particularly important because measuring underlying personality traits is different than attempting to measure transient cognitive or affect states. While current cognitive and affective states are no doubt part of effectiveness, they are difficult to meaningfully measure for an overall usable score. Focus therefore shifted to traits rather than states for measurement purposes.

Additionally, several specific experiences were mentioned by the experts that were unsurprisingly not already specifically included, such as doing inventory and searching for current information, news, medical condition, medicine, or a hobby. While it is understood that no list can contain all the specific experiences related to search, the specific ones mentioned by the experts were noted for inclusion in the instrument. Finally, the experts also mentioned a group of items related to knowing the limits or boundaries of the material being searched, such as predicting search results, combining tools deliberately, fine tuning results, realistic expectations, knowing your limits, knowing what cannot be found, knowing when a need is fulfilled or can't be fulfilled, knowing when an answer is not good enough, knowing when to stop, and knowing the motives behind why information is available. All of these relate to tool experience, but can also be connected to the idea of *deliberate practice* (Ericcson et al., 1993) mentioned previously.

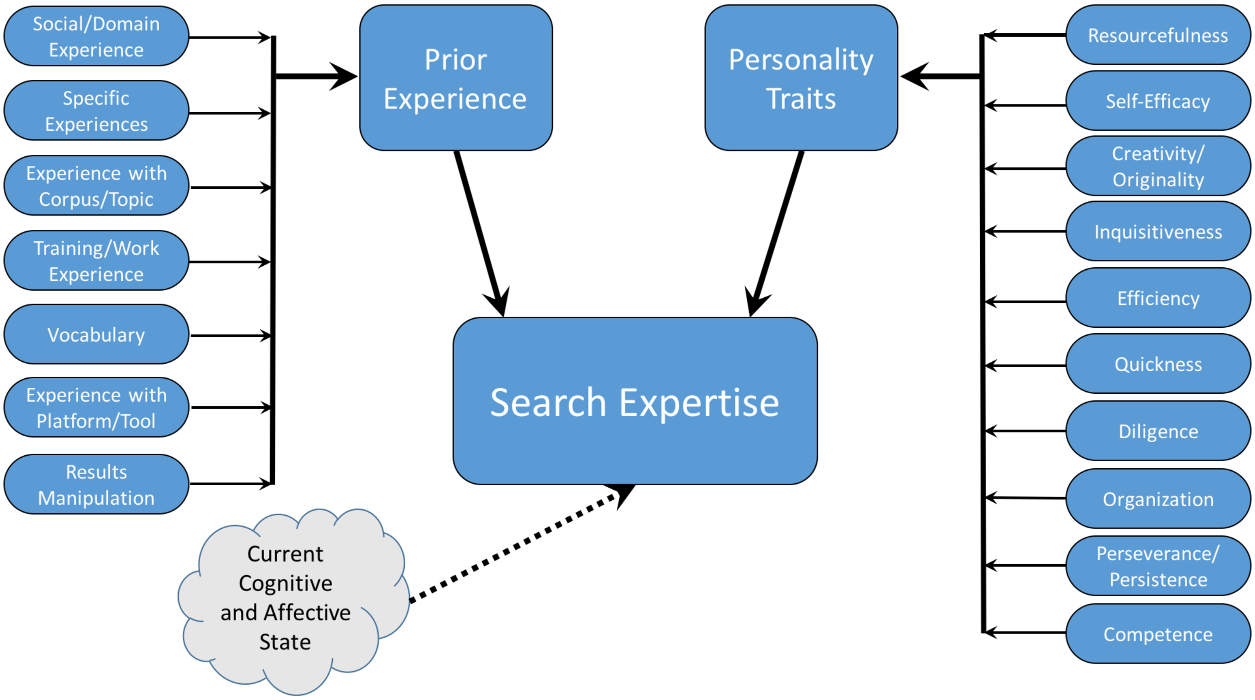
A summary of the differences between the experts' items and groupings and the proposed model is in Table 14, along with changes made to the model.

Table 14: Changes to Search Expertise Model

Summary of Differences	Proposed Action
Varied number of groupings from different focus groups, from 7 to 13. This indicates that some of the categories are not precisely bordered.	This is not a surprising result from different sessions of open card sorting. It does indicate some interaction between categories. The categories leading to prior Experience in the proposed model are representative rather than exhaustive. Additional categories can be added as needed here for different populations.
Searcher characteristics not sorted as cognitive or affective states but as personality traits and an emphasis on those characteristics as being persistent rather than transitory from the experts.	The model was updated to reflect the change from cognitive and affective states to personality traits. Traits listed by the expert searchers are also listed explicitly.
Skew in items to Platform/Tool and Specific Experiences categories – this was partly caused by the items related to training and ongoing skill improvement.	The model was updated with a Training/Work category.
Lack of items in the Corpus/Topic category – this could reflect the prior research that put search expertise and domain expertise as distinct entities.	No change is needed. The category will be more or less important depending on the context being examined.
Emphasis on specific items that do not easily apply to the general case.	No change is needed other than that items related to formal training are now in separate category. Specific experiences can be included as desired in future use.
Emphasis on items related to the manipulation of search results.	The model was updated with a Results Manipulation category.

Overall, any model will be a simplification of the complex nature of online search expertise and will need to be flexible so that categories might be added as needed for specific contexts or specific technical environments. Additionally, having a simple base model for online search expertise allows additions to be added easily rather than trying to include every possibility. Still, the results here indicate some significant changes to the proposed model are needed, including shifting to personality traits, adding a category for results manipulation and adding a category for training and formal experience. These changes are shown in Figure 16 below.

Figure 16: Revised Model for Online Search Expertise



As discussed, a category for Training and Work Experience was added to contain the many experiences cited that were previously grouped in with Specific Experiences. Another category was added for the manipulation of search results to contain the items previously grouped under Experience with Platform/Tool. Both of these categories reflect the importance placed by the expert searchers, represented by the number of items for each new category.

Note that cognitive and affective state are still shown in the model even though their effect upon online search expertise is transitory. The dotted line connecting them to search expertise represents this influence. Additionally, the specific personality traits mentioned by the search experts are now listed explicitly as important components of personality. Their specific inclusion here highlights the emphasis that the search experts placed upon these qualities in their interviews.

The interviews and focus groups with search experts produced a number of alterations to the proposed model as well as specific concepts and items that could be used in the creation of an initial instrument. These effects were expected in that much of the earlier research took place in a very different environment from the current one.

CHAPTER 5: Creating and Testing the Initial Instrument

Results from the interviews were compared to the proposed model as well as the concepts underlying the model and evaluated for use in an initial instrument to measure online search expertise. While it is clear that the changing online environment indicates that any instrument used to measure online search expertise must therefore undergo frequent modification, it is also clear that the current environment must be used to initially ground the instrument. Both qualitative and quantitative data were collected using a mixed methods design in order to ground and test the instrument in order to overcome the limitations inherent in each protocol (Creswell, Plano Clark, Gutmann, & Hanson, 2003).

5.1 Initial Item Pool

The initial instrument was created using the item lists from the expert interviews and focus groups as well as concepts from prior research. Each of these items was examined for its usefulness and its practicality in terms of measurement in a survey instrument. Table 15 lists all 148 of the specific items mentioned by the experts in their interviews and focus groups as well as whether those specific items were used in prior research to represent or measure search expertise. The ‘Used in Initial Instrument?’ column details whether those items are part of the instrument, although it does not include items that were deleted during pilot testing of the instrument. The last column shows the type of item developed for the instrument to gather information about that concept. Some of the items are descriptive or demographic in nature while others test performance. Other items are based upon self-ratings or latent factors, measured using Likert scales.

Table 15: List of Items from Experts for measuring Online Search Expertise

Specific Skill or Concept	Mentioned by the Experts?	Found in Prior Research?	Used in Initial Instrument?	Type Of Item Used
Able to analyze/evaluate results set	YES	YES	YES	self-rated/ latent
Able to communicate search results	YES	NO	NO	--
Able to conduct systematic searches	YES	YES	NO	--
Able to get consistent results	YES	NO	NO	--
Able to market skills	YES	NO	NO	--
Able to predict search results	YES	NO	YES	performance
Able to select best tool	YES	YES	NO	--
Able to translate a question into a search	YES	YES	NO	--
Being able to connect to unknown controlled vocabularies	YES	YES	NO	--
Being able to handle difficult searches	YES	YES	NO	--
Broad understanding of databases	YES	YES	NO	--
Can judge information quality	YES	YES	NO	--
Can judge information reliability	YES	YES	NO	--
Choosing an appropriate source	YES	YES	NO	--
Concentration	YES	NO	YES	latent
Confidence/Fearlessness	YES	YES	YES	latent
Continually updates search skills	YES	YES	NO	--
Creativity	YES	YES	YES	latent
Curiosity	YES	YES	YES	latent
Deliberate combination of tools	YES	NO	NO	--
Efficient	YES	NO	YES	latent
Enjoys Search Process/Passion for Searching	YES	NO	YES	latent
Experience (daily searching)	YES	YES	YES	descriptive
Experience (member of a team)	YES	NO	NO	--
Experience (reference desk)	YES	YES	YES	descriptive
Experience (years online)	YES	YES	YES	descriptive
Experience doing searches for others	YES	YES	YES	descriptive
Experience in a particular system/database	YES	YES	NO	--
Experience searching cross-discipline	YES	YES	NO	--
Experience searching for current information	YES	NO	YES	descriptive
Experience searching for news	YES	NO	YES	descriptive
Experience searching related to a hobby	YES	NO	YES	descriptive
Experience with a profession	YES	NO	NO	--
Experience with academic sources	YES	YES	YES	descriptive

Table 15 (cont.): List of Items from Experts for measuring Online Search Expertise

Specific Skill or Concept	Mentioned by the Experts?	Found in Prior Research?	Used in Initial Instrument?	Type Of Item Used
Experience with bibliographic tool	YES	YES	YES	descriptive
Experience with different information formats	YES	YES	NO	--
Experience with finding aids	YES	YES	NO	--
Experience with Google	YES	YES	YES	descriptive
Experience with library catalogue	YES	YES	YES	descriptive
Experience with multiple (3 or more) tools/databases	YES	YES	YES	descriptive
Experience with non-digital searching	YES	YES	NO	--
Experience with PubMed	YES	YES	YES	descriptive
Experience with WorldCat	YES	YES	YES	descriptive
Familiarity with corpus	YES	YES	NO	--
Familiarity with search tools	YES	YES	YES	self-rated/ performance
Finding right answer within correct context	YES	YES	YES	performance
Flexibility/Adaptability/Adaptivity	YES	NO	YES	latent
Formal training in how to search	YES	YES	YES	descriptive
Formal training in Library Science	YES	YES	YES	descriptive
Good analytical skills	YES	YES	YES	latent
Good at analyzing information needs	YES	NO	NO	--
Good at fine tuning results	YES	NO	NO	--
Good at learning and understanding new systems	YES	YES	YES	self-rated/ latent
Good communication skills	YES	NO	YES	self-rated/ latent
Good language skills	YES	NO	NO	--
Good negotiation skills	YES	NO	NO	--
Good reviews from clients	YES	NO	NO	--
Good vocabulary	YES	YES	NO	--
Has a degree in Information Science	YES	YES	YES	descriptive
Has done extensive research using search	YES	YES	NO	--
Has done inventory	YES	NO	NO	--
Has made presentations on search	YES	NO	YES	descriptive
Has realistic expectations	YES	NO	NO	--
Has searched for information about a medical condition	YES	NO	YES	descriptive
Has searched for information about a medication	YES	NO	YES	descriptive
Has searched for legal information	YES	YES	YES	descriptive
Has studied a tool	YES	YES	NO	--
Has taught courses on search	YES	YES	YES	descriptive
Has trained others in searching	YES	YES	YES	descriptive
Has worked with archives	YES	YES	YES	descriptive

Table 15 (cont.): List of Items from Experts for measuring Online Search Expertise

Specific Skill or Concept	**Mentioned by the Experts?**	**Found in Prior Research?**	**Used in Initial Instrument?**	**Type Of Item Used**
Has worked with other expert searchers	YES	YES	NO	--
Humility	YES	NO	NO	--
Immersion in a topic area	YES	YES	NO	--
Inspiration	YES	NO	NO	--
Intuition	YES	NO	NO	--
Iterative searches	YES	YES	NO	--
Keeps up to date with sources	YES	YES	NO	--
Keeps up to date with technologies	YES	YES	NO	--
Keeps up to date with tools	YES	YES	NO	--
Knowing Boolean	YES	YES	YES	self-rated/ performance
Knowing advanced features of Google	YES	YES	YES	self-rated/ performance
Knowing limitations of a tool	YES	YES	NO	--
Knowing quotes	YES	YES	YES	self-rated/ performance
Knowing the limits of your searching abilities/skills	YES	NO	NO	--
Knowing truncation	YES	YES	YES	self-rated/ performance
Knowing what can't be found	YES	NO	NO	--
Knowing what information is available	YES	YES	NO	--
Knowing when information need is fulfilled or unable to be fulfilled	YES	NO	NO	--
Knowing when the answer you found isn't good enough	YES	NO	NO	--
Knowing when to stop	YES	NO	NO	--
Knowing when/how to broaden previous search	YES	YES	YES	self-rated/ performance
Knowing when/how to limit previous search	YES	YES	YES	self-rated/ performance
Knowing which fields are searchable	YES	YES	NO	--
Knowing why information is available (motives)	YES	NO	NO	--
Knowing/evaluating results	YES	YES	NO	--
Knowledge of common database fields	YES	YES	NO	--
Knowledge of database coverage	YES	YES	NO	--
Knowledge of metadata	YES	YES	NO	--
Knowledge of what is being searched	YES	YES	NO	--
Knows language of the field	YES	YES	YES	self-rated/ performance
Knows medical terminology	YES	YES	NO	--
Knows the standards	YES	YES	NO	--
Motivation	YES	YES	YES	latent

Table 15 (cont.): List of Items from Experts for measuring Online Search Expertise

Specific Skill or Concept	Mentioned by the Experts?	Found in Prior Research?	Used in Initial Instrument?	Type Of Item Used
Open mind	YES	NO	NO	--
Patience	YES	NO	YES	latent
People skills	YES	NO	NO	--
Persistence	YES	YES	YES	latent
Prepares for searching	YES	NO	NO	--
Problem Solving	YES	YES	YES	latent
Professional experience	YES	YES	YES	descriptive
Searches instinctually	YES	NO	NO	--
Self-awareness of search skills	YES	YES	YES	self-rated
Self-evaluation of their search results	YES	YES	NO	--
Self-trained in how to search	YES	NO	YES	descriptive
Sensitivity/Specificity	YES	YES	YES	self-rated
Spends time improving search skills	YES	YES	NO	--
Spends time learning discipline	YES	YES	NO	--
Strong organizational skills	YES	YES	YES	latent
Subject knowledge	YES	YES	NO	--
Technological expertise	YES	YES	NO	--
Tenacity	YES	YES	YES	latent
Thinking about end result	YES	NO	NO	--
Thoughtfully trying more than one approach	YES	YES	NO	--
Understand thesaurus/controlled vocabulary	YES	YES	NO	--
Understanding connection between search terms and results	YES	NO	NO	--
Understanding full text search	YES	YES	NO	--
Understanding Googles personalization	YES	YES	NO	--
Understanding how Google works	YES	YES	NO	--
Understanding how system will respond to request	YES	YES	YES	performance
Understanding implications of search results	YES	NO	NO	--
Understanding the information culture	YES	NO	NO	--
Understands how indexing works	YES	YES	NO	--
Understands how language is used in searching	YES	NO	NO	--
Understands how language is used in storage	YES	NO	NO	--
Understands limiting search sets by source	YES	YES	YES	self-rated/ performance
Understands limiting search sets by time	YES	YES	YES	self-rated/ performance

Table 15 (cont.): List of Items from Experts for measuring Online Search Expertise

Specific Skill or Concept	Mentioned by the Experts?	Found in Prior Research?	Used in Initial Instrument?	Type Of Item Used
Understands limiting search sets by type of information	YES	YES	YES	self-rated/ performance
Understands publication cycle	YES	NO	NO	--
Understands relevance	YES	YES	NO	--
Use of citations	YES	YES	NO	--
Uses expertise of others	YES	NO	NO	--
Uses search skills frequently (weekly)	YES	YES	YES	descriptive
Uses Table of Content searching	YES	NO	NO	--
Work experience that includes searching	YES	YES	YES	descriptive
Working with faculty/graduate students	YES	NO	NO	--

A number of items in Table 15 were judged to be difficult or impossible to measure in a standardized instrument. These included items related to specific context or specific searches, such as knowing what information is available, why it is available, what sources are appropriate to use, and understanding the information culture. These items all have very specific and salient meaning that changes based upon the topic or field of study rather than a meaning that crosses many topic areas. The nature of this instrument is that it be useful in a broad area, with modifications made when desired for use in a particular field or context. For this reason, items related to context must be part of that customization rather than part of the overall design. This exclusion in no way implies that these items are not important but rather that they will have different meanings in different contexts. The items related to context are in Table 16.

Table 16: Items related to Context

- Able to communicate search results
- Able to conduct systematic searches
- Able to get consistent results
- Able to market skills
- Able to select best tool
- Being able to connect to unknown controlled vocabularies
- Choosing an appropriate source
- Experience (member of a team)
- Experience searching cross-discipline
- Experience with a profession
- Experience with different information formats
- Familiarity with corpus
- Good at analyzing information needs
- Good at fine tuning results Good language skills
- Good negotiation skills
- Good reviews from clients
- Has realistic expectations
- Has worked with other expert searchers
- Iterative searches
- Knowing when information need is fulfilled or unable to be fulfilled
- Knowing the limits of your searching abilities/skills
- Knowing what can't be found
- Immersion in a topic area
- Knowing when the answer you found isn't good enough
- Knowing when to stop
- Knowing/evaluating results
- Knowing what information is available
- Knowing why information is available (motives)
- Knowledge of database coverage
- Knowledge of what is being searched
- Knows medical terminology
- Knows the standards
- Self-evaluation of their search results
- Spends time learning discipline
- Subject knowledge
- Understanding the information culture
- Understanding implications of search results
- Uses expertise of others
- Working with faculty/graduate students

Similarly, a number of items were not included because they are difficult to measure consistently (see Table 17). These items are not based on context but rather relate to qualities that could have very different meanings for different searchers. Some of these items relate to innate qualities of the searcher as well. While items like inspiration and intuition are not directly measured by the instrument, items related to those concepts could be added when desired.

Table 17: Difficult to Measure Items

- Broad understanding of databases
- Continually updates search skills
- Good vocabulary
- Has done extensive research using search
- Humility
- Inspiration
- Intuition
- Keeps up to date with sources
- Keeps up to date with technologies
- Keeps up to date with tools
- Open mind
- People skills
- Prepares for searching
- Searches instinctually
- Spends time improving search skills
- Thinking about end result
- Thoughtfully trying more than one approach
- Understanding connection between search terms and results
- Understands how language is used in searching
- Understands how language is used in storage

Some items were excluded because they were based upon overly specific technologies (see Table 18). While it is impossible to create a tool without reference to current technologies, it is also not useful to create a tool that will work only in certain technological environments. Several of these items are also not specific enough about the technologies they mention, making them less useful overall.

Table 18: Items Based Upon Specific Technologies

- Experience in a particular system/database
- Experience with finding aids
- Experience with non-digital searching
- Has done inventory
- Knowing limitations of a tool
- Knowing which fields are searchable
- Knowledge of common database fields
- Knowledge of metadata
- Understand thesaurus/controlled vocabulary
- Understanding Google's personalization
- Understands how indexing works
- Understands publication cycle
- Uses Table of Content searching
- Understanding how Google works

Some items were excluded based upon their level of difficulty (see Table 19), either being too difficult or not being difficult enough to properly discriminate between most users.

However, there could be specific uses for this instrument where these items might actually be discriminatory.

Table 19: Items With Poor Levels of Difficulty

- Able to translate a question into a search
- Being able to handle difficult searches
- Deliberate combination of tools
- Has studied a tool
- Technological expertise
- Understanding full text search
- Use of citations

Several items were discarded during the initial refining process, including items using specific searches to test for the ability to judge information quality and reliability. These were judged to be unsuitable for the final instrument, which is intended to be self-administered. Some of these items were taken from the Network of Illinois Learning Resources in Community (NILRC, http://www.nilrc.org/) in part due to their availability for public use. The items from the NILRC asked participants to select groups of keywords for a specific search, select an appropriate source for a research need, and to judge information reliability and credibility. Some items came from the Revised Need for Cognition Scale (Cacioppo Petty, & Kao, 1984, Cacioppo, Petty, Feinstein, & Jarvis, 1996) but were later removed in favor of the IPIP subscales (http://ipip.ori.org/). Other personality items that were removed after the IPIP subscales were selected were taken from the Ten Item Personality Inventory (TIPA), a subset of the Big Five Personality Assessment (Gosling, Rentfrow, & Swann, 2003). These items were not developed past initial stages.

The items used in Table 20 were used to develop the instrument.

Table 20: Items Included in Instrument

- Able to predict search results
- Confidence/Fearlessness
- Creativity
- Curiosity
- Efficient
- Enjoys Search Process/Passion for Searching
- Experience (daily searching)
- Experience (reference desk)
- Experience (years online)
- Experience doing searches for others
- Experience searching for current information
- Experience searching for news
- Experience searching related to a hobby
- Experience with academic sources
- Experience with bibliographic tool
- Has searched for legal information
- Has taught courses on search
- Has trained others in searching
- Has worked with archives
- Knowing Boolean
- Knowing advanced features of Google
- Knowing quotes
- Knowing truncation
- Understanding how system will respond to request
- Understands limiting search sets by source
- Understands limiting search sets by time
- Understands limiting search sets by type of information
- Experience with Google
- Experience with library catalogue
- Experience with multiple (3 or more) tools/databases
- Experience with PubMed
- Experience with worldcat
- Familiarity with search tools
- Flexibility/Adaptability/Adaptivity
- Formal training in how to search
- Formal training in Library Science
- Good Analytical skills
- Good communication skills
- Has a degree in Information Science
- Has made presentations on search
- Has searched for information about a medical condition
- Has searched for information about a medication
- Knowing when/how to broaden previous search
- Knowing when/how to limit previous search
- Knows language of the field
- Motivation
- Patience
- Persistence
- Problem Solving
- Professional experience
- Self-awareness of search skills
- Self-trained in how to search
- Sensitivity/Specificity
- Strong Organizational skills
- Tenacity
- Uses search skills frequently (weekly)
- Work experience that includes searching

Even though some of the items collected from prior research and the expert interviews were not used for this version of the instrument, they are still available for later use when the particular application makes them interesting and feasible. It is understood that online search expertise contains many components – so many components that to include them all would be impractical for a general use measure.

5.2 Construction of the Instrument

The next step was to take the list of items and combine them into an initial inventory. The instrument needed to be short enough to be usable in other research without placing an undue burden upon participants, but also long enough to be both reliable and valid. In this research, a decision was made to have a greater number of items than might reasonably be administered as part of a laboratory study, with the hope of being able to eliminate less useful items later.

The initial sections for the instrument were:

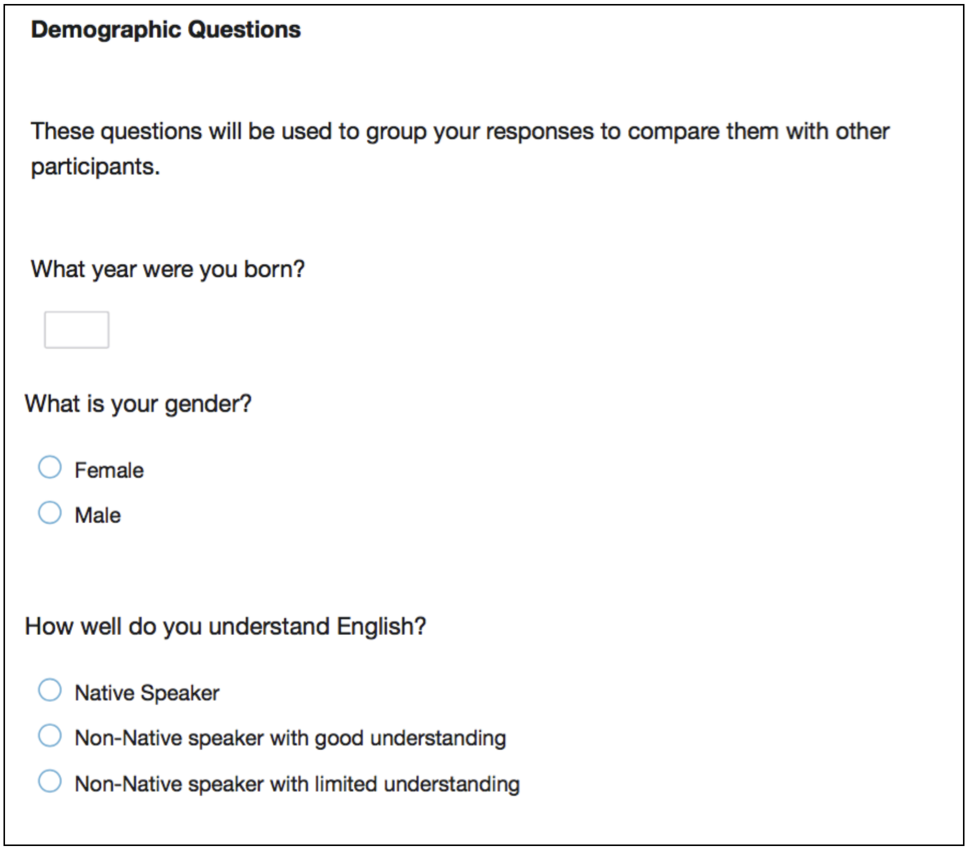
- Demographics – This section asked about age, gender, ability to understand English, education, income, and environment.
- History – This section asked about their experience with online search, their training, where they searched from, what kind of information they had searched for, and what search sites they had experience with using.
- Self-Rated Search Ability – This section consisted of 14 items from the Search Self-Efficacy scale (Brennan, Kelly, & Zhang, 2016).
- Skills – This section tested participant's abilities to select the proper tool to use to solve specific search needs along with several items from NILRC that detailed specific search needs and asked for the best solution in a list.
- Personality – This section used items from the IPIP (International Personality Item Pool).

During the pilot testing and subsequent discussion, the items from the NILRC were discarded and the items from the Search Self-Efficacy Scale were narrowed and combined with items from other sections.

5.2.1 Demographics Section

The first part of the instrument contained several demographic items designed to primarily be used for descriptive purposes, but also used to determine eligibility by age and familiarity with English (see Figure 17). Many of the items used here were taken from the standard items within the Qualtrics database, including items on gender, education, and income.

Figure 17: Demographic Questions on Initial Instrument



Demographic Questions

These questions will be used to group your responses to compare them with other participants.

What year were you born?

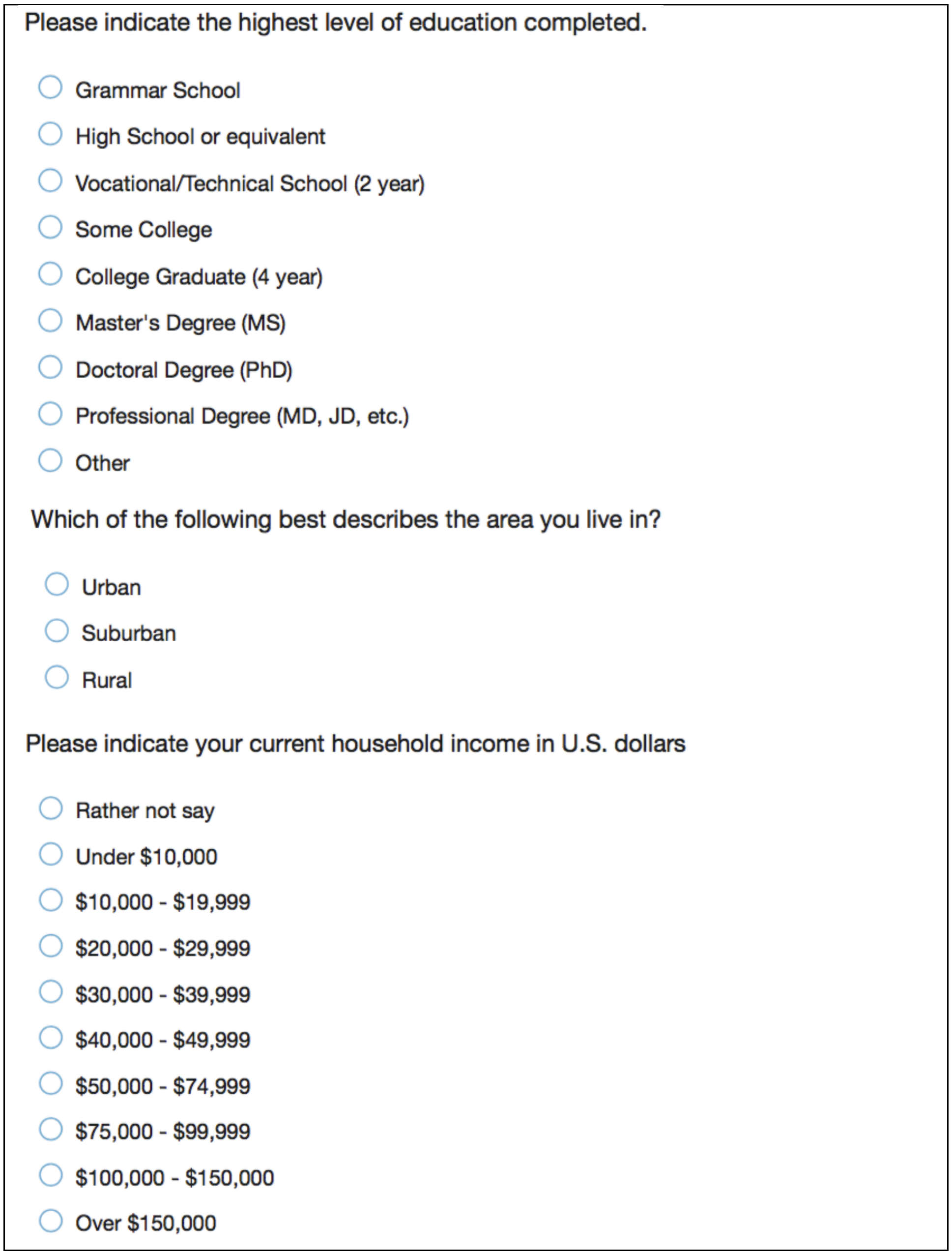
What is your gender?

○ Female
○ Male

How well do you understand English?

○ Native Speaker
○ Non-Native speaker with good understanding
○ Non-Native speaker with limited understanding

Figure 17 (cont.): Demographic Questions on Initial Instrument



Please indicate the highest level of education completed.

○ Grammar School
○ High School or equivalent
○ Vocational/Technical School (2 year)
○ Some College
○ College Graduate (4 year)
○ Master's Degree (MS)
○ Doctoral Degree (PhD)
○ Professional Degree (MD, JD, etc.)
○ Other

Which of the following best describes the area you live in?

○ Urban
○ Suburban
○ Rural

Please indicate your current household income in U.S. dollars

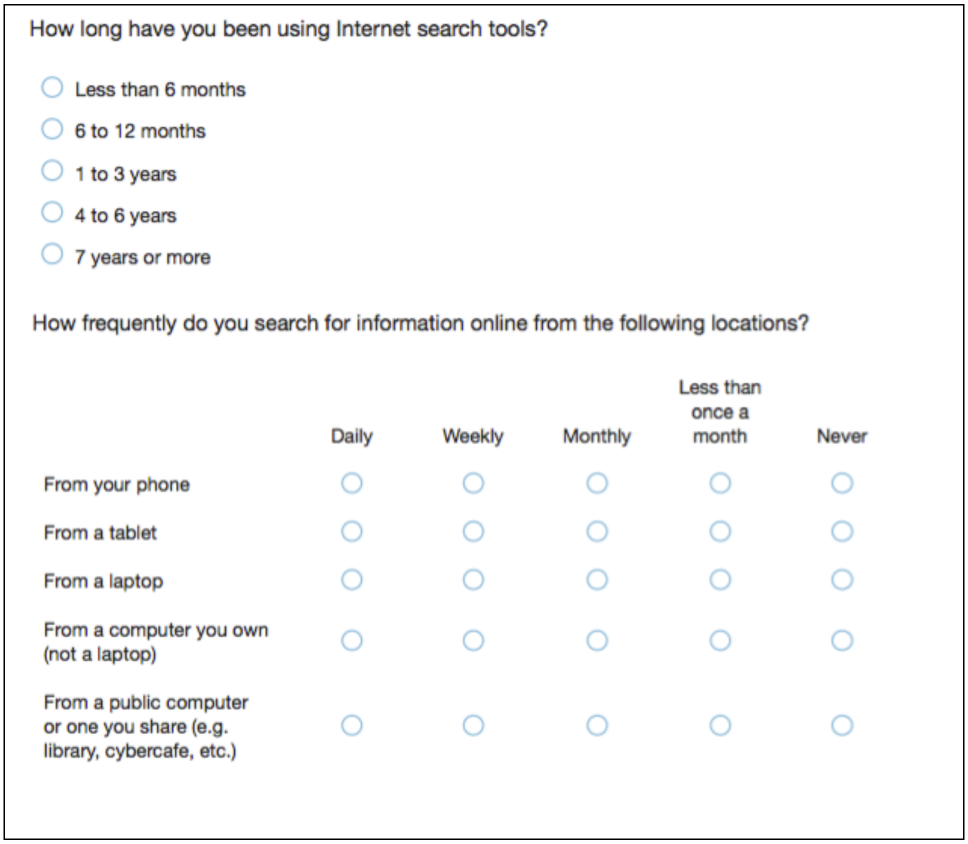
○ Rather not say
○ Under $10,000
○ $10,000 - $19,999
○ $20,000 - $29,999
○ $30,000 - $39,999
○ $40,000 - $49,999
○ $50,000 - $74,999
○ $75,000 - $99,999
○ $100,000 - $150,000
○ Over $150,000

5.2.2 History Section

The next section of the instrument (see Figure 18) asked the participants general questions about their history with search. The items from the experts included in this section were:

- Experience (years online)
- Formal training in how to search
- Self-trained in how to search
- Experience doing searches for others
- Formal training in Library Science
- Has a degree in Information Science
- Has made presentations on search
- Has taught courses on search
- Has trained others in searching
- Professional experience
- Experience (daily searching)
- Uses search skills frequently (weekly)
- Work experience that includes searching
- Experience (reference desk)

Figure 18: History Questions on Initial Instrument



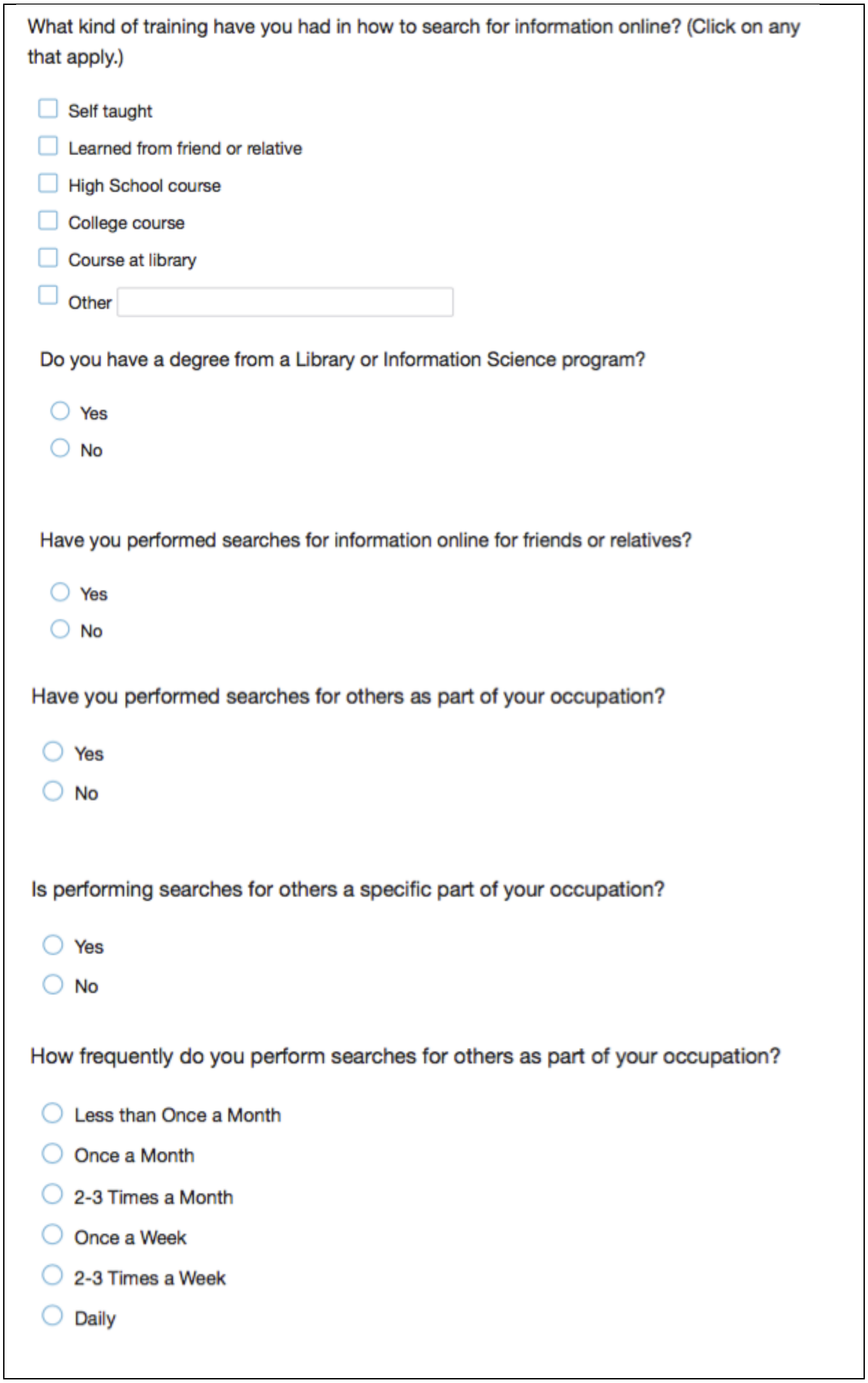
How long have you been using Internet search tools?

○ Less than 6 months
○ 6 to 12 months
○ 1 to 3 years
○ 4 to 6 years
○ 7 years or more

How frequently do you search for information online from the following locations?

	Daily	Weekly	Monthly	Less than once a month	Never
From your phone	○	○	○	○	○
From a tablet	○	○	○	○	○
From a laptop	○	○	○	○	○
From a computer you own (not a laptop)	○	○	○	○	○
From a public computer or one you share (e.g. library, cybercafe, etc.)	○	○	○	○	○

Figure 18 (cont.): History Questions on Initial Instrument



What kind of training have you had in how to search for information online? (Click on any that apply.)

☐ Self taught
☐ Learned from friend or relative
☐ High School course
☐ College course
☐ Course at library
☐ Other

Do you have a degree from a Library or Information Science program?

○ Yes
○ No

Have you performed searches for information online for friends or relatives?

○ Yes
○ No

Have you performed searches for others as part of your occupation?

○ Yes
○ No

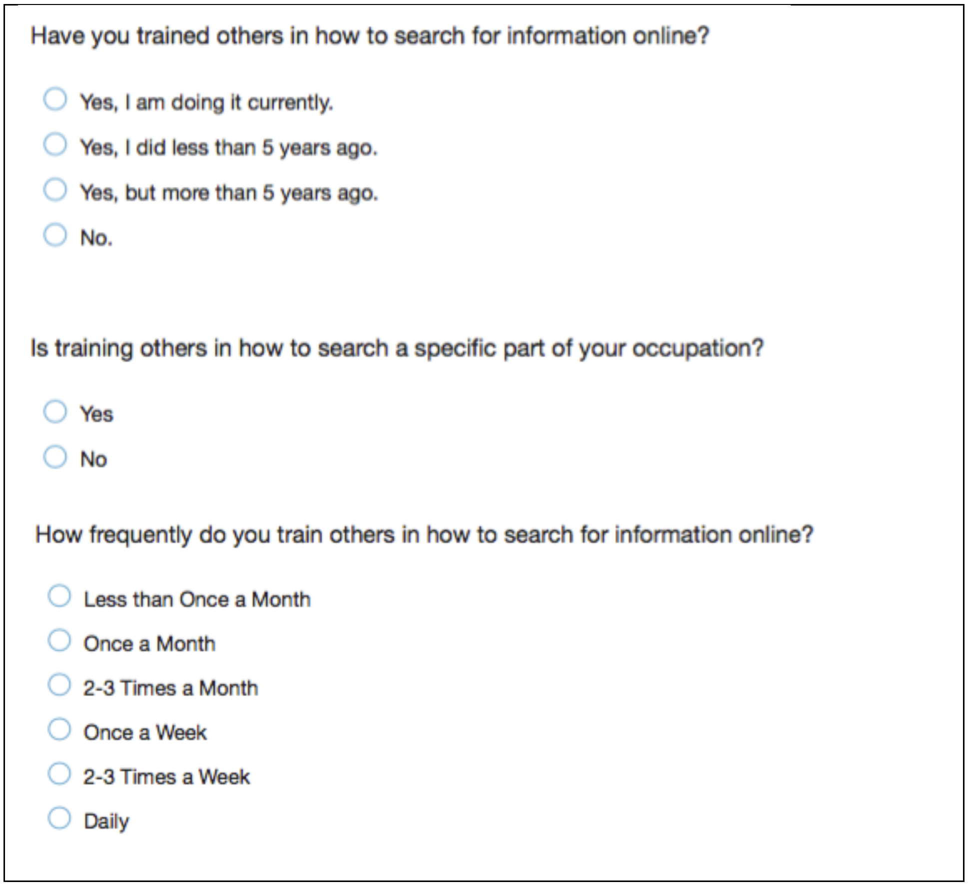
Is performing searches for others a specific part of your occupation?

○ Yes
○ No

How frequently do you perform searches for others as part of your occupation?

○ Less than Once a Month
○ Once a Month
○ 2-3 Times a Month
○ Once a Week
○ 2-3 Times a Week
○ Daily

Figure 18 (cont.): History Questions on Initial Instrument



Have you trained others in how to search for information online?

○ Yes, I am doing it currently.
○ Yes, I did less than 5 years ago.
○ Yes, but more than 5 years ago.
○ No.

Is training others in how to search a specific part of your occupation?

○ Yes
○ No

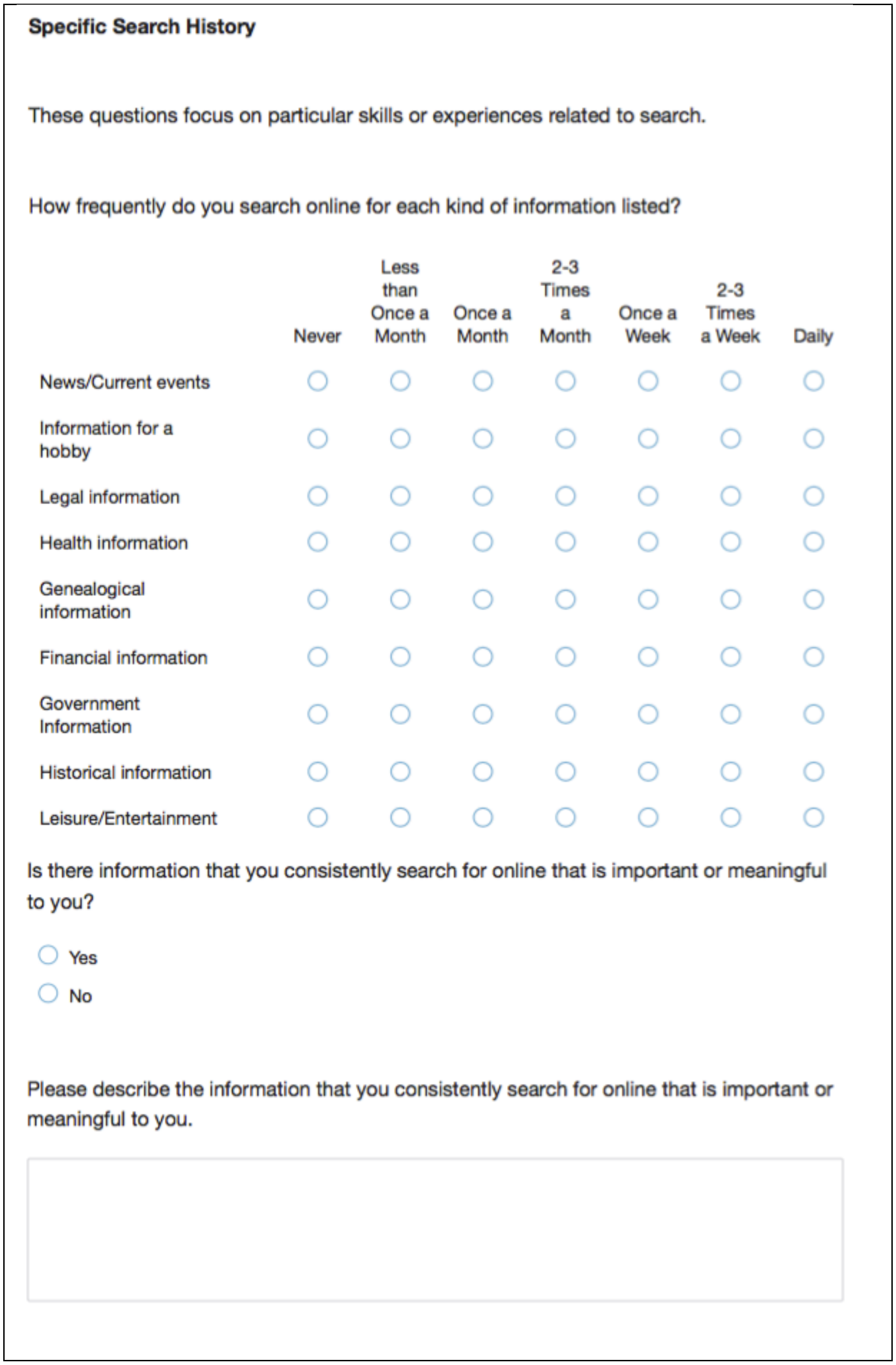
How frequently do you train others in how to search for information online?

○ Less than Once a Month
○ Once a Month
○ 2-3 Times a Month
○ Once a Week
○ 2-3 Times a Week
○ Daily

This section also asked participants questions about specific types of experiences they may have had in the past (see Figure 19). The items from the experts included in this section were:

- Experience searching for current information
- Experience searching for news
- Experience searching related to a hobby
- Experience with academic sources
- Experience with bibliographic tool
- Experience with Google
- Experience with library catalogue
- Experience with multiple (3 or more) tools/databases
- Experience with PubMed
- Experience with WorldCat
- Has searched for information about a medical condition
- Has searched for information about a medication
- Has searched for legal information
- Has worked with archives

Figure 19: Specific Search History on Initial Instrument



Specific Search History

These questions focus on particular skills or experiences related to search.

How frequently do you search online for each kind of information listed?

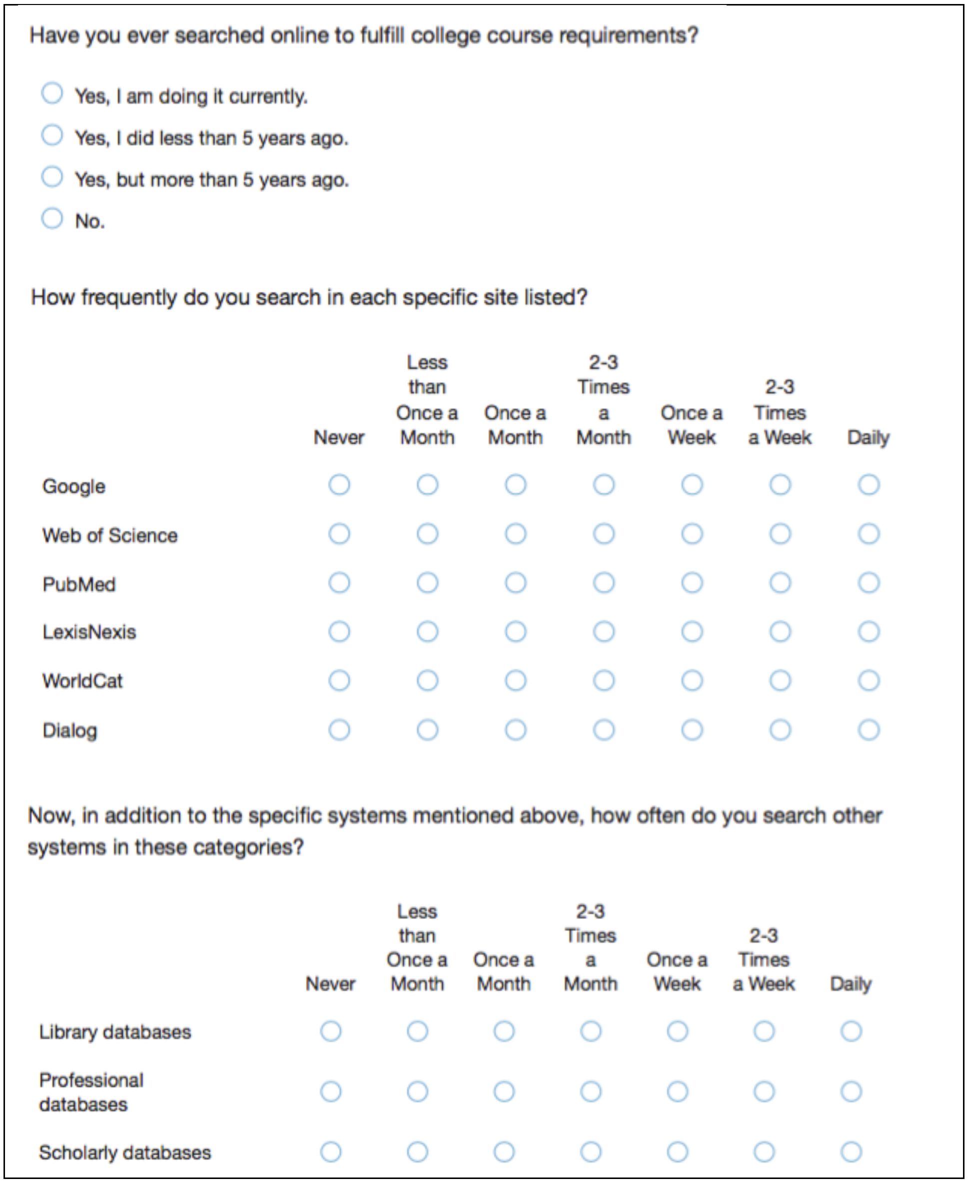
	Never	Less than Once a Month	Once a Month	2-3 Times a Month	Once a Week	2-3 Times a Week	Daily
News/Current events	○	○	○	○	○	○	○
Information for a hobby	○	○	○	○	○	○	○
Legal information	○	○	○	○	○	○	○
Health information	○	○	○	○	○	○	○
Genealogical information	○	○	○	○	○	○	○
Financial information	○	○	○	○	○	○	○
Government Information	○	○	○	○	○	○	○
Historical information	○	○	○	○	○	○	○
Leisure/Entertainment	○	○	○	○	○	○	○

Is there information that you consistently search for online that is important or meaningful to you?

○ Yes
○ No

Please describe the information that you consistently search for online that is important or meaningful to you.

Figure 19 (cont.): Specific Search History on Initial Instrument



Have you ever searched online to fulfill college course requirements?

○ Yes, I am doing it currently.
○ Yes, I did less than 5 years ago.
○ Yes, but more than 5 years ago.
○ No.

How frequently do you search in each specific site listed?

	Never	Less than Once a Month	Once a Month	2-3 Times a Month	Once a Week	2-3 Times a Week	Daily
Google	○	○	○	○	○	○	○
Web of Science	○	○	○	○	○	○	○
PubMed	○	○	○	○	○	○	○
LexisNexis	○	○	○	○	○	○	○
WorldCat	○	○	○	○	○	○	○
Dialog	○	○	○	○	○	○	○

Now, in addition to the specific systems mentioned above, how often do you search other systems in these categories?

	Never	Less than Once a Month	Once a Month	2-3 Times a Month	Once a Week	2-3 Times a Week	Daily
Library databases	○	○	○	○	○	○	○
Professional databases	○	○	○	○	○	○	○
Scholarly databases	○	○	○	○	○	○	○

5.2.3 Self-Rated Search Ability Section

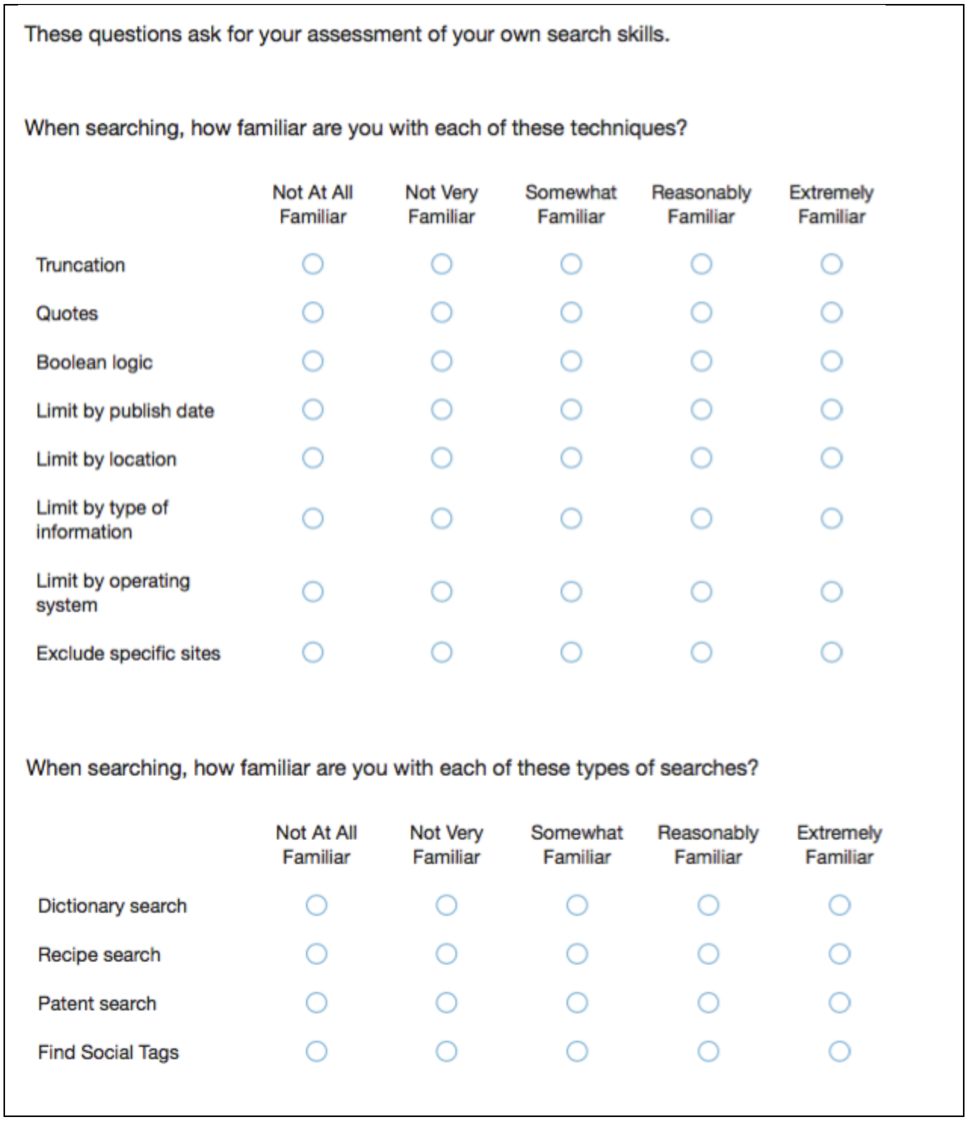
The results from the expert interviews and focus groups contained a number of items related to either familiarity with certain concepts or tools or confidence in the ability to use certain tools (see Figure 20). These items were included in the instrument in a section titled Search Self-Efficacy, although not all of the items in that section were taken from the Search

Self-Efficacy Scale (Kelly, 2010). Although these items are self-rated items and include items used for search self-efficacy previously, using the title ‘Search Self-Efficacy Scale’ would be confusing, so they are simply called self-rated search ability here. The items from the experts included in this section were:

- Knowing Boolean*
- Knowing quotes*
- Knowing truncation*
- Knowing when/how to broaden previous search*
- Knowing when/how to limit previous search*
- Understands limiting search sets by source*
- Understands limiting search sets by time*
- Understands limiting search sets by type of information*
- Familiarity with search tools
- Finding right answer within correct context
- Good at learning and understanding new systems
- Good communication skills
- Knows language of the field
- Self-awareness of search skills
- Sensitivity/Specificity
- Understands limiting search sets by source*
- Understands limiting search sets by time*
- Understands limiting search sets by type of information*
- Able to analyze/evaluate results set

Not all questions were retained for the final version. Some of these items (marked with an asterisk) were also tested in the Skills section of the instrument in order to compare the participants’ self-rated search ability with their measured ability.

Figure 20: Self-Rated Search Ability on Initial Instrument



These questions ask for your assessment of your own search skills.

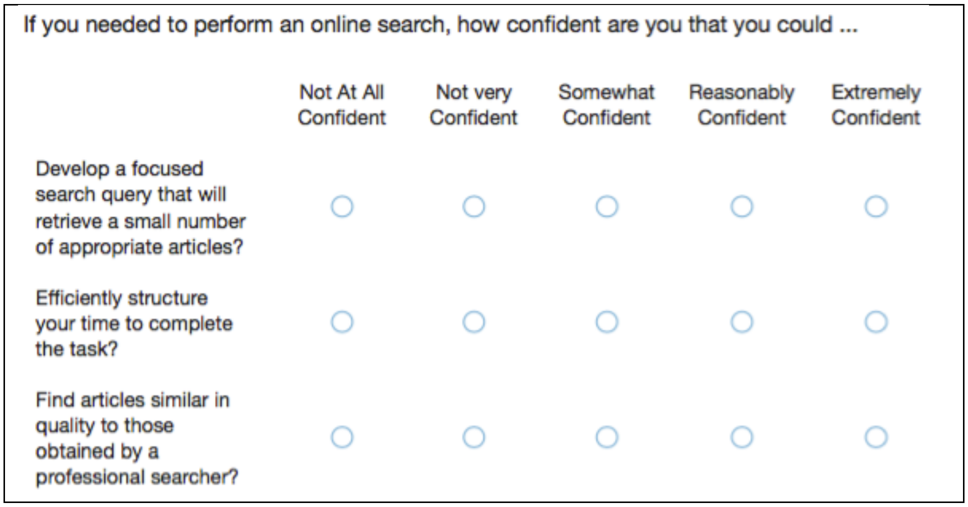
When searching, how familiar are you with each of these techniques?

	Not At All Familiar	Not Very Familiar	Somewhat Familiar	Reasonably Familiar	Extremely Familiar
Truncation	○	○	○	○	○
Quotes	○	○	○	○	○
Boolean logic	○	○	○	○	○
Limit by publish date	○	○	○	○	○
Limit by location	○	○	○	○	○
Limit by type of information	○	○	○	○	○
Limit by operating system	○	○	○	○	○
Exclude specific sites	○	○	○	○	○

When searching, how familiar are you with each of these types of searches?

	Not At All Familiar	Not Very Familiar	Somewhat Familiar	Reasonably Familiar	Extremely Familiar
Dictionary search	○	○	○	○	○
Recipe search	○	○	○	○	○
Patent search	○	○	○	○	○
Find Social Tags	○	○	○	○	○

Figure 20 (cont.): Self-Rated Search Ability on Initial Instrument



If you needed to perform an online search, how confident are you that you could ...

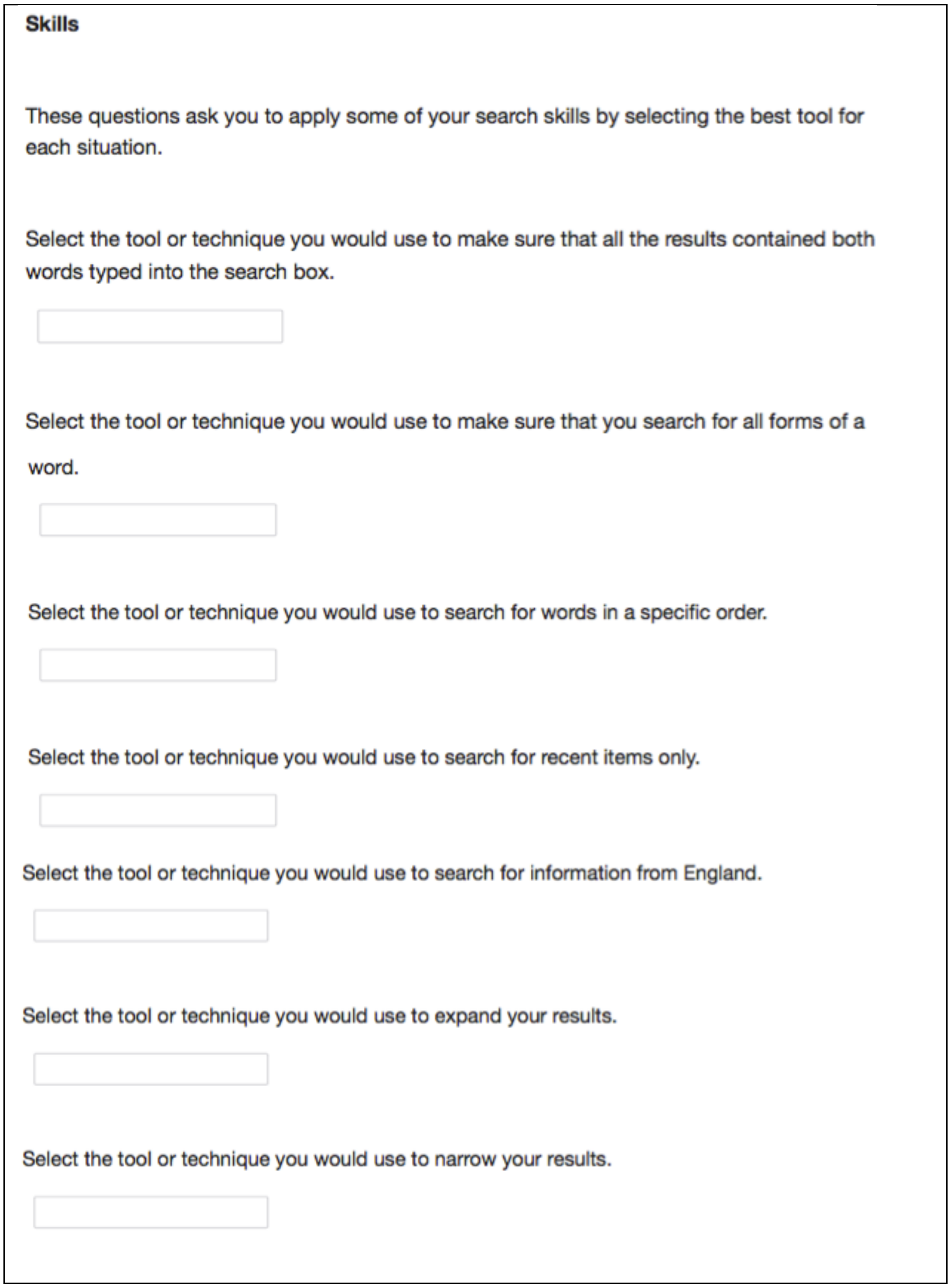
	Not At All Confident	Not very Confident	Somewhat Confident	Reasonably Confident	Extremely Confident
Develop a focused search query that will retrieve a small number of appropriate articles?	○	○	○	○	○
Efficiently structure your time to complete the task?	○	○	○	○	○
Find articles similar in quality to those obtained by a professional searcher?	○	○	○	○	○

5.2.4 Skills/Performance Section

This section asked participants to select tools or techniques that would finish specific tasks. Unlike the self-efficacy questions, these questions did not ask for their ratings of their abilities, but instead had correct answers. The empty boxes shown in Figure 21 were actually pull down menus containing a list of possible answers: Boolean AND, Truncation, Quotes, Personalization, Limit by date, Limit by source, Iterative Search, Relevance, Google Advanced Features, Limit by type of information, Boolean OR, Adding words to search, Deleting words from search, Stop words. The items from the experts included in this section were:

- Able to predict search results
- Understanding how system will respond to request
- Knows language of the field
- Knowing Boolean
- Knowing quotes
- Knowing truncation
- Knowing when/how to broaden previous search
- Knowing when/how to limit previous search
- Understands limiting search sets by source
- Understands limiting search sets by time
- Understands limiting search sets by type of information

Figure 21: Skill Questions on Initial Instrument



Skills

These questions ask you to apply some of your search skills by selecting the best tool for each situation.

Select the tool or technique you would use to make sure that all the results contained both words typed into the search box.

Select the tool or technique you would use to make sure that you search for all forms of a word.

Select the tool or technique you would use to search for words in a specific order.

Select the tool or technique you would use to search for recent items only.

Select the tool or technique you would use to search for information from England.

Select the tool or technique you would use to expand your results.

Select the tool or technique you would use to narrow your results.

5.2.5 Personality Section

The last section of the instrument focused on personality. The personality questions came from the International Personality Item Pool (IPIP). The International Personality Item Pool started in the Netherlands in 1997 as an item-writing project (Hendriks, 1997; Hendriks, Hofstee, & de Raad, 2002) that became a resource for personality assessment professionals. It has been referenced in more than 600 published papers worldwide (http://ipip.ori.org/HistoryOfTheIPIP.htm). IPIP includes a list of subscales based upon questions from various personality inventories, each of which has been tested for reliability using Cronbach's alpha. IPIP specifically publishes public domain items that represent items from many of the proprietary personality inventories. These inventories would otherwise be unavailable for use in research.

Table 21 shows a list of constructs gathered from the experts along with the subscales used in this research. The subscales listed below are the Six Factor Personality Questionnaire (6FPQ) (Jackson, Ashton, & Tomes, 1996), the Temperament and Character Inventory (TCI) (Cloninger, Przybeck, Svrakic, & Wetzel, 1994), the Values in Action Character Survey (VIA) (Peterson & Seligman, 2004), the HEXACO Personality Inventory (HEXACO) (Lee & Ashton, 2004), and the Big Five (AB5C) (Hofstee, de Raad, & Goldberg, 1992).

It is important to note that the construct names from the expert interviews and focus groups used common English words rather than technical terms to describe concepts. These items were matched to specific IPIP subscales where possible. When the language did not match, specific items were also examined to determine possible usefulness. In cases where there was a choice of subscales, the subscale with the highest Cronbach's alpha was selected. If there were two or more subscales with similar scores, subscales sharing items with other selected subscales were selected to limit item count as much as possible. Some titles for subscales did not match the descriptive words used by the search experts. In those cases, sample items from the subscale are included to show a match with the description given by the experts.

Table 21: Mapping of Expert Items to International Personality Item Pool Subscales

Specific Item From Experts	IPIP Subscale Name/Items
Analytical Skills Able to analyze/evaluate results set	Resourcefulness • I like to solve complex problems. • I can handle lots of information. • I can tackle anything. • I can perform a wide variety of tasks.
Concentration	Organization • I detect mistakes. • I have an eye for detail. • I don't pay attention (reverse).
Confidence/Fearlessness	Low Self-Efficacy (reverse)
Creativity	Creativity/Originality
Curiosity	Inquisitiveness
Efficient	Efficiency
Enjoys search process Passion for searching	Diligence • I push myself very hard to succeed. • I work hard.
Flexibility Adaptability Adaptivity	Quickness • I catch on to things quickly. • I quickly get the idea of things.
Motivation	Diligence • I complete tasks successfully. • I push myself very hard to succeed. • I quickly lose interest in the tasks I start (reverse).
Patience	Industry/Perseverance/Persistence
Persistence	Industry/Perseverance/Persistence
Problem solving	Competence • I like to solve complex problems. • I feel up to any task.
Strong organizational skills	Organization
Tenacity	Industry/Perseverance/Persistence

While it is clear that some of the items within the selected subscales were not specifically matched to items mentioned by the experts, the subscales were used in complete form for testing so as to collect as much data as possible. The items from the experts above were reorganized opposite the subscales and listed in Table 22 along with the alpha scores reported by IPIP.

Table 22: International Personality Item Pool Subscales

Construct from Experts	Source	IPIP Subscale Name	Number of Items	IPIP Alpha
Analytical	6FPQ	Resourcefulness	10	0.81
Confidence	TCI	Low Self-Efficacy	9	0.77
Creativity	VIA	Creativity/Originality	8	0.85
Curiosity	HEXACO	Inquisitiveness	10	0.78
Efficient	AB5C	Efficiency	11	0.907
Flexibility	AB5C	Quickness	10	0.84
Motivation	HEXACO	Diligence	10	0.81
Organized	AB5C	Organization	12	0.78
Persistence	VIA	Industry/Perseverance/ Persistence	7	0.81
Problem Solver	TCI	Competence	9	0.75

The subscale names from IPIP are used to refer to the concepts from this point forward except where specifically discussing the experts' categories. The actual questions on the instrument are shown in Figure 22. The items from the experts included in this section were:

- Able to analyze/evaluate results set
- Concentration
- Confidence/Fearlessness
- Creativity
- Curiosity
- Efficient
- Enjoys Search Process/Passion for Searching
- Flexibility/Adaptability/Adaptivity
- Good Analytical skills
- Good at learning and understanding new systems
- Good communication skills
- Knowing advanced features of Google
- Motivation
- Patience
- Persistence
- Problem Solving
- Strong Organizational skills
- Tenacity

All items were ordered based upon subscale, and all participants answered them in the same order. Items on multiple subscales were included on the first subscale where they appeared.

Figure 22: Personality Questions on Initial Instrument

These questions relate to different personality traits.

For each item listed, select how well it applies to you.

	Very Inaccurate	Moderately Inaccurate	Neither Inaccurate Nor Accurate	Moderately Accurate	Very Accurate
I am good at many things.	○	○	○	○	○
I can handle lots of information.	○	○	○	○	○
I can manage many things at the same time.	○	○	○	○	○
I can perform a wide variety of tasks.	○	○	○	○	○
I can tackle anything.	○	○	○	○	○

	Very Inaccurate	Moderately Inaccurate	Neither Inaccurate Nor Accurate	Moderately Accurate	Very Accurate
I can work under pressure.	○	○	○	○	○
I like to solve complex problems.	○	○	○	○	○
I need things explained only once.	○	○	○	○	○
I don't pay attention.	○	○	○	○	○
I give up easily.	○	○	○	○	○

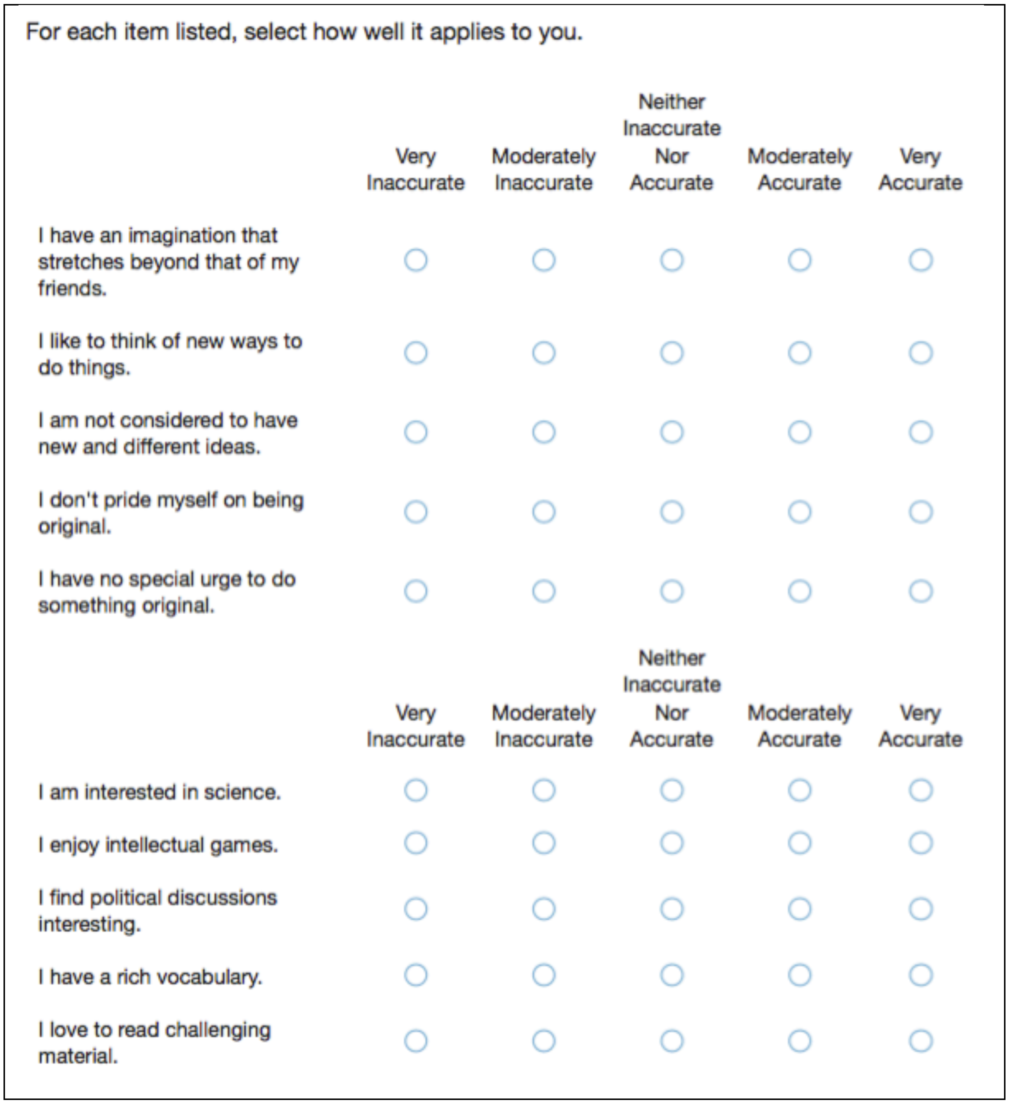
Figure 22 (cont.): Personality Questions on Initial Instrument

For each item listed, select how well it applies to you.

	Very Inaccurate	Moderately Inaccurate	Neither Inaccurate Nor Accurate	Moderately Accurate	Very accurate
I am afraid of many things.	○	○	○	○	○
I am often down in the dumps.	○	○	○	○	○
I become overwhelmed by events.	○	○	○	○	○
I feel that I'm unable to deal with things.	○	○	○	○	○
I need reassurance.	○	○	○	○	○

	Very Inaccurate	Moderately Inaccurate	Neither Inaccurate Nor Accurate	Moderately Accurate	Very accurate
I readily overcome setbacks.	○	○	○	○	○
I think quickly.	○	○	○	○	○
I am able to come up with new and different ideas.	○	○	○	○	○
I am an original thinker.	○	○	○	○	○
I come up with new ways to do things.	○	○	○	○	○

Figure 22 (cont.): Personality Questions on Initial Instrument



For each item listed, select how well it applies to you.

	Very Inaccurate	Moderately Inaccurate	Neither Inaccurate Nor Accurate	Moderately Accurate	Very Accurate
I have an imagination that stretches beyond that of my friends.	○	○	○	○	○
I like to think of new ways to do things.	○	○	○	○	○
I am not considered to have new and different ideas.	○	○	○	○	○
I don't pride myself on being original.	○	○	○	○	○
I have no special urge to do something original.	○	○	○	○	○
	Very Inaccurate	Moderately Inaccurate	Neither Inaccurate Nor Accurate	Moderately Accurate	Very Accurate
I am interested in science.	○	○	○	○	○
I enjoy intellectual games.	○	○	○	○	○
I find political discussions interesting.	○	○	○	○	○
I have a rich vocabulary.	○	○	○	○	○
I love to read challenging material.	○	○	○	○	○

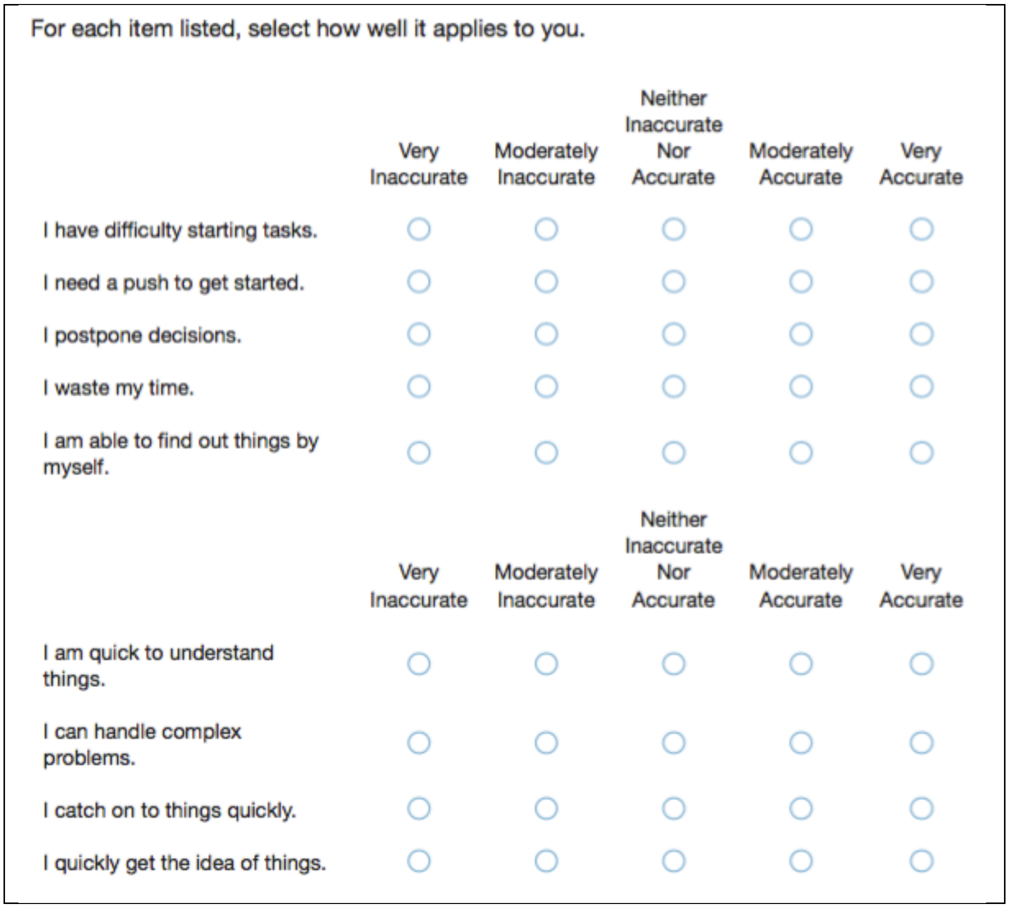
Figure 22 (cont.): Personality Questions on Initial Instrument

For each item listed, select how well it applies to you.

	Very Inaccurate	Moderately Inaccurate	Neither Inaccurate Nor Accurate	Moderately Accurate	Very Accurate
I would love to explore strange places.	○	○	○	○	○
I don't bother worrying about political and social problems.	○	○	○	○	○
I don't know much about history.	○	○	○	○	○
I will not probe deeply into a subject.	○	○	○	○	○
I finish what I start.	○	○	○	○	○

	Very Inaccurate	Moderately Inaccurate	Neither Inaccurate Nor Accurate	Moderately Accurate	Very Accurate
I follow through with my plans.	○	○	○	○	○
I get chores done right away.	○	○	○	○	○
I make plans and stick to them.	○	○	○	○	○
I find it difficult to get down to work.	○	○	○	○	○
I frequently forget to do things.	○	○	○	○	○

Figure 22 (cont.): Personality Questions on Initial Instrument

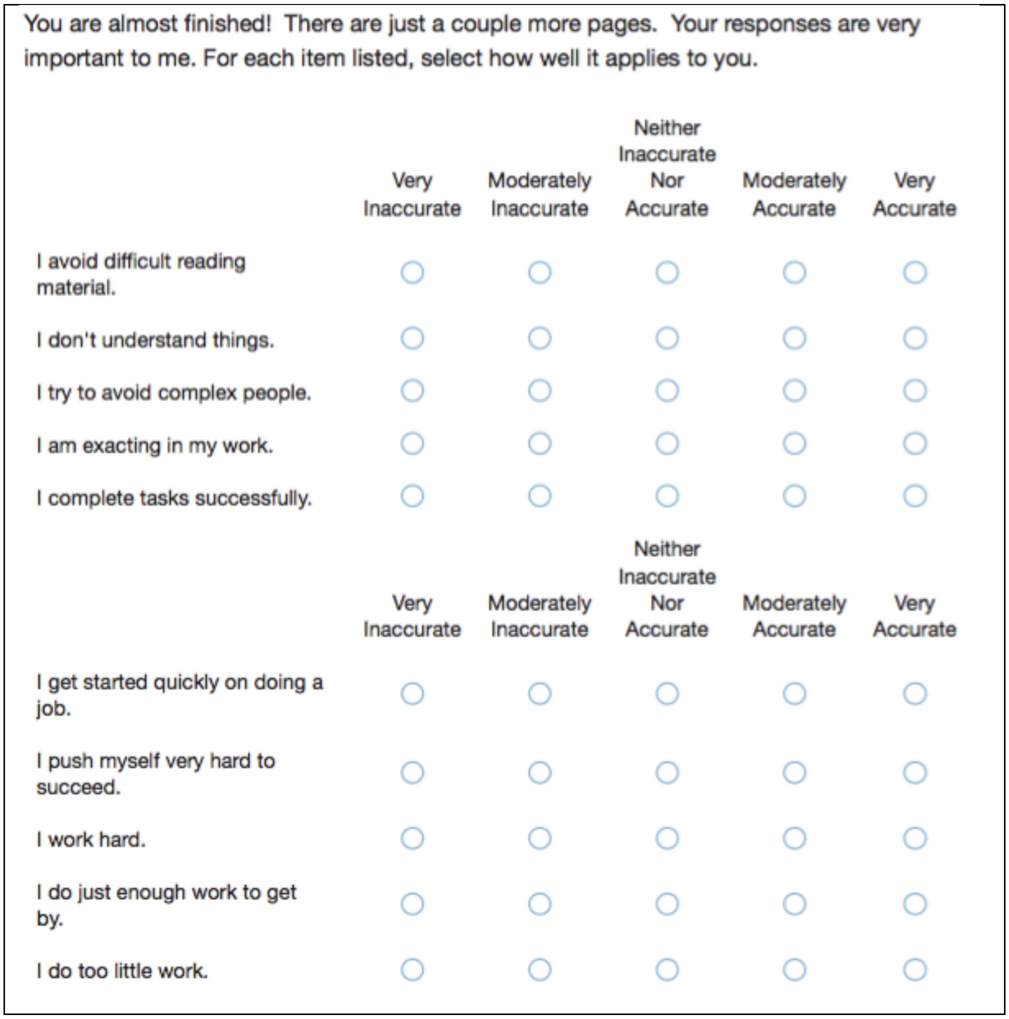


For each item listed, select how well it applies to you.

	Very Inaccurate	Moderately Inaccurate	Neither Inaccurate Nor Accurate	Moderately Accurate	Very Accurate
I have difficulty starting tasks.	○	○	○	○	○
I need a push to get started.	○	○	○	○	○
I postpone decisions.	○	○	○	○	○
I waste my time.	○	○	○	○	○
I am able to find out things by myself.	○	○	○	○	○

	Very Inaccurate	Moderately Inaccurate	Neither Inaccurate Nor Accurate	Moderately Accurate	Very Accurate
I am quick to understand things.	○	○	○	○	○
I can handle complex problems.	○	○	○	○	○
I catch on to things quickly.	○	○	○	○	○
I quickly get the idea of things.	○	○	○	○	○

Figure 22 (cont.): Personality Questions on Initial Instrument



You are almost finished! There are just a couple more pages. Your responses are very important to me. For each item listed, select how well it applies to you.

	Very Inaccurate	Moderately Inaccurate	Neither Inaccurate Nor Accurate	Moderately Accurate	Very Accurate
I avoid difficult reading material.	○	○	○	○	○
I don't understand things.	○	○	○	○	○
I try to avoid complex people.	○	○	○	○	○
I am exacting in my work.	○	○	○	○	○
I complete tasks successfully.	○	○	○	○	○

	Very Inaccurate	Moderately Inaccurate	Neither Inaccurate Nor Accurate	Moderately Accurate	Very Accurate
I get started quickly on doing a job.	○	○	○	○	○
I push myself very hard to succeed.	○	○	○	○	○
I work hard.	○	○	○	○	○
I do just enough work to get by.	○	○	○	○	○
I do too little work.	○	○	○	○	○

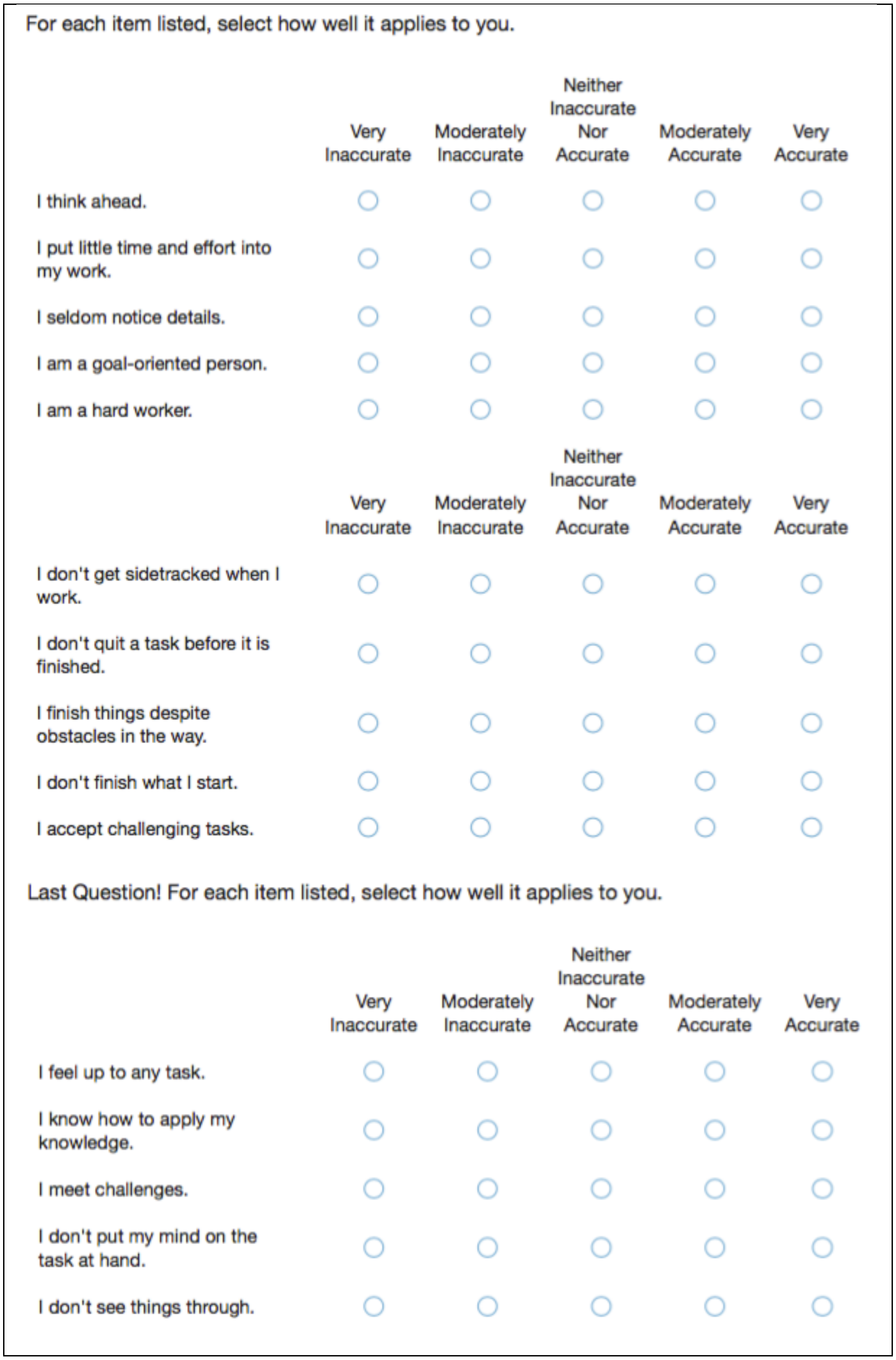
Figure 22 (cont.): Personality Questions on Initial Instrument

For each item listed, select how well it applies to you.

	Very Inaccurate	Moderately Inaccurate	Neither Inaccurate Nor Accurate	Moderately Accurate	Very Accurate
I hang around doing nothing.	○	○	○	○	○
I quickly lose interest in the tasks I start.	○	○	○	○	○
I stop when work becomes too difficult.	○	○	○	○	○
I demand quality.	○	○	○	○	○
I detect mistakes.	○	○	○	○	○

	Very Inaccurate	Moderately Inaccurate	Neither Inaccurate Nor Accurate	Moderately Accurate	Very Accurate
I follow through on my commitments.	○	○	○	○	○
I have an eye for detail.	○	○	○	○	○
I make well-considered decisions.	○	○	○	○	○
I pay attention to details.	○	○	○	○	○
I set high standards for myself and others.	○	○	○	○	○

Figure 22 (cont.): Personality Questions on Initial Instrument



For each item listed, select how well it applies to you.

	Very Inaccurate	Moderately Inaccurate	Neither Inaccurate Nor Accurate	Moderately Accurate	Very Accurate
I think ahead.	○	○	○	○	○
I put little time and effort into my work.	○	○	○	○	○
I seldom notice details.	○	○	○	○	○
I am a goal-oriented person.	○	○	○	○	○
I am a hard worker.	○	○	○	○	○

	Very Inaccurate	Moderately Inaccurate	Neither Inaccurate Nor Accurate	Moderately Accurate	Very Accurate
I don't get sidetracked when I work.	○	○	○	○	○
I don't quit a task before it is finished.	○	○	○	○	○
I finish things despite obstacles in the way.	○	○	○	○	○
I don't finish what I start.	○	○	○	○	○
I accept challenging tasks.	○	○	○	○	○

Last Question! For each item listed, select how well it applies to you.

	Very Inaccurate	Moderately Inaccurate	Neither Inaccurate Nor Accurate	Moderately Accurate	Very Accurate
I feel up to any task.	○	○	○	○	○
I know how to apply my knowledge.	○	○	○	○	○
I meet challenges.	○	○	○	○	○
I don't put my mind on the task at hand.	○	○	○	○	○
I don't see things through.	○	○	○	○	○

5.2.6 Item Construction

Items were constructed so as to remain consistent and compatible with previous tested usage wherever possible. Therefore, items from the IPIP were used with a five-point Likert scale ranging from 'Very Inaccurate' to 'Moderately Inaccurate' to 'Neither Inaccurate or Accurate' to 'Moderately Accurate' to 'Very Accurate.' All items from the IPIP were also used within known subscales already identified by that repository.

Other Classic Test Theory items developed for concepts from the experts used a similar five-point Likert scale for both familiarity and confidence. Descriptive items in contrast used a seven-point Likert scale to measure frequency in order to include more specific data points. All items were created and administered online through Qualtrics and used their format throughout.

Some of these questions were taken from an existing Search Self-Efficacy scale originally designed by Debowski, Wood and Bandura (2001), and later modified for testing by Kelly (2010). The Search Self-Efficacy Scale was determined to be of limited use in discriminating between participants (Brennan, Zhang, & Kelly, 2016), so each item was evaluated based upon their reported means and standard deviations. The three items with the lowest overall means and highest variances were retained for this instrument, but they were rescaled to match the items from the IPIP.

5.3 Assessment of Content Validity through Cognitive Interviewing

It is important when creating and modifying an instrument to assess whether it measures what it intends to measure whenever possible, referred to as its content validity (DeVellis, 2012). Content validity can be assessed by examination of existing research regarding the topic of the instrument and by asking experts in that area. This assessment was done in phases 1 and 2 of this research.

Another method to verify content validity is to have the expert complete the instrument while giving their opinions about the included items and their meanings. However, it is important to remember that an instrument given to all segments of the population must have content validity to each one of those segments. This is particularly important in online search expertise, as changes in technology have affected both conceptualization and practice, and it can be accomplished through individual one-on-one cognitive interviews with deliberate selection of participants to represent multiple segments of the overall population.

Cognitive interviewing is defined as "the administration of draft survey questions while collecting additional verbal information about the survey responses, which is used to evaluate the quality of the response or to help determine whether the question is generating the information that its author intends" (Beatty & Willis, 2007, p. 287). Often equated with think-aloud interviewing, it seeks to use cognitive psychology to understand how respondents react to a test or measure (Gerber & Wellens, 1996). Cognitive interviewing examines the respondent in a number of ways, including their comprehension, recall, judgment, and response to the item being investigated (Tourangeau, 1984).

Typically, this process is carried out in a laboratory setting to control aspects of the experience or of the respondent (Willis, 1999). Respondents are usually trained in how to perform the think-aloud protocol. The respondent then goes through the questions on the instrument and verbalizes their thoughts when encountering those questions (Dillman, 2000). However, this collection of data could be passive, as in simple observation, or it could be probing, with the researcher asking questions. In some cases, these thoughts are simply recorded at the time they were expressed, but then discussed with the respondent retrospectively. In other cases, the interviewer will ask questions immediately based upon those verbalized thoughts or upon the specific areas of interest. For this research, the cognitive interviews were simple observation while participants used think-aloud protocols, followed by a final question on any remaining thoughts.

5.3.1 Participants

Participants for this phase were deliberately selected so as to include a variety of user types, including expert/trained searchers (Group 1), casual searchers (Group 2), students and academics (Group 3), and frequent searchers (Group 4). Participants for groups two, three, and four were recruited using the University at North Carolina Faculty and Staff email list (see Appendix F). Participants for Group 1 were recruited from referrals from trained researchers. All participants in Groups 2, 3, and 4 were sent a follow up email (see Appendix G) that asked them to self-report their level of expertise as well as their training in search, their experience searching online, and whether they had an LIS degree (see Table 23). These questions have been frequently used to sort users in prior research and so were deemed appropriate to use to sort participants here. Eleven of the participants identified as female; three identified as male. One of the participants noted the limitations of only having male and female as options and did not report, which ultimately led to a reframing of the choices based upon recommendations of the UNC LGBQT Center. All participants reported seven years or more experience using search tools, so that question was discarded for sorting purposes.

Table 23: Participants in Cognitive Interviews

Participant	Type of online searcher	Training in search	LIS Degree?
Trained Searcher 1	Expert, I search as part of my job	Self-taught Learned from friend or relative College course	Yes
Trained Searcher 2	Expert, I search as part of my job	Self-taught	Yes
Trained Searcher 3	Expert, I search as part of my job	Self-taught High School course College Course Course at library	Yes, pursuing
Trained Searcher 4	Expert, I search as part of my job	Self-taught High School course College Course Course at library	Yes, pursuing
Casual Internet User 1	I am an Average or Casual Online Searcher.	Self-taught	No
Casual Internet User 2	I am an Average or Casual Online Searcher.	Self-taught	No
Casual Internet User 3	I am an Average or Casual Online Searcher.	Self-taught	No
Casual Internet User 4	Above Average, I search for schoolwork or other information frequently.	Self-taught	No
Student and Academic 1	Above Average, I search for schoolwork or other information frequently.	Self-taught Learned from friend or relative High School course Course at library	No
Student and Academic 2	Above Average, I search for schoolwork or other information frequently.	Self-taught Learned from friend or relative High School course Course at library	No
Student and Academic 3	Above Average, I search for schoolwork or other information frequently.	Learned from friend or relative Course at library	No
Frequent Internet User 1	Above Average, I search for schoolwork or other information frequently.	Self-taught Course at library	No
Frequent Internet User 2	Above Average, I search for schoolwork or other information frequently.	College course	No
Frequent Internet User 3	Above Average, I search for schoolwork or other information frequently.	Self-taught	No

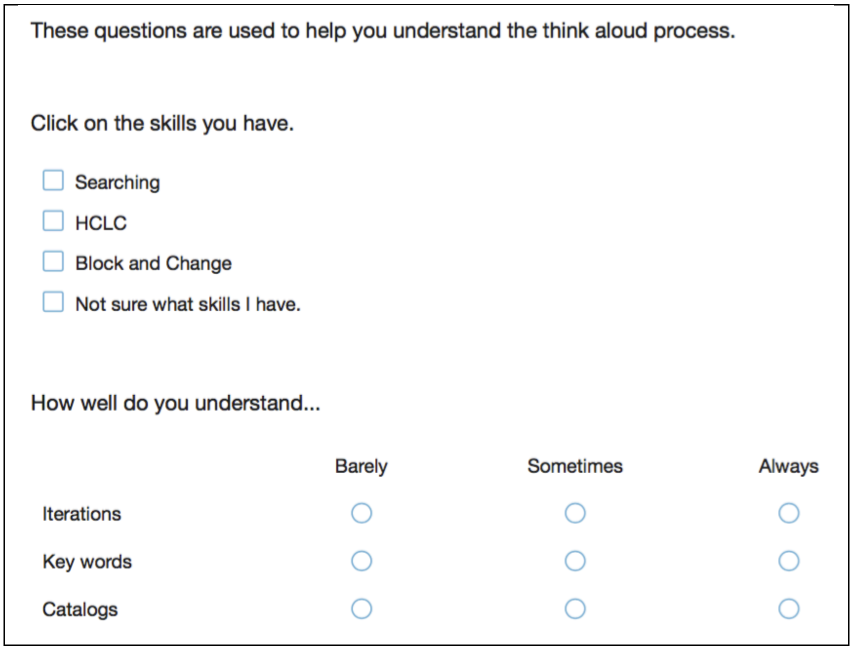
The trained searchers (Group 1) were given special attention, with participants either known to be search experts already or referred for participation from search experts who participated in phases 1 and 2. All four participants in Group 1 were research librarians or doctoral students in information science. Participants classified as casual internet users (Group 2) all reported themselves as Average or Casual online searchers except for participant 4, who reported outside of the questions that they often had difficulty finding things online. The student and academic participants (Group 3) were all current students at UNC. The last group, frequent Internet users (Group 4) included UNC employees who were neither students or faculty. All of these participants also identified themselves as having above average search skills.

5.3.2 Method

Participants were informed ahead of time that they would be completing an online questionnaire on a laboratory computer. Upon arrival, participants were seated in front of a test computer and instructed that the session was expected to take between 45 and 60 minutes. They were then reminded of the consent form they had received and agreed to previously, and they were asked to agree to it verbally as well. They were then instructed how to share their thoughts and feelings as they completed a set of questions about online search (see Appendix E). Participants were then told that the recording would start and that they would begin with practice questions.

Participants were then shown two test items (see Figure 23) and asked to practice the think aloud protocol for each item. The test items used were similar to the types of items used in the instrument so that participants could practice the think aloud protocol. The interviewer then gave feedback on their technique and verified that they understood the think aloud protocol. Participants were also given the chance to ask any questions they had about the protocol. Giving participants an opportunity to practice think aloud protocols in a pre-task session is important for their understanding as well as helping with any difficulties they may have in starting (Gibson, 1997).

Figure 23: Cognitive Interview Test Questions



These questions are used to help you understand the think aloud process.

Click on the skills you have.

- ☐ Searching
- ☐ HCLC
- ☐ Block and Change
- ☐ Not sure what skills I have.

How well do you understand...

	Barely	Sometimes	Always
Iterations	○	○	○
Key words	○	○	○
Catalogs	○	○	○

The session then began. The instructions for the survey were as follows:

> *"This survey focuses on your experiences doing online searching only. It does not include your experience offline (not on the Internet) or experiences asking a friend for information. When answering the questions on this survey, please focus on online search."*

The session was orally recorded, and the computer screen was recorded as well using the Macbook built-in software. The investigator also watched and took notes, but only responded when directly asked about an issue that would have prevented the participant from continuing. For all other questions, the interviewer stated that the participant should simply state their reactions to the questions. At the end of the session, participants were asked for any further thoughts on the instrument as well as any additions to their earlier statements. They were then thanked and given $10 Amazon gift cards.

5.3.3 Data Analysis

The recordings for these interviews were viewed and analyzed using qualitative methods to identify and transcribe any feedback from the participants and to highlight any specific comments from participants that represented common or frequent thoughts.

5.4 Results and Discussion

The instrument was divided into sections with related items. Each item is listed individually in Appendix L with the text of the item, the possible answers, and the results. The highlights from the data in each specific section will be discussed below. During the initial part of the interview, one participant had trouble with the interface and remarked that the questionnaire was “obviously not designed for old people.” However, when asked if they needed assistance, the participant declined and indicated their readiness to proceed.

5.4.1 Demographics Section

Section one included all demographic items not related to experience. The items for this section were:

- What year were you born?
- What is your gender?
- How well do you understand English?
- Please indicate the highest level of education completed.
- Which of the following best describes the area you live in?
- Please indicate your current household income in US dollars.

The primary feedback from participants were for the gender question, with one participant asking for more choices. This change was made to add a number of gender choices based upon those suggested by the UNC LGBTQ Chapter in their memorandum on sex, gender, and sexual orientation in research. All participants selected that they were native English speakers, but comments on the meaning of the answer led to minor changes in the wording.

5.4.2 History Section Feedback

This section asked participants about searching online, based primarily upon questions that are frequently asked in research and used to group participants. The items for this section were:

- How long have you been using Internet search tools?
- How frequently do you search for information online from the following locations? [From your phone; From a tablet; From a laptop; From a computer you own (not a laptop)]
- From a public computer or one you share (e.g. library, cybercafe, etc.)
- What kind of training have you had in how to search for information online? (Click any that apply.)
- (Follow up if they answered College Course to previous question) Do you have a degree from a Library or Information Science program?
- Have you performed searches for information online for friends or relatives?
- Have you performed searches for others as part of your occupation?
- (Follow up if they answer Yes to searching for others.) Is performing searches for others a specific part of your occupation?
- (Follow up if they answer Yes to searching for others.) How frequently do you perform searches for others as part of your occupation?
- Have you trained others in how to search for information online?
- (Follow up if they answer Yes, I am doing it currently.) Is training others in how to search a specific part of your occupation?
- (Follow up if they answer Yes, I am doing it currently.) How frequently do you train others in how to search for information online?

These items have been used by researchers in the past to categorize users into high and low levels of expertise, and their use here is primarily as benchmarks to compare their discriminatory power to each other and to examine the subsequent, less traditional questions. Not all of the items were expected to have significant discriminatory power, but they were retained for the next phase so that statistical analysis could be examined for them.

All but one of the participants selected the highest answer for experience on the Internet without any hesitation. This was not entirely unexpected and demonstrated how little discriminatory power this item has. Still, further testing on a wider pool of participants was determined to be useful, so higher ranges were added to give the participants more options.

Participants often expressed confusion over the choices in the question asking how frequently they searched online from different computer locations. This confusion stemmed primarily from uncertainty over the specific choices listed and what they described: P9-2 said, "*work computer doesn't fit any category.*" The choices were examined and changed to be clearer by using more specific language. It was also noted that all participants selected the most frequent option for both their phone and a laptop, suggesting that these items might have diminished discriminatory power in the final phase. However, the categories were retained for examination over a wider pool of participants.

The item related to searching for others was often misunderstood by participants: P7-2 said, "That's so vague." The wording was changed to be more specific in the final instrument. Other changes were made to item language and options where indicated by confusion expressed by these participants.

5.4.3 Specific Search Experience Section Feedback

This section asked specific questions about searching experience for different kinds of information. The items for this section were:

- How frequently do you search online for each kind of information listed? [News/current events; Information for a hobby; Legal information; Health information; Genealogical information; Financial information; Government Information; Historical information; Leisure/Entertainment]

- Is there information that you consistently search for online that is important or meaningful to you?
- (Follow up if they answer yes to searching for important or meaningful information.) Please describe the information that you consistently search for that is important or meaningful to you.
- Have you ever searched online to fulfill college course requirements?
- How frequently do you search in each specific site listed? [Google; Web of Science; PubMed; LexisNexis; WorldCat; Dialog]
- Now, in addition to the specific systems mentioned above, how often do you search other systems in these categories? [Library databases; Professional databases; Scholarly databases]

Participants expressed uncertainty about the available choices for the item asking for their frequency of searching for particular kinds of information:

- P2-4: "*There should be another category here. Seems like a jump. Rarely*"
- P9-2 wanted '*Seldom*' or '*As needed*' as a choice

The instructions for those items were changed for the next version to add additional options.

Participants also expressed confusion regarding the open-ended question: P4-3 said, "*What does that mean? I'm not sure that it's meaningful, just fun.*" Their answers were also very different from one another, indicating that they were interpreting the question in different ways. That item, as well as the follow-up items, were removed for the next version.

5.4.4 Self-Rated Search Ability Section Feedback

This section asked the participants about their own perception of their search skills. Some of these questions were taken from an existing search self-efficacy scale originally designed by Debowski, Wood, & Bandura (2001), and later modified for testing by Kelly (2010). The items for this section were:

- When searching, how familiar are you with each of these techniques? [Truncation; Quotes; Boolean logic; Limit by publish date; Limit by location; Limit by type of information; Limit by operating system; Exclude specific sites]
- When searching, how familiar are you with each of these types of searches? [Dictionary search; Recipe search; Patent search; Find social tags]
- If you needed to perform a search, how confident are you that you could… [Develop a focused search query that will retrieve a small number of appropriate articles?; Efficiently structure your

time to complete the task?; Find articles similar in quality to those obtained by a professional searcher?]

Participants expressed uncertainty about Boolean logic:

- P1-2: "*Boolean algebra*"
- P3-4: "*don't know*"
- P4-3: "*not sure*"
- P12-4: "*don't know*"

This was changed to Boolean AND and OR for the next version.

The question about types of searches also elicited confused remarks from participants and was eliminated:

- P2-4: "*I feel like these are common words…never heard in context of searching*."
- P8-1: "*so this means all online?*"
- P5-2: "*sounds familiar but not totally sure what it is*"
- P10-3: "*Is this a paper dictionary or online?*"
- P13-1: "*I usually just use Google*"
- P8-1: "*not sure of meaning*"
- P13-1: "*I kinda know what that is*"

The confidence item was also changed to parallel the skill section in the next version. The results from these interviews led directly to the use of specific skill items in the next revision of the instrument in order to determine any correlation between self-rated ability in specific search skills and actual ability in those specific search skills.

5.4.5 Skill Section Feedback

These items were tested specifically to see if participants are able to correctly select the tools needed to do particular search tasks. The items for this section were:

- Select the tool or technique you would use to make sure that all the results contained both words typed into the search box.
- Select the tool or technique you would use to make sure that you search for all forms of a word.
- Select the tool or technique you would use to search for words in a specific order.
- Select the tool or technique you would use to search for recent items only.
- Select the tool or technique you would use to search for information from England.
- Select the tool or technique you would use to expand your results.
- Select the tool or technique you would use to narrow your results.

[A drop-down box was used for each question with these choices: Not sure; Truncation; Quotes; Boolean AND; Boolean OR; Capitalize query terms; Use dash/underscore; Limit by publish date; Limit by location; Limit by type of information; Limit by operating system; Exclude specific sites; Adding search terms; Deleting Search terms]

Two of the items asked questions whose answers contained standard English words that were used by participants to guess the answer. The first of these asked about recent items and participants noted:

- P2-4: "*just a guess*"
- P4-3: "*I guess that's what it means by limit.*"
- P7-2: "*guess*"
- P9-2: "*guess, deduce*"

The second asked about information from England and participants noted:

- P2-4: "*probably limit by location*"
- P5-2: "*I didn't know that you could search for information from a certain place. I guess that would be limit by location*."
- P9-2: "*guess*"

These two items were discarded in the next version due to the participants' ability to guess at the correct answer based upon the general meaning of the English word.

In several other items, the participants, even those in the expert group, expressed some uncertainty over the correct answer:

- P13-1: "*wanted to choose 2 things*" and "*You could narrow it by many of these*"
- P6-1: "*Not sure, all forms, all definitions?*"
- P8-1: "*a lot of these could be used to narrow*"
- P14-1: "*There's lots of ways you could narrow*"

This was especially true for the item involving narrowing of results. The confusion expressed by all four members of the expert group for that item prompted a further examination of all the items and answers in this section, which resulted in changing the scoring of these to allow for multiple correct answers.

Despite the confusion expressed by the participants in this section, the results also indicate that these items might be useful to discriminate levels of search expertise. Looking at the reactions from the participants as well as any reactions observed by the researcher, uncertainty was expressed:

- Group 1, Experts: expressed or displayed uncertainty 5 times, primarily with the narrowing question noted above.
- Group 2, Casual searchers: expressed uncertainty or that they were guessing 15 times.
- Group 3, Students and academics: expressed or displayed uncertainty 6 times.
- Group 4, Frequent searchers: expressed or displayed uncertainty 8 times.

These results indicate that some participants in all four groups had trouble answering one or more of the items in this section and that this uncertainty shows some differences between the groups. Of course, this sample is not large enough to know if in fact there are statistically significant differences, but the results showed promise for further analysis in the next phase.

5.4.6 Personality Section Feedback

The personality section differs from the previous sections in that the specific subscales are already in use. Since these subscales cannot be broken apart into individual items without further testing, none of the items were discarded or altered. Comments from participants during the cognitive interviews have been included in Appendix L to later inform any items of interest based upon later data. All items for this section were presented in groups of 4 or 5 statements, usually two groups to a page, with a matrix of selections. The data from these items was not used to examine or alter the individual items here, but the comments were interesting. Participants often commented on the use of the middle option, 'Neutral,' to instead represent 'depends' or 'sometimes' or even to express uncertainty in their answer. The participants said 'depends' aloud 14 times, each time selecting the center choice of 'Neutral.' Participants said 'sometimes' aloud 8 times when selecting the center choice of 'Neutral.' Some additional comments included:

- P9-2: "So broad, not sure how to answer, what is function of middle column? Use does not apply."
- P4-3: "Does middle section count as sometimes accurate? If I am between I choose the middle section."
- P9-2: "Example, I guess it's relative, don't know what to put, feels like center column doesn't suit what I need."

- P3-4: “Some questions I didn’t know which way to answer so I stuck to the middle”

These results indicate that the idea of personality traits gathered from the search experts as important parts of online search expertise are not as fixed as they indicated. This suggests that perhaps the idea of personality states might still be more relevant, as detailed in the original proposed model. The difference between a state, which is difficult to measure outside of the moment, and the more enduring trait is important to understanding the nature of online search expertise.

5.5 Changes to Instrument

The instrument was modified based upon the feedback from the cognitive interviews. Each modified item is shown below along with the new version of the question (see Table 24).

Table 24: Changes to Instrument after Cognitive Interviews

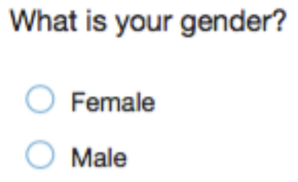
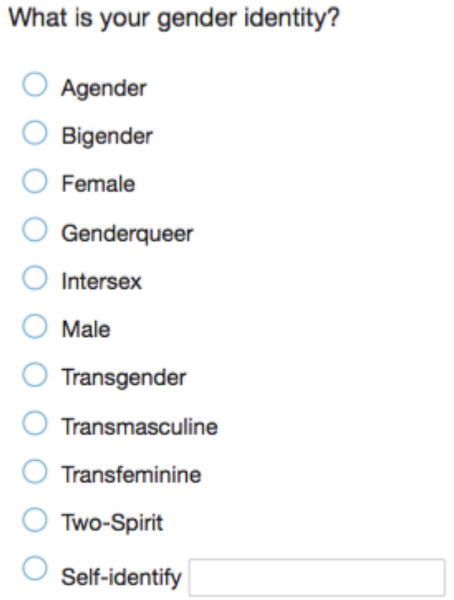
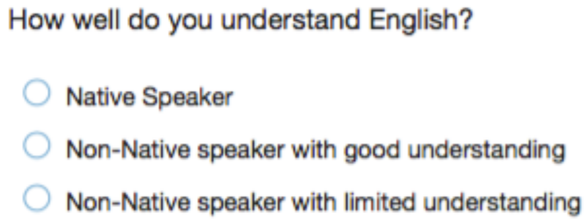
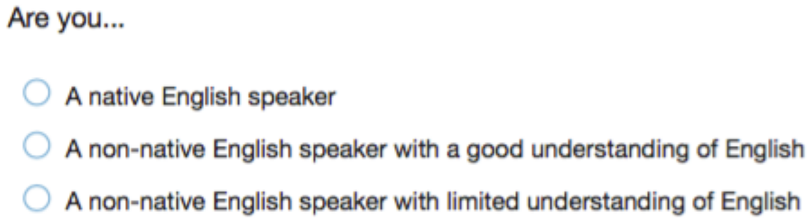
Original Instrument	 What is your gender? ○ Female ○ Male
Modified Instrument	 What is your gender identity? ○ Agender ○ Bigender ○ Female ○ Genderqueer ○ Intersex ○ Male ○ Transgender ○ Transmasculine ○ Transfeminine ○ Two-Spirit ○ Self-identify
Remarks	This was changed based upon comments from two participants, as noted in the table above. One participant (P11-3) specifically asked for more gender options and mentioned a UNC LGBTQ Chapter memorandum on sex, gender, and sexual orientation in research. The list was changed based upon those guidelines for the final version.
Original Instrument	 How well do you understand English? ○ Native Speaker ○ Non-Native speaker with good understanding ○ Non-Native speaker with limited understanding
Modified Instrument	 Are you... ○ A native English speaker ○ A non-native English speaker with a good understanding of English ○ A non-native English speaker with limited understanding of English
Remarks	This was changed to remove the stem of the item after one of the participants (P7-2) expressed confusion over how to answer the question.

Table 24 (cont.): Changes to Instrument after Cognitive Interviews

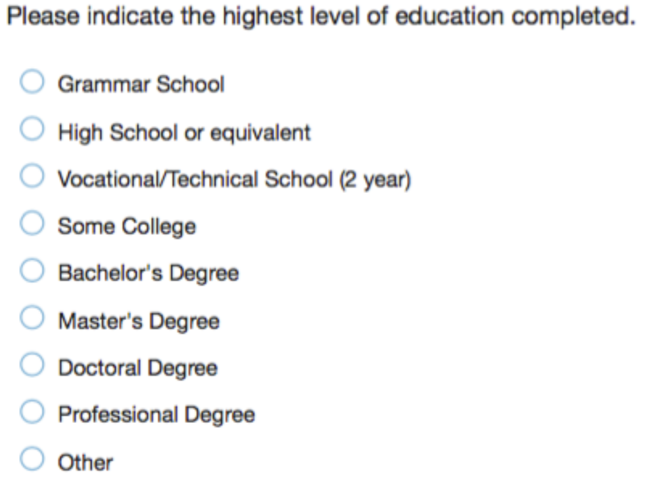
Original Instrument	 Please indicate the highest level of education completed. ○ Grammar School ○ High School or equivalent ○ Vocational/Technical School (2 year) ○ Some College ○ College Graduate (4 year) ○ Master's Degree (MS) ○ Doctoral Degree (PhD) ○ Professional Degree (MD, JD, etc.) ○ Other
Modified Instrument	 Please indicate the highest level of education completed. ○ Grammar School ○ High School or equivalent ○ Vocational/Technical School (2 year) ○ Some College ○ Bachelor's Degree ○ Master's Degree ○ Doctoral Degree ○ Professional Degree ○ Other
Remarks	The parenthetical clarifications from College Graduate, Master's Degree, Doctoral Degree, and Professional Degree were removed to be more inclusive after two participants indicated that they restricted their choices. Since this restriction was unintentional, the parenthetical additions were removed.

Table 24 (cont.): Changes to Instrument after Cognitive Interviews

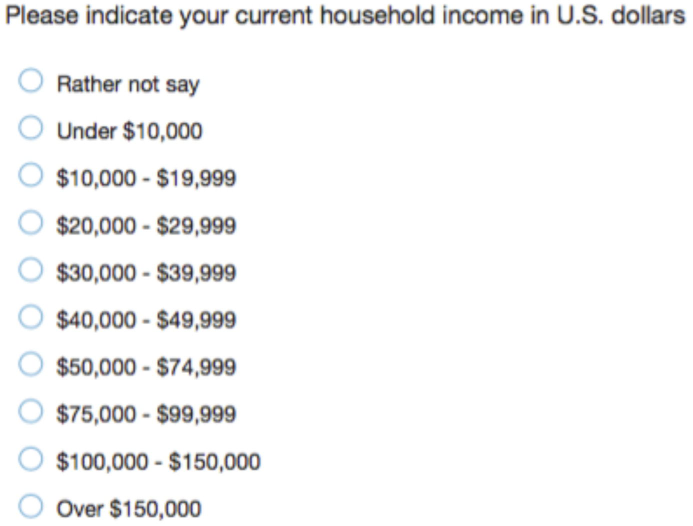
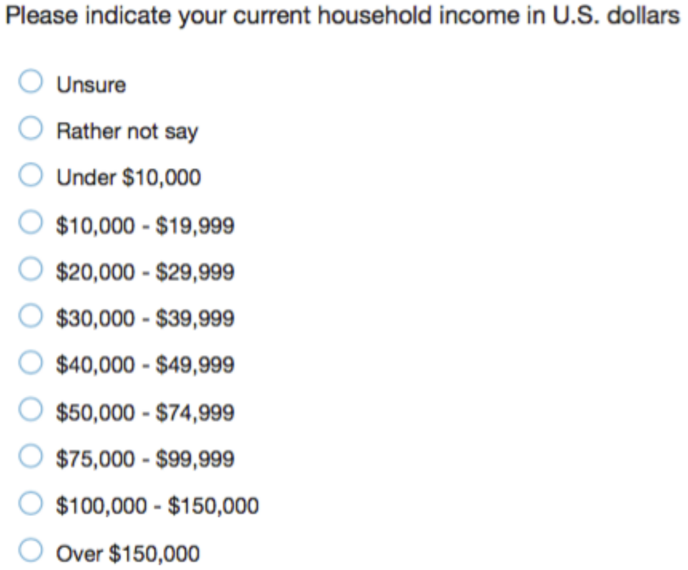
Original Instrument	 Please indicate your current household income in U.S. dollars ○ Rather not say ○ Under $10,000 ○ $10,000 - $19,999 ○ $20,000 - $29,999 ○ $30,000 - $39,999 ○ $40,000 - $49,999 ○ $50,000 - $74,999 ○ $75,000 - $99,999 ○ $100,000 - $150,000 ○ Over $150,000
Modified Instrument	 Please indicate your current household income in U.S. dollars ○ Unsure ○ Rather not say ○ Under $10,000 ○ $10,000 - $19,999 ○ $20,000 - $29,999 ○ $30,000 - $39,999 ○ $40,000 - $49,999 ○ $50,000 - $74,999 ○ $75,000 - $99,999 ○ $100,000 - $150,000 ○ Over $150,000
Remarks	Two participants (P2-4 and P4-3) wanted an additional choice to indicate that they were unsure of their household income. That choice was added for the final version of the instrument.

Table 24 (cont.): Changes to Instrument after Cognitive Interviews

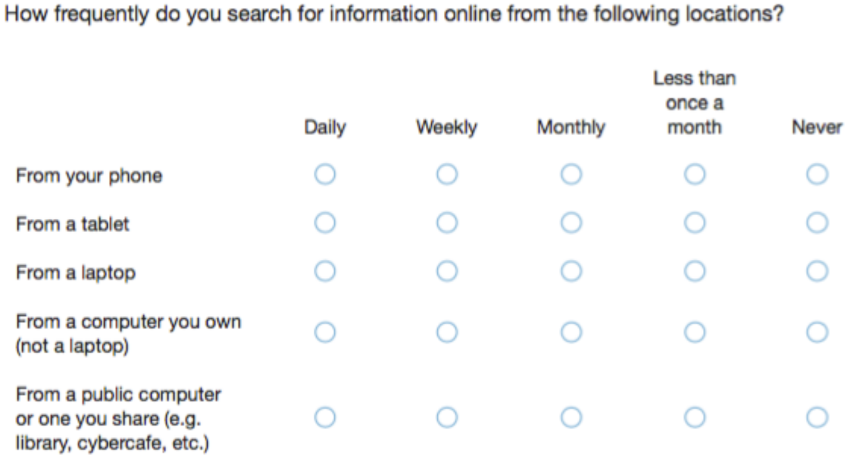
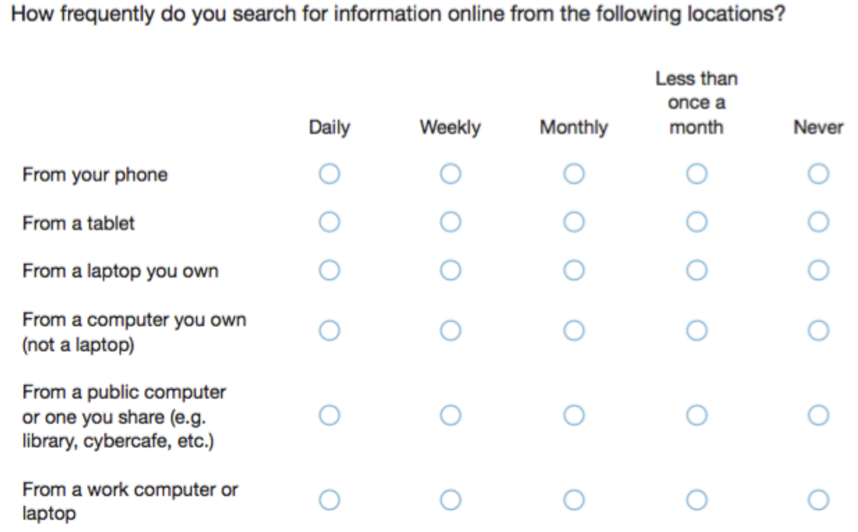
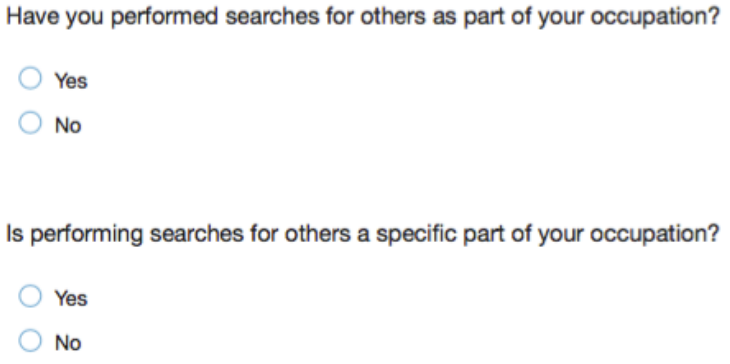
<table>
<tr><td>Original Instrument</td><td>
How long have you been using Internet search tools?
○ Less than 6 months
○ 6 to 12 months
○ 1 to 3 years
○ 4 to 6 years
○ 7 years or more</td></tr>
<tr><td>Modified Instrument</td><td>
How long have you been using Internet search tools?
○ Less than 6 months
○ 6 months to less than a year
○ 1 to 2 years
○ 3 to 4 years
○ 5 to 7 years
○ 8 to 10 years
○ 11 to 15 years
○ More than 15 years</td></tr>
<tr><td>Remarks</td><td>All but one of the participants selected 7 years or more for this item, limiting its discriminatory power. Additional categories were added at the high end for the final instrument.</td></tr>
<tr><td>Original Instrument</td><td>
How frequently do you search for information online from the following locations?
<table>
<tr><th></th><th>Daily</th><th>Weekly</th><th>Monthly</th><th>Less than once a month</th><th>Never</th></tr>
<tr><td>From your phone</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>From a tablet</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>From a laptop</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>From a computer you own (not a laptop)</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>From a public computer or one you share (e.g. library, cybercafe, etc.)</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
</table></td></tr>
</table>

Table 24 (cont.): Changes to Instrument after Cognitive Interviews

<table>
<tr><td>Modified Instrument</td><td>
How frequently do you search for information online from the following locations?
<table>
<tr><th></th><th>Daily</th><th>Weekly</th><th>Monthly</th><th>Less than once a month</th><th>Never</th></tr>
<tr><td>From your phone</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>From a tablet</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>From a laptop you own</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>From a computer you own (not a laptop)</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>From a public computer or one you share (e.g. library, cybercafe, etc.)</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>From a work computer or laptop</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
</table></td></tr>
<tr><td>Remarks</td><td>Several participants were confused about the categories in this question, and one participant (P9-2) specifically mentioned a need for a work computer category. This was added for the final instrument as well as the clarification that the laptop was one owned by the participant.</td></tr>
<tr><td>Original Instrument</td><td>
Have you performed searches for others as part of your occupation?
○ Yes
○ No

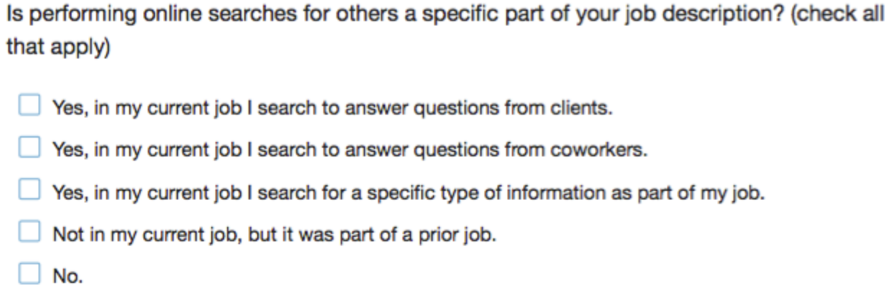
Is performing searches for others a specific part of your occupation?
○ Yes
○ No</td></tr>
<tr><td>Modified Instrument</td><td>
Is performing online searches for others a specific part of your job description? (check all that apply)
☐ Yes, in my current job I search to answer questions from clients.
☐ Yes, in my current job I search to answer questions from coworkers.
☐ Yes, in my current job I search for a specific type of information as part of my job.
☐ Not in my current job, but it was part of a prior job.
☐ No.</td></tr>
<tr><td>Remarks</td><td>Comments from participants (P9-2 and P13-1) indicated that they were answering a different question rather than ‘Have you performed searches for others as part of your occupation?’ The two questions related to this were then combined into a more specific question with multiple answers possible for the final instrument.</td></tr>
</table>

Table 24 (cont.): Changes to Instrument after Cognitive Interviews

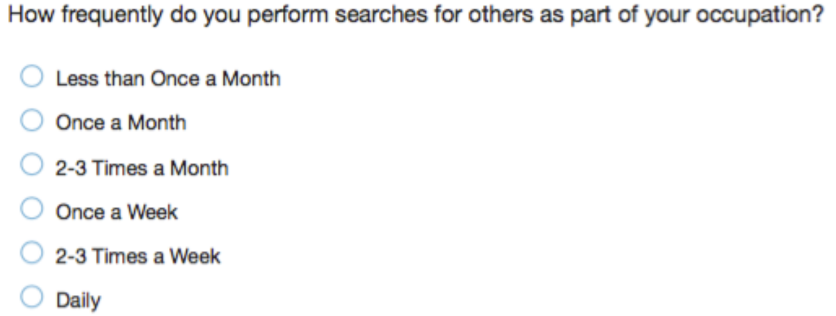
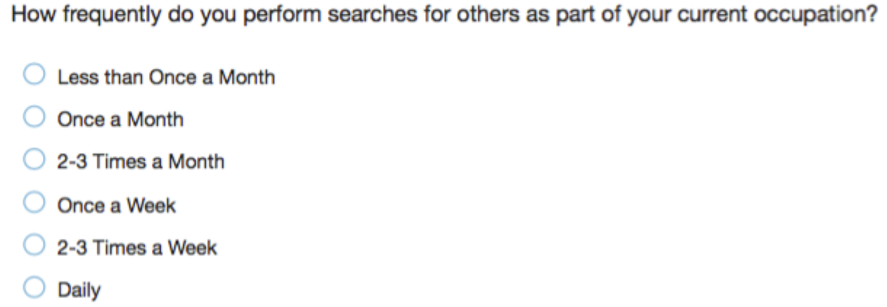
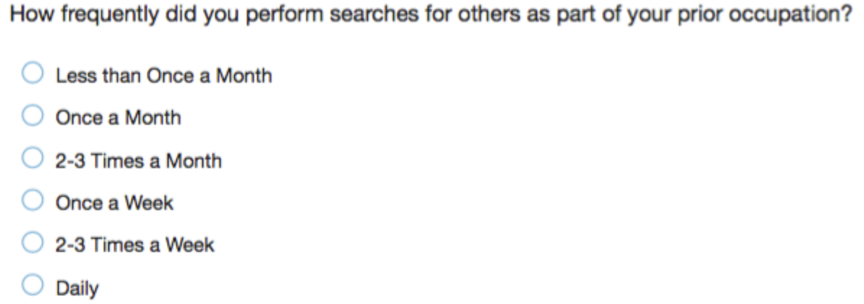
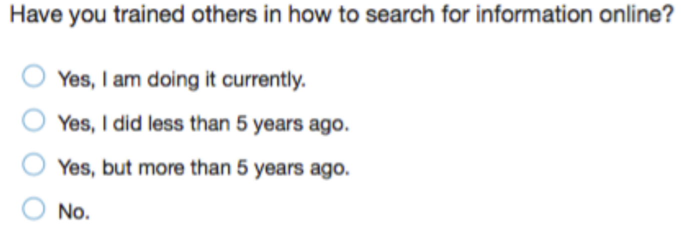
Original Instrument	 How frequently do you perform searches for others as part of your occupation? ○ Less than Once a Month ○ Once a Month ○ 2-3 Times a Month ○ Once a Week ○ 2-3 Times a Week ○ Daily
Modified Instrument	 How frequently do you perform searches for others as part of your current occupation? ○ Less than Once a Month ○ Once a Month ○ 2-3 Times a Month ○ Once a Week ○ 2-3 Times a Week ○ Daily  How frequently did you perform searches for others as part of your prior occupation? ○ Less than Once a Month ○ Once a Month ○ 2-3 Times a Month ○ Once a Week ○ 2-3 Times a Week ○ Daily
Remarks	This question was only seen if the answer to the previous question was 'Yes.' Participants remained uncertain for this question and the time period it asked about (P8-1 and P13-1), so it was changed and split into two more specific questions that specifically distinguished between current and former occupations.
Original Instrument	 Have you trained others in how to search for information online? ○ Yes, I am doing it currently. ○ Yes, I did less than 5 years ago. ○ Yes, but more than 5 years ago. ○ No.

Table 24 (cont.): Changes to Instrument after Cognitive Interviews

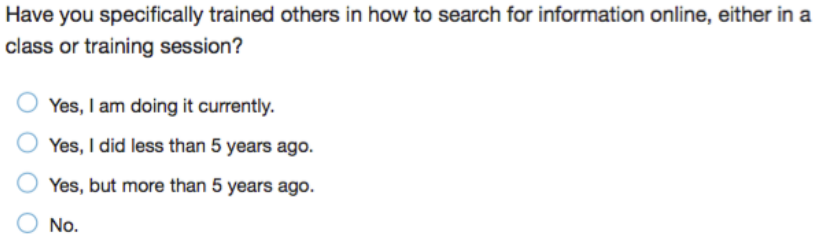
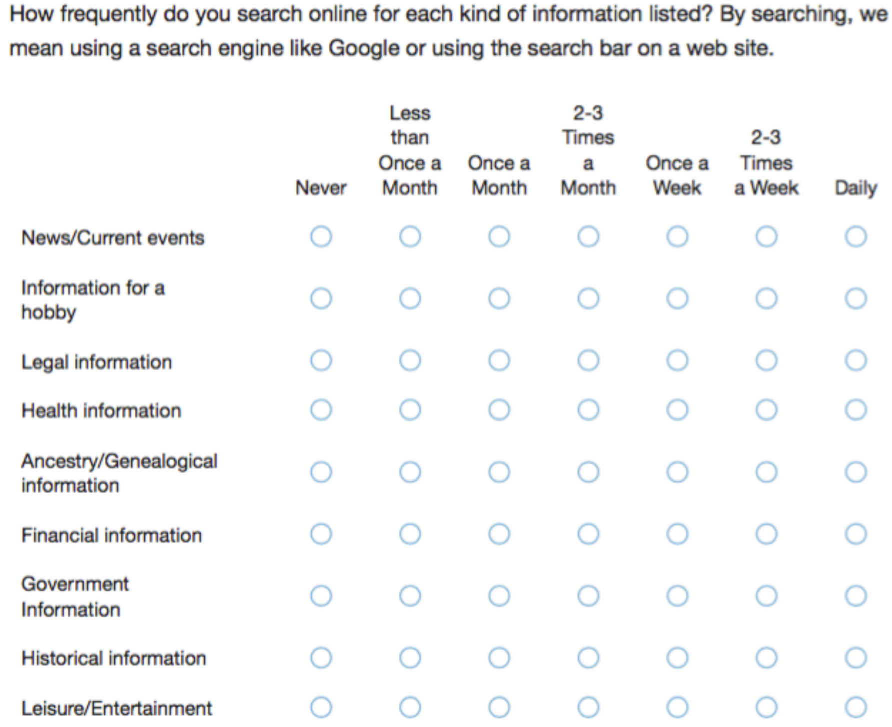
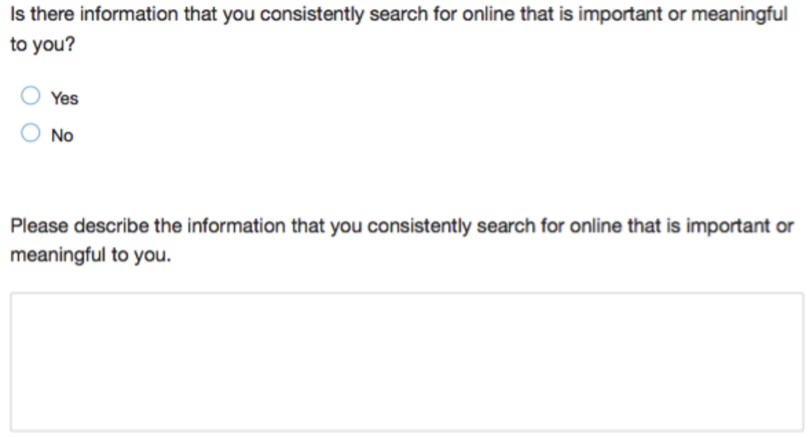
<table>
<tr><td>Modified Instrument</td><td>
Have you specifically trained others in how to search for information online, either in a class or training session?
○ Yes, I am doing it currently.
○ Yes, I did less than 5 years ago.
○ Yes, but more than 5 years ago.
○ No.</td></tr>
<tr><td>Remarks</td><td>Some participants (P1-2, P3-4, P4-3, P12-4) were confused about what this question was asking them and selected based upon different criteria. The question was changed for the final instrument to be more specific.</td></tr>
<tr><td>Original Instrument</td><td>
How frequently do you search online for each kind of information listed?
<table>
<tr><th></th><th>Never</th><th>Less than Once a Month</th><th>Once a Month</th><th>2-3 Times a Month</th><th>Once a Week</th><th>2-3 Times a Week</th><th>Daily</th></tr>
<tr><td>News/Current events</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Information for a hobby</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Legal information</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Health information</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Genealogical information</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Financial information</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Government Information</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Historical information</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Leisure/Entertainment</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
</table></td></tr>
</table>

Table 24 (cont.): Changes to Instrument after Cognitive Interviews

<table>
<tr><td>Modified Instrument</td><td>
How frequently do you search online for each kind of information listed? By searching, we mean using a search engine like Google or using the search bar on a web site.
<table>
<tr><th></th><th>Never</th><th>Less than Once a Month</th><th>Once a Month</th><th>2-3 Times a Month</th><th>Once a Week</th><th>2-3 Times a Week</th><th>Daily</th></tr>
<tr><td>News/Current events</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Information for a hobby</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Legal information</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Health information</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Ancestry/Genealogical information</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Financial information</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Government Information</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Historical information</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Leisure/Entertainment</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
</table></td></tr>
<tr><td>Remarks</td><td>Several participants (P3-4, P4-3, P5-2) were unsure of the category ‘Genealogical Information,’ and so it was changed to be ‘Ancestry/Genealogical Information’ for the final instrument. Several participants wanted an ‘Almost Never’ choice, but this was not changed to keep the question similar to other questions about experience.</td></tr>
<tr><td>Original Instrument</td><td>
Is there information that you consistently search for online that is important or meaningful to you?
○ Yes
○ No

Please describe the information that you consistently search for online that is important or meaningful to you.</td></tr>
<tr><td>Modified Instrument</td><td>(Discarded)</td></tr>
<tr><td>Remarks</td><td>This question generated many different types of answers, and some participants (P4-3, P6-1, P10-3) indicated that they were answering a different question. Since this type of answer is difficult to score, the question was eliminated.</td></tr>
</table>

Table 24 (cont.): Changes to Instrument after Cognitive Interviews

<table>
<tr><td>Original Instrument</td><td>

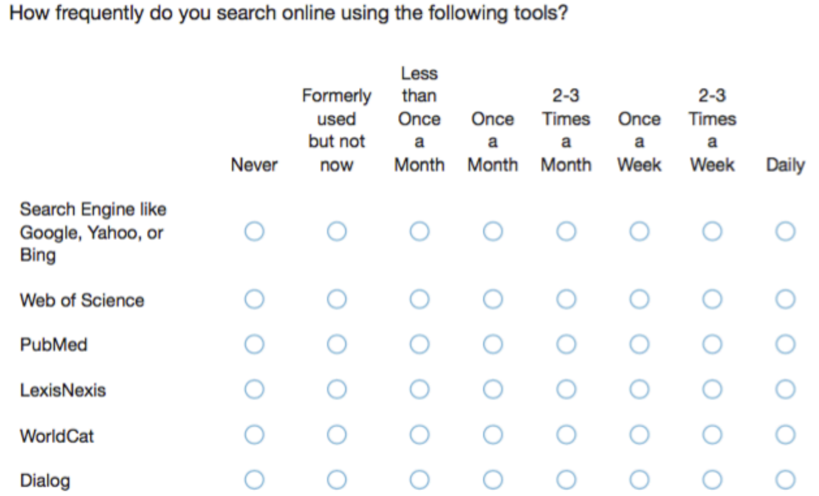
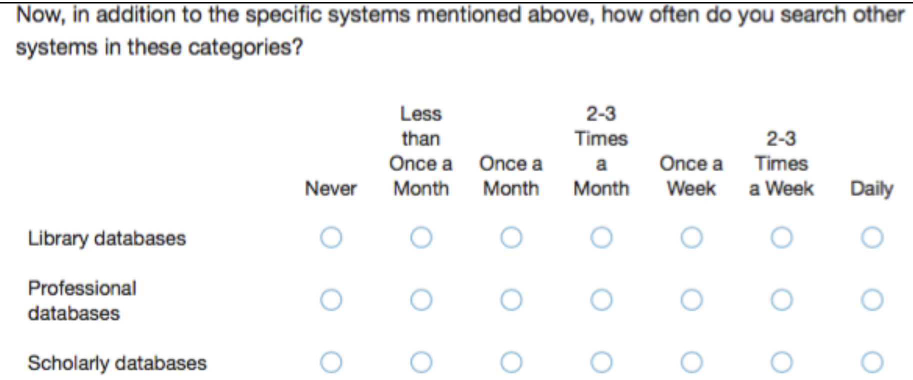
How frequently do you search in each specific site listed?
<table>
<tr><th></th><th>Never</th><th>Less than Once a Month</th><th>Once a Month</th><th>2-3 Times a Month</th><th>Once a Week</th><th>2-3 Times a Week</th><th>Daily</th></tr>
<tr><td>Google</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Web of Science</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>PubMed</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>LexisNexis</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>WorldCat</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Dialog</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
</table>
</td></tr>
<tr><td>Modified Instrument</td><td>

How frequently do you search online using the following tools?
<table>
<tr><th></th><th>Never</th><th>Formerly used but not now</th><th>Less than Once a Month</th><th>Once a Month</th><th>2-3 Times a Month</th><th>Once a Week</th><th>2-3 Times a Week</th><th>Daily</th></tr>
<tr><td>Search Engine like Google, Yahoo, or Bing</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Web of Science</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>PubMed</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>LexisNexis</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>WorldCat</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Dialog</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
</table>
</td></tr>
<tr><td>Remarks</td><td>Some participants (P2-4, P8-1, P13-1) mentioned that they had used these sites in the past but did not do so now. Since experience includes both times, a choice of ‘Formerly used but not now’ was added. There were also some comments made about Google and so this item was changed to be more inclusive.</td></tr>
<tr><td>Original Instrument</td><td>

Now, in addition to the specific systems mentioned above, how often do you search other systems in these categories?
<table>
<tr><th></th><th>Never</th><th>Less than Once a Month</th><th>Once a Month</th><th>2-3 Times a Month</th><th>Once a Week</th><th>2-3 Times a Week</th><th>Daily</th></tr>
<tr><td>Library databases</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Professional databases</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Scholarly databases</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
</table>
</td></tr>
</table>

Table 24 (cont.): Changes to Instrument after Cognitive Interviews

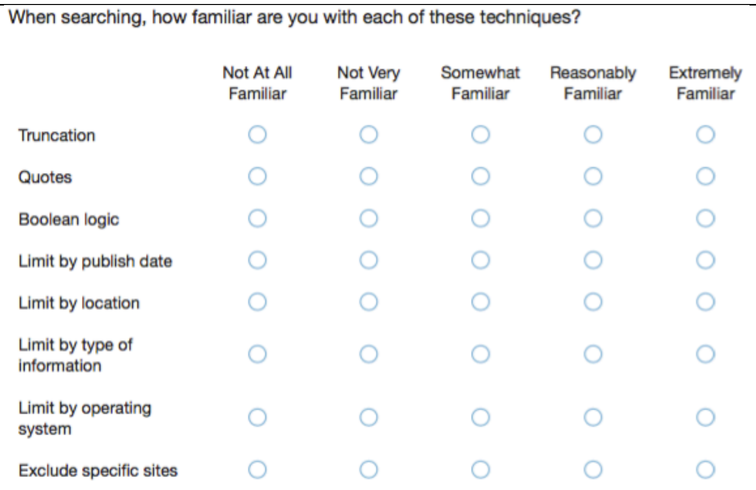
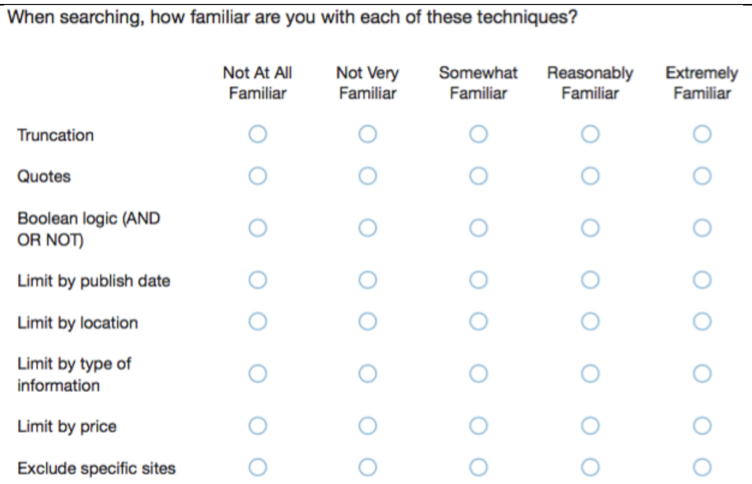
<table>
<tr><td>Modified Instrument</td><td>(Discarded)</td></tr>
<tr><td>Remarks</td><td>Many participants (P1-2, P2-4, P3-4, P4-3, P7-2, P8-1, P11-3, P13-1, P14-1) expressed uncertainty over what this question was asking. It was removed in the final instrument.</td></tr>
<tr><td>Original Instrument</td><td>
When searching, how familiar are you with each of these techniques?
<table>
<tr><th></th><th>Not At All Familiar</th><th>Not Very Familiar</th><th>Somewhat Familiar</th><th>Reasonably Familiar</th><th>Extremely Familiar</th></tr>
<tr><td>Truncation</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Quotes</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Boolean logic</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Limit by publish date</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Limit by location</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Limit by type of information</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Limit by operating system</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Exclude specific sites</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
</table></td></tr>
<tr><td>Modified Instrument</td><td>
When searching, how familiar are you with each of these techniques?
<table>
<tr><th></th><th>Not At All Familiar</th><th>Not Very Familiar</th><th>Somewhat Familiar</th><th>Reasonably Familiar</th><th>Extremely Familiar</th></tr>
<tr><td>Truncation</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Quotes</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Boolean logic (AND OR NOT)</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Limit by publish date</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Limit by location</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Limit by type of information</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Limit by price</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Exclude specific sites</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
</table></td></tr>
<tr><td>Remarks</td><td>Several participants (P1-2 and P3-4) were uncertain about the item ‘Boolean logic’ and so it was changed to be more specific. The ‘Limit by operating system’ did not discriminate well and was replaced with ‘Limit by price.’</td></tr>
</table>

Table 24 (cont.): Changes to Instrument after Cognitive Interviews

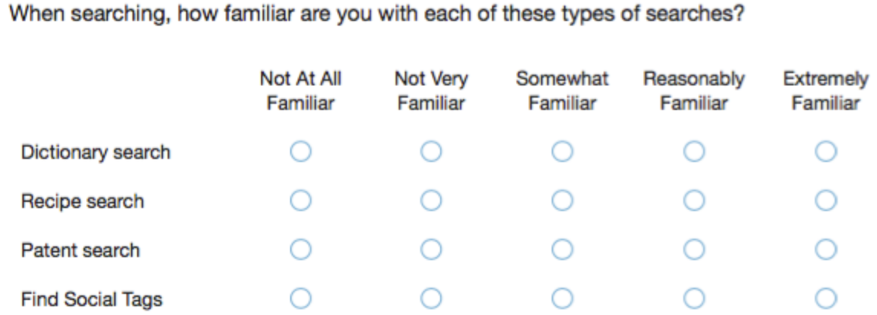
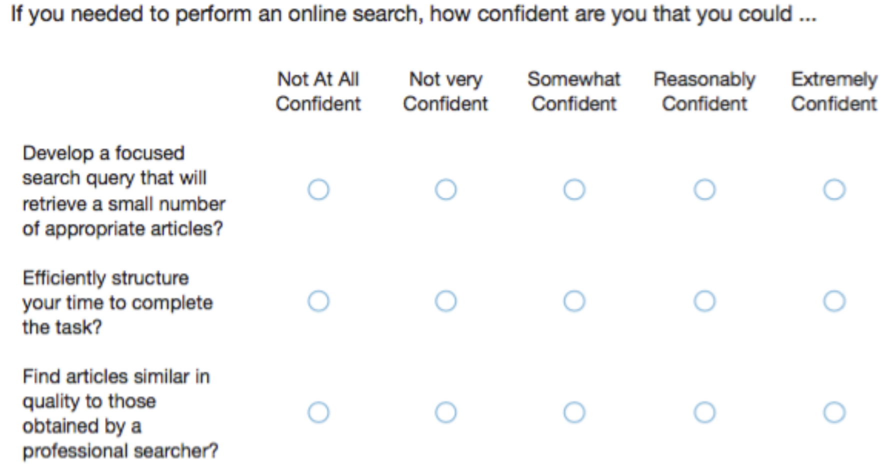
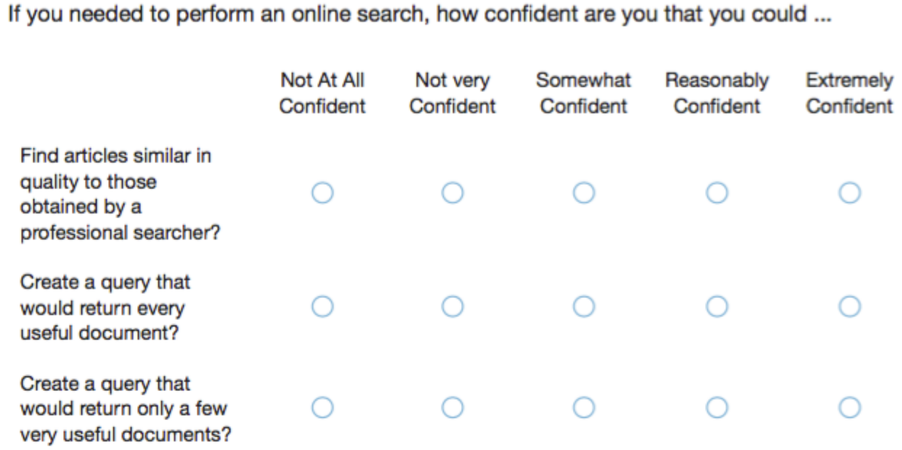
<table>
<tr><td>Original Instrument</td><td>
When searching, how familiar are you with each of these types of searches?
<table>
<tr><th></th><th>Not At All Familiar</th><th>Not Very Familiar</th><th>Somewhat Familiar</th><th>Reasonably Familiar</th><th>Extremely Familiar</th></tr>
<tr><td>Dictionary search</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Recipe search</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Patent search</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Find Social Tags</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
</table></td></tr>
<tr><td>Modified Instrument</td><td>(Discarded)</td></tr>
<tr><td>Remarks</td><td>The items here confused many participants (P1-2, P2-4, P4-3, P5-2, P8-1, P9-2, P10-3, P13-1), in part because they used common words rather than more specific terms. The question was therefore discarded.</td></tr>
<tr><td>Original Instrument</td><td>
If you needed to perform an online search, how confident are you that you could ...
<table>
<tr><th></th><th>Not At All Confident</th><th>Not very Confident</th><th>Somewhat Confident</th><th>Reasonably Confident</th><th>Extremely Confident</th></tr>
<tr><td>Develop a focused search query that will retrieve a small number of appropriate articles?</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Efficiently structure your time to complete the task?</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Find articles similar in quality to those obtained by a professional searcher?</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
</table></td></tr>
<tr><td>Modified Instrument</td><td>
If you needed to perform an online search, how confident are you that you could ...
<table>
<tr><th></th><th>Not At All Confident</th><th>Not very Confident</th><th>Somewhat Confident</th><th>Reasonably Confident</th><th>Extremely Confident</th></tr>
<tr><td>Find articles similar in quality to those obtained by a professional searcher?</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Create a query that would return every useful document?</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Create a query that would return only a few very useful documents?</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr>
</table></td></tr>
<tr><td>Remarks</td><td>These questions were taken from the Search Self Efficacy Tool as potentially useful, but generated some confusion in the participants (P3-4, P8-1, P11-3). The first two items were therefore discarded, although the last item was retained for possible usefulness. Two concepts related to creating queries were also added here to supplement the questions in the next section.</td></tr>
</table>

Table 24 (cont.): Changes to Instrument after Cognitive Interviews

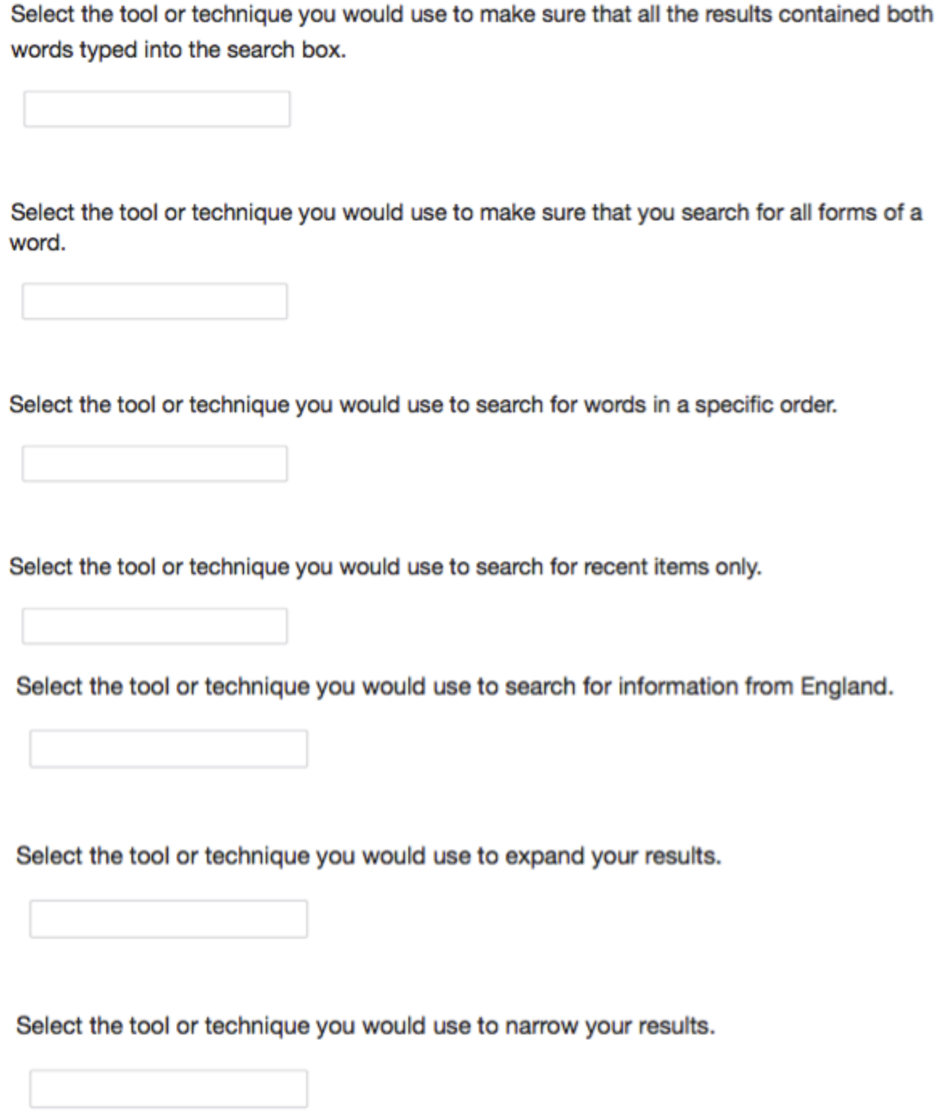
Original Instrument	 Select the tool or technique you would use to make sure that all the results contained both words typed into the search box. Select the tool or technique you would use to make sure that you search for all forms of a word. Select the tool or technique you would use to search for words in a specific order. Select the tool or technique you would use to search for recent items only. Select the tool or technique you would use to search for information from England. Select the tool or technique you would use to expand your results. Select the tool or technique you would use to narrow your results.

Table 24 (cont.): Changes to Instrument after Cognitive Interviews

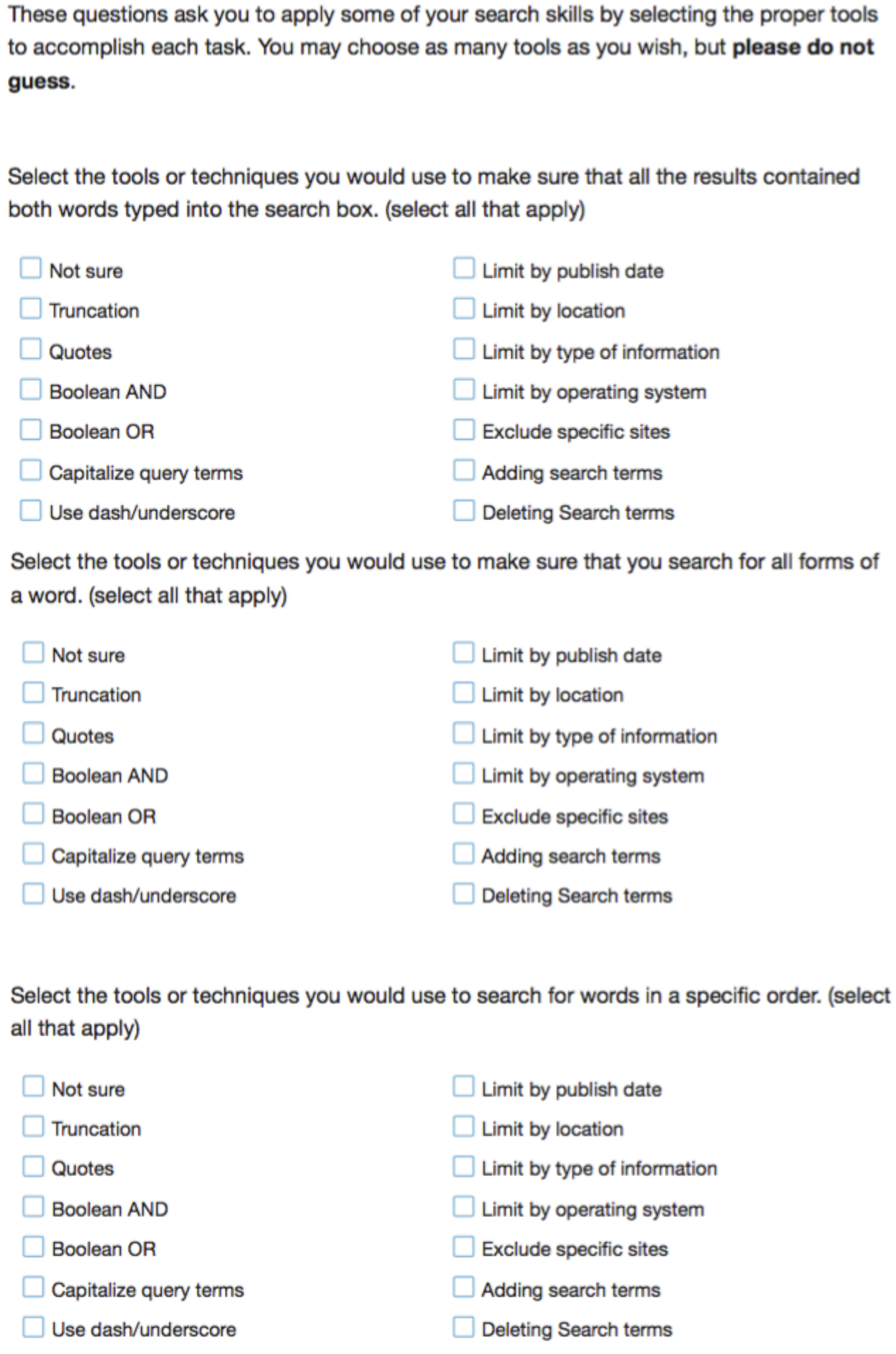
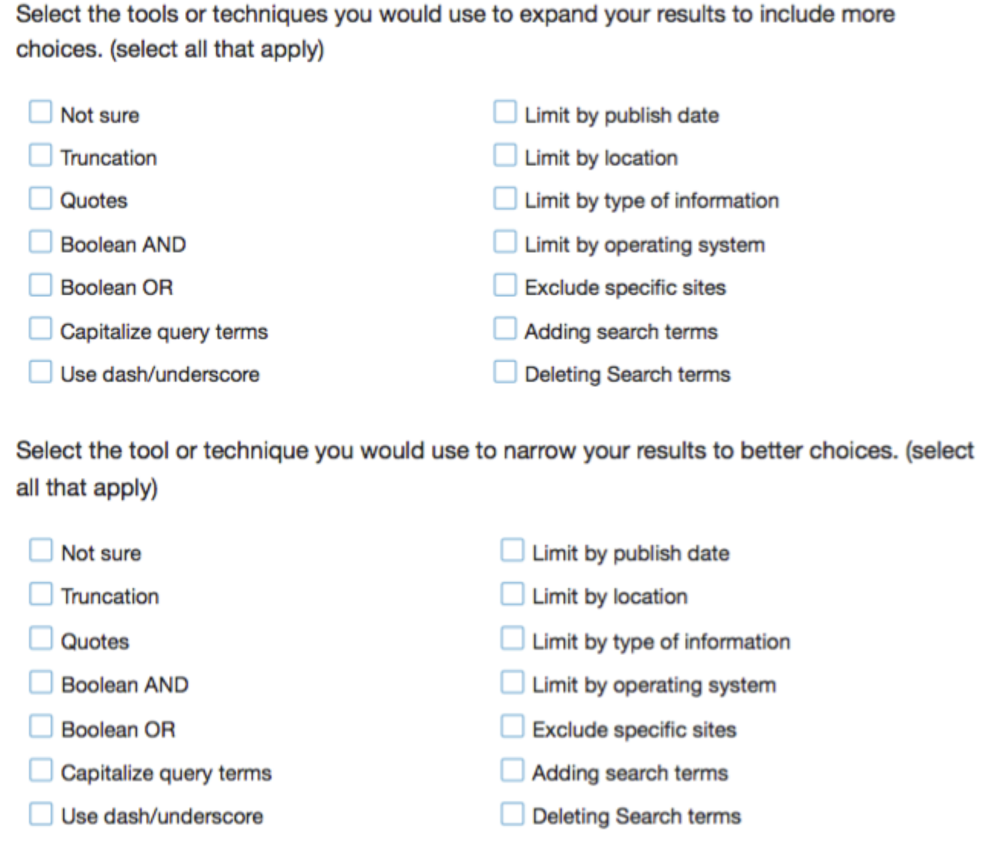
Modified Instrument	 These questions ask you to apply some of your search skills by selecting the proper tools to accomplish each task. You may choose as many tools as you wish, but **please do not guess**. Select the tools or techniques you would use to make sure that all the results contained both words typed into the search box. (select all that apply) ☐ Not sure ☐ Truncation ☐ Quotes ☐ Boolean AND ☐ Boolean OR ☐ Capitalize query terms ☐ Use dash/underscore ☐ Limit by publish date ☐ Limit by location ☐ Limit by type of information ☐ Limit by operating system ☐ Exclude specific sites ☐ Adding search terms ☐ Deleting Search terms Select the tools or techniques you would use to make sure that you search for all forms of a word. (select all that apply) ☐ Not sure ☐ Truncation ☐ Quotes ☐ Boolean AND ☐ Boolean OR ☐ Capitalize query terms ☐ Use dash/underscore ☐ Limit by publish date ☐ Limit by location ☐ Limit by type of information ☐ Limit by operating system ☐ Exclude specific sites ☐ Adding search terms ☐ Deleting Search terms Select the tools or techniques you would use to search for words in a specific order. (select all that apply) ☐ Not sure ☐ Truncation ☐ Quotes ☐ Boolean AND ☐ Boolean OR ☐ Capitalize query terms ☐ Use dash/underscore ☐ Limit by publish date ☐ Limit by location ☐ Limit by type of information ☐ Limit by operating system ☐ Exclude specific sites ☐ Adding search terms ☐ Deleting Search terms

Table 24 (cont.): Changes to Instrument after Cognitive Interviews

	 Select the tools or techniques you would use to expand your results to include more choices. (select all that apply) ☐ Not sure ☐ Truncation ☐ Quotes ☐ Boolean AND ☐ Boolean OR ☐ Capitalize query terms ☐ Use dash/underscore ☐ Limit by publish date ☐ Limit by location ☐ Limit by type of information ☐ Limit by operating system ☐ Exclude specific sites ☐ Adding search terms ☐ Deleting Search terms Select the tool or technique you would use to narrow your results to better choices. (select all that apply) ☐ Not sure ☐ Truncation ☐ Quotes ☐ Boolean AND ☐ Boolean OR ☐ Capitalize query terms ☐ Use dash/underscore ☐ Limit by publish date ☐ Limit by location ☐ Limit by type of information ☐ Limit by operating system ☐ Exclude specific sites ☐ Adding search terms ☐ Deleting Search terms
Remarks	This section was presented as questions with drop-down lists where each participant could select one answer. Some participants (P1-2, P7-2, P8-1, P13-1) expressed a desire to select more than one choice; the questions were changed to allow multiple answers, and the instructions were changed to tell the participants to select all answers that applied. This was a departure from the original intent of the questions, which was to have a distinctly correct answer for each task. This illustrates how difficult it is to write skill questions related to online searching. The items related to recent searching and searching by location were discarded due to lack of discriminatory power.

5.6 Discussion

The cognitive interviews were helpful in determining which items were unclear to the respondents so that the language could be changed for phase 4. In some cases, especially in the experience section, the confusion experienced by the participants led to a change in the questions and the flow of the questions. The items in the final personality sections were not changed as a result of these interviews – these items were kept as is in order to retain their functionality. Overall the participants displayed conscientiousness when completing the instrument and expressed dissatisfaction with their own abilities related to search or their concern that they were properly doing the task. This feeling of inadequacy cut across all four groups.

The groupings themselves were created using standard questions from research, but observation of the participants and their answers gave little evidence that the groupings actually consisted of different levels of skill, especially in the casual users, students and academics, and frequent searchers. The experts in Group 1 were consistently different in their comments and frequently mentioned qualifiers on their answers. This result is consistent with past research that has experienced difficulty both in classifying participants based upon expertise and in finding differences between groups based upon those classifications.

The instrument was revised for the next phase using this feedback and adding language where participants expressed confusion or uncertainty. The prior experience questions were changed as well as the question flow in order to reduce uncertainty. The self-rated search ability and specific skills sections were revised to allow for these two sections to be compared to each other using later data. The updated instrument is in Appendix H.

CHAPTER 6: Evaluating the Instrument

6.1 Introduction

This phase of the research tested the edited instrument that resulted from the previous cognitive interviews and administered it against a heterogeneous set of online users. The goal of this phase was to record data from enough users to run meaningful statistical tests, including reliability and validity testing, in order to further refine the instrument.

6.2 Method

In this phase, the revised instrument was distributed online to 4 separate groups of users. These groups were selected specifically to be as inclusive as possible of users in an online setting and to represent specific high and low ability groups. All testing was done online only. Standard instrument development practices indicate that 300 people are sufficient to eliminate subject variance (DeVellis, 2012), and so the design targeted that number as a minimum. The study design originally targeted 3 separate cohorts with expected participation as shown in Table 25. These cohorts were selected based both upon convenience and upon anticipated skill levels of the members of those groups. The UNC Staff group was anticipated to be a mixture of all levels of expertise, and it was specifically expected to include some members with low levels of search expertise. The Amazon Mechanical Turk group was also expected to contain a mixture of levels of search expertise, with perhaps higher levels of online experience. The RUSA group was expected to include many members with high levels of search expertise, especially since membership in that group is primarily trained research librarians. Participation for the RUSA cohort was less than expected, so additional users were recruited from the ASIS&T mailing list. The ASIS&T list was selected as an appropriate addition since it too contains many members who are trained librarians or information scientists. Funding for this research was through the SILS Carnegie Grant.

Table 25: Participants for Online Evaluation

Cohort	Expected Number	Actual Number
UNC Staff mailing list	100	444
Amazon Mechanical Turk	200	291
RUSA mailing list	100	59
ASIS&T mailing list	N/A	43
	Total	837

6.2.1 Recruitment

Recruitment for the study was done through posting a message with a short description of the instrument along with a link to the Qualtrics implementation of the instrument to selected mailing lists (see Appendix I). The language for each message was targeted at that particular mailing list. The message also contained information that completing the survey would allow them to voluntarily submit any email address to register for a drawing to win one of two $25 Amazon gift certificates. The selected mailing lists were the UNC Staff mailing list, the RUSA mailing list, and the ASIS&T mailing list.

The UNC Staff email list is a list used by many employees of UNC and includes a diverse population who occupy various positions at UNC. This list was also used to recruit participants for cognitive interviews. The RUSA (Reference and User Services Association) email list is the primary list for that organization and consists mainly of reference librarians. The

ASIS&T (Association for Information Science and Technology) email list is the primary list for professionals who are members of the organization, consisting of researchers, teachers, and practitioners.

Recruitment for this study was also done through Amazon Mechanical Turk. Amazon Mechanical Turk is a crowd sourced Internet marketplace where jobs, or Human Intelligence Tasks (HITS), are offered to registered users for specified payment. The respondents from Amazon Mechanical Turk were offered $1.00 in payment for successfully completing the instrument in less than 30 minutes. The survey was restricted to workers who had achieved Amazon master status through high performance over time.

6.2.2 Participants

There were a total of 837 individual participants from four distinct groups (see Table 25, above). Participants were screened to ensure they were over 18 and had a good understanding of English. Participant demographics are described later.

6.2.3 The Instrument

The instrument for this phase was specifically modified to address some of the challenges of using Amazon Mechanical Turk workers (see Appendix H). All participants were given the same modified instrument except for instructions about payment for the Amazon Mechanical Turk workers and instructions about entry into the prize drawing for all other participants. All participants were screened for age to ensure that they were 18 or older. All participants were asked to report their knowledge of English as well to ensure their understanding of the questions. Those below 18 or with imperfect understanding of English were sent to a farewell message thanking them but informing them that they were either not qualified or had failed a validation message (see Appendix J). All participants were required to answer all questions on the instrument before moving forward. This restriction was implemented to prevent Amazon Mechanical Turk workers from simply pressing continue on each page to collect the end code and receive payment.

Validation questions were used for all participants throughout the instrument to ensure the participant took the time to read the items. Each validation message instructed the participant to select a particular option. Failure to do so sent the participant to the farewell message. Participants who were not qualified or who failed the validation questions were not paid or entered into the drawing. The validation message instructions specifically asked the participants to select particular choices:

- When considering online search, for this question please answer that you are unsure so that we know that you are not a robot.
- Select the tools or techniques you would use to answer online questions. For this question, please check only the choice Quotes to show that you are not a robot.
- I am reading this question and will answer very inaccurate.
- I am reading this question and will answer very accurate.

Participants who did not select the specified choice were sent to a farewell message thanking them but informing them that they were either not qualified or had failed a validation message (see Appendix J).

6.2.4 Procedure

While each cohort interacted with the same instrument questions, they used a separate Qualtrics instrument and database to ensure that they were distinct. The instruments also differed slightly at the end when all the other items had been completed. The Amazon Mechanical Turk workers were given a code to enter on the job page on Amazon (http://amazon.com). Those codes were then verified against a list of codes associated with completed instruments in the database. Verified codes were then cleared for payment. This was an ongoing process as workers completed the instrument. All other participants were given an entry field where they could choose to enter an email for entry into the drawing. Those emails were separated from the rest of the data at the end of the collection period, then randomized. Two email addresses were selected and contacted for payment of the prize. The prizes were awarded in November, 2016.

6.2.5 Data Analysis

All data was exported and then combined into one large database on Qualtrics, keeping the source cohort information. Data was then analyzed using SPSS v24 for Mac. As noted in Chapter 4, the questions on the instrument fell into several distinct categories, demographic and descriptive items, self-rated ability items, skill items, and items representing latent characteristics. The examination of the items was based upon their category, with only the self-rated and latent items utilizing factor analysis. The demographic and descriptive items were examined using frequency distributions and compared across the groups. The items in the self-rated ability section were examined using exploratory factor analysis to determine which, if any, of the items measured the same underlying construct. The items were also examined for internal consistency using Cronbach's alpha. The values of these items were also averaged into a Self-Rated Search Ability score. The items in the skills section of the instrument were scored using a formula, and those scores were combined into a Search Skill score. This score was used for comparing participants as well as participant groups. The items in the personality section of the instrument were from established IPIP subscales containing psychometric items representing latent abilities and were therefore examined using confirmatory factor analysis. The items for each personality subscale were grouped together and the calculated alphas were compared to the alphas reported on the IPIP website. These items were then examined using confirmatory factor analysis to determine which items fit as expected within the established subscales for this data.

6.3 Results

Because the levels of participation in the original targeted groups were not as expected, a fourth group was added to supplement the RUSA list. There were a total of 837 individual participants across all four groups. The original three groups were targeted to open for participation on the same day, but technical issues with setting up Amazon Mechanical Turk delayed the start of data collection for that group by three days. The ASIS&T group was added after 1 weeks' time. The UNC Staff list exceeded expectations quickly and was therefore closed to further participation after four days. The other lists were held open longer to increase participation and then closed after several days passed with no new participants.

The Amazon Mechanical Turk job experienced an initial rush of participants of the 'master' designation followed by a sharp decline several hours later. Investigations revealed that several of the workers had left negative feedback for the job and so it is speculated that this caused the decline. It is also speculated that the validation questions may have been responsible for the negative feedback.

The breakdown of participants and the collection dates are shown in Table 26. The total number of participants that were analyzed for this study was 466.

Table 26: Phase 4 Participants

Source	Opened	Closed	Total Participants	Discarded Surveys	Total Surveys Analyzed
UNC Staff List	10/5/2016	10/9/2016	444	207	237
Amazon Mechanical Turk	10/8/2016	10/21/2016	291	144	147
RUSA List	10/5/2016	10/21/2016	59	9	50
ASSIS&T List	10/12/2016	10/21/2016	43	11	32
Total			**837**	**371**	**466**

It was somewhat unexpected that the processed data contained so many surveys that were discarded. Surveys were discarded for one of three reasons: those that were abandoned by the participant, those that were terminated due to failure to pass validation checks, and those that took too much time (see Table 27). Time was limited on all surveys because the Amazon Mechanical Turk job was limited to 30 minutes, although one worker did continue past the time allotted. The decision to limit the time for the Amazon Mechanical Turk workers was due in part to past behaviors of those workers, where they would continuously scan for new and higher-paying opportunities. For this research, it was also important for participants to complete the instrument with as few distractions as possible Because of this, the limitation was put into place for the Amazon Mechanical Turk participants and also used to eliminate all other surveys over 30 minutes. This limitation could have excluded those who processed the questions more slowly or deliberately, and future research should revisit the decision to limit by time.

Table 27: Phase 4 Discarded Surveys by Type

Source	Abandoned Surveys	Invalid Surveys	Surveys Over Time	Total Surveys Removed
UNC Staff List	62	110	35	207
Amazon Mechanical Turk	38	105	1	144
RUSA List	0	0	9	9
ASSIS&T List	4	5	2	11
Total	**104**	**220**	**47**	**371**

No item responses from discarded surveys were used in the analysis; only completed surveys were used. The decision on whether to keep incomplete data in the analysis is primarily based upon the need for sufficient data to analyze (Sternberg, 2006), and the discarded surveys were not needed to have sufficient data. Additionally, the discarded surveys were arguably less useful due to the reasons for being discarded. Surveys discarded due to the failure to pass validity checks indicate a failure of the participant to keep attention on the task and therefore have a strong likelihood of containing random data for answered items. These types of surveys were the most common discarded surveys at 220 total. Surveys discarded for being over the time limit given the limit imposed on Amazon Mechanical Turk participants were discarded to have the same conditions for all participants. Additionally, the time for many surveys in this category indicated that the participant could have left them unattended for some time, again indicating a lack of sustained attention. The over the time limit category accounted for 47 discarded surveys. The remaining discarded surveys were abandoned and never completed, which totaled 104 surveys. While these surveys could contain valid answers to some of the initial questions, the completed items were of the demographic and descriptive categories and so were of less usefulness without the remaining data. The primary use of those items was to describe the participants and to use as groupings to further examine the psychometric categories, neither of which is meaningful in this context.

Unfortunately, the study attracted fewer participants from Amazon Mechanical Turk than was anticipated. It is believed that this was for a number of reasons. Firstly, the study was limited to what Amazon calls their Master class rather than all the workers. This decision was made based upon advice from other creators of tasks and from a description of the Master workers as being those workers with the highest satisfaction ratings. Secondly, there were several workers who posted a bad review of the task soon after it went active. The reviews stated that the task giver was slow to pay, although payment was given within 2 hours, perhaps because they were accustomed to immediate payment. It is believed that this could have prevented some workers from doing the task.

The abandoned data was identified in Qualtrics with FALSE in the Finished field, showing that the user had never gotten to the end page of the survey. It is interesting to note that no participants from the RUSA list were discarded for this reason. The breakdown of where participants abandoned the instrument is shown below:

- These UNC Staff List respondents show Finished = FALSE (total = 62)
  - 5 abandoned at the consent
  - 7 abandoned at D1 date of birth
  - 1 abandoned after giving date of birth
  - 1 abandoned after giving English speaking
  - 4 abandoned on question H1
  - 5 abandoned after answering question H3
  - 4 abandoned after validation question Z1
  - 4 abandoned on question SE1
  - 18 abandoned on question S1
  - 2 abandoned after validation question Z2
  - 2 abandoned after validation question P2-14
  - 7 abandoned on question P5
  - 2 abandoned after question P6
- These Amazon Mechanical Turk respondents show Finished = FALSE (total = 38)
  - 10 abandoned at the consent
  - 2 abandoned after giving salary
  - 5 abandoned after answering question H3
  - 1 abandoned after validation question Z1
  - 2 abandoned on question SE1
  - 14 abandoned on question S1
  - 2 abandoned after question P2
  - 2 abandoned on question P5
- These ASIS&T list respondents show Finished = FALSE (total = 4)
  - 1 abandoned at D2 Gender
  - 1 abandoned on question H1
  - 1 abandoned after validation question Z1
  - 1 abandoned after validation question Z2

It is apparent that many of the participants who abandoned the instrument did so at question S1 for both the UNC Staff list and the Amazon Mechanical Turk job. This particular question was the first question that asked participants to choose the correct tool to accomplish a specific task, and it might have appeared too difficult for those participants, or to warrant more effort than they were willing to provide. The data collected in the instrument before question S1 is demographic and historical, and of very limited use. Since these participants abandoned the instrument before completion, they did not enter in an email address and were not eligible for the drawing. Amazon Mechanical Turk workers who abandoned the survey were not paid.

Qualtrics identified the participants who failed the validation checks with a TRUE in the Finished field but with missing data after the relevant validation check that was not passed. Since these checks were placed in the instrument to verify that the participants were reading and paying attention to the questions, data from these participants cannot be used.

- These UNC Staff List respondents show Finished = TRUE (total = 110)
    - 3 said no to the consent
    - 10 failed Z1 validation (Age)
    - 46 failed Z2 validation (in Select Tool section)
    - 41 failed Z3 (P2-4) validation (in Personality section)
    - 10 failed Z4 (P6-4) validation (in Personality section)
- These Amazon Mechanical Turk respondents show Finished = TRUE (total = 105)
    - 20 said no to the consent or failed the capcha
    - 7 failed Z1 validation (Age)
    - 36 failed Z2 validation (in Select Tool section)
    - 35 failed Z3 (P2-4) validation (in Personality section)
    - 7 failed Z4 (P6-4) validation (in Personality section)
- These ASSIS&T list respondents show Finished = TRUE (total = 5)
    - 1 failed Z2 validation (in Select Tool section)
    - 1 failed Z3 (P2-4) validation (in Personality section)
    - 3 failed Z4 (P6-4) validation (in Personality section)

A great majority of the failures in validation occurred at Z2 and Z3. Z2 was the validation check in the question set that asked participants to select the correct tool to perform a specified task and asked for one of the options to be selected to verify that they were paying attention. This validation check was soon after the question S1 that caused many participants to abandon the instrument. When combined with the data on abandoning the survey, it suggests that this was a point where many participants either abandoned (at S1) or stopped carefully reading (at Z2). Since these participants failed the validation checks, they did not enter in an email address and were not entered into the drawing. Amazon Mechanical Turk workers who failed validation were not paid.

6.3.1 Groups and Demographics

Participants for this phase of the research were specifically recruited from different groups so that results from those groups could be compared. Specifically, the participants in the RUSA and ASIS&T groups were targeted as likely to have more online search expertise than those in other groups. The RUSA mailing list specifically targets American Library Association members who are involved in reference and user services (http://www.ala.org/RUSA/about) while the ASIS&T list targets information professionals (http://www.asis.org/about.html). The use of reference or information professionals as experts has been common in past research on search expertise. These participants were therefore treated as experts during the statistical analysis, and the groups were examined for evidence both for and against that classification.

Participants in the Amazon Mechanical Turk (TURK) and UNC Staff groups were recruited based both upon convenience and upon their user demographics. The Amazon Mechanical Turk participants were expected to be fairly skilled online users. The UNC Staff list participants were expected to include maintenance workers, faculty workers, service workers, students, and professors. This diversity made them a reasonable choice to compliment the participants from the other groups. In the analysis following, notes will be made where participants within these groups significantly differed from expectations.

6.3.2 Time Variables

Qualtrics allows the measurement of a number of time variables while a participant is completing an instrument. For this research, participants' overall time was recorded as well as the time spent on each page of the instrument. Unfortunately, some of the hidden timing questions on certain pages did not function properly, so no data was gathered for those pages. For the hidden timing questions that did function properly, the time spent on the page was gathered from a variable which measured the time from when the page was displayed until the page was submitted by the participant by clicking Next.

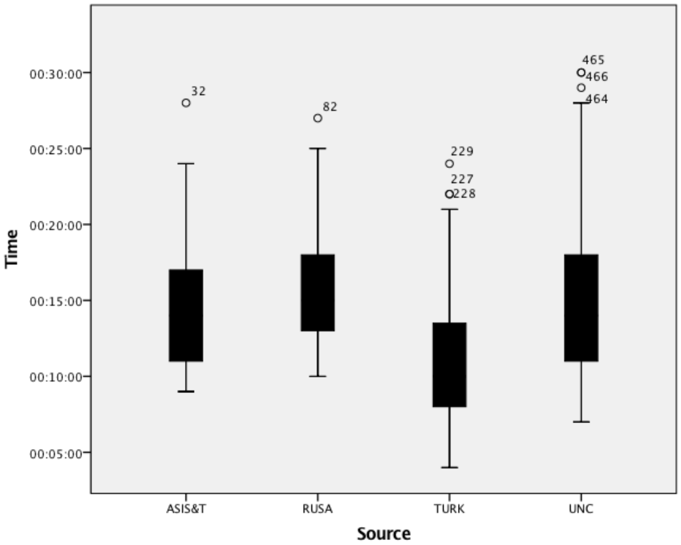
Time data was gathered and examined for all participants in order to examine any influence time might have had upon stopping behaviors. However, since the instructions to the TURK group specifically noted a time limitation, it is not reasonable to include invalid participants from any of the groups as their overall time could skew results. Therefore, for overall time, only the 466 valid participants were considered. Time results by page included all participants who encountered that page.

Overall time for the 466 valid participants shows a mean of 13 minutes, 46 seconds. The overall times by group for valid participants is in Table 28. Times are shown in minutes:seconds format. These times are also shown graphically in Figure 24. It is interesting to note the time differences between the TURK group and the other three groups. However, the TURK group was the only group that was specifically aware of a time limitation, so that might have impacted their behavior. The Amazon Mechanical Turk system pays based upon completed tasks, however, so it may be those participants are accustomed to performing at higher speeds.

Table 28: Overall Time by Group (minutes:seconds)

Group	Mean	Std. Dev.	Minimum	Maximum
ASIS&T	14:50	4:29	9:00	28:00
RUSA	15:46	4:14	10:00	27:00
TURK	10:57	4:05	4:00	24:00
UNC	14:56	4:51	7:00	30:00
TOTAL	13:46	4:55	4:00	30:00

Figure 24: Boxplots of Overall Time by Group



Note that for the time spent on each page, all data was considered from all participants. This was done in order to examine stopping behaviors as well as places where participants might have experienced difficulties answering the questions. This time data is shown below in Table 29. Times are shown in seconds.

Table 29: Time Spent on Each Page, All Participants [Mean (Standard Deviation)]

Section	Questions	ASIS&T	RUSA	TURK	UNC
Demographics	3	17.808 (9.713)	15.480 (6.237)	16.239 (23.520)	21.975 (26.567)
General Online Experience	12	No data	No data	No data	No data
Online Search Experience	16	80.467 (27.628)	250.102 (728.912)	90.841 (272.628)	239.323 (1858.696)
Self-Rated Search Ability	11	46.155 (19.389)	63.713 (97.875)	60.012 (132.500)	70.550 (115.195)
Search Skills	6	61.829 (39.237)	106.802 (320.182)	35.700 (38.971)	55.944 (140.148)
Personality Page 1	20	No data	No data	No data	No data
Personality Page 2	20	87.051 (52.842)	134.855 (457.966)	1414.516 (16822.090)	151.387 (629.873)
Personality Page 3	20	No data	No data	No data	No data
Personality Page 4	18	66.208 (37.103)	56.421 (22.083)	38.326 (22.949)	97.218 (318.904)
Personality Page 5	8	30.030 (16.470)	27.424 (21.083)	26.077 (64.606)	27.044 (13.099)

The means for these Online Search Experience questions show some difference between the groups, but these differences are not statistically significant. When the means were also compared without the discarded surveys, the differences between groups virtually disappeared. It is however interesting to note that many of the participants who did not complete the survey stopped at the question just after this section. This behavior could indicate that some threshold was reached for those users in the amount of time or effort they wished to expend on the survey. Set two of the Personality questions shows a large difference between the means of the TURK group and the other groups, but again this difference disappears when comparing only valid surveys. The standard deviations for some of the time variables was also larger, specifically for the UNC cohort on the search experience page and the TURK cohort on the second personality page. For the UNC cohort, there were two participants who did not click on the page at all for more than 7 hours, indicating that the participants either abandoned or postponed completing the survey. The TURK result on the second personality page includes a single participant who started the page much like other participants, but who took more than 58 hours to click the submit button. This indicates that the participant left the instrument and returned to it at a much later time. The remainder of these results will not include data from incomplete or invalid surveys.

6.3.3 Demographics of Participants

The instrument began with demographic questions that are commonly used in research to describe research participants (see Appendix H). Specific demographic questions asked were:

- Age
- Gender
- Ability with English
- Level of Education
- Income
- Environment

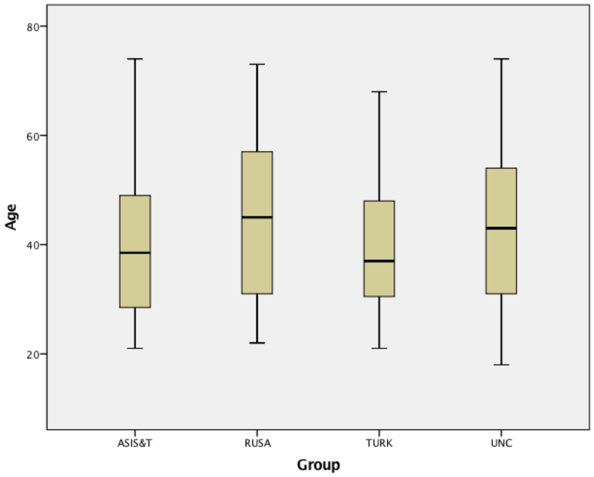
Each question is discussed individually within this section.

The first question asked for the participant's year of birth. This was a validation question, and disqualified all participants who reported an age less than 18. The age data is reported in Table 30 and shown by group in Figure 25. The ages of all four groups are similar, with the Amazon Mechanical Turk workers averaging the youngest. There were no statistically significant differences in age between the four cohorts. The youngest valid participants were 18; the oldest were 74.

Table 30: Age of Participants

N	Valid	466
	Missing	0
Mean		41.75
Median		41.00
Mode		32
Std. Deviation		13.138
Minimum		18
Maximum		74

Figure 25: Age by Group



Participants were next asked to give their gender identity using the options from the UNC LGBTQ Chapter in their memorandum on sex, gender, and sexual orientation in research (see Table 31). Overall, participants primarily answered female at almost 70%. The remainder were primarily male at 29%. Four participants selected other options.

Table 31: Gender by Source

Gender	ASIS&T	RUSA	TURK	UNC	Total
Female	22	44	72	187	325
Male	9	6	75	47	137
Agender	0	0	0	1	1
Genderqueer	0	0	0	2	2
Intersex	1	0	0	0	1
Total	32	50	147	237	466

It is interesting to note that only the Amazon Mechanical Turk workers have approximately equal numbers of male and female participants. All the other sources are predominately female. Gender identity is not considered to affect online search expertise.

The next demographic question asked for ability with the English language. Of the 466 participants, 440 identified themselves as a native English speaker. The remaining 26 identified themselves as non-native speakers with a good understanding of English. Since this was a validation question as well, all those identifying as having a limited understanding of English would have been removed from the dataset, but there were no participants in that group.

The participants were next asked to select the highest level of education they had completed (see Table 32). The Amazon Mechanical Turk workers are the only group with a significant number of participants with either High School, Vocational/Technical School, or Some College. The RUSA group of researchers is unsurprisingly primarily holding Master's Degrees because those are commonly held by librarians in research positions, the target audience for that list. It was somewhat surprising that so many of the participants from the UNC Staff list had advanced degrees. Overall, the participants are primarily in the Bachelor's and Master's degree categories. The lack of participants without college degrees in the UNC group, could indicate that the targeted group did not contain the staff members originally expected. The relationship between Education and cohort was significant, X^2 (18, N = 466) = 188.126, p < .01, with the ASIS&T and RUSA groups more likely to hold advanced degrees.

Table 32: Education by Source

Educational Level	ASIS&T	RUSA	TURK	UNC	TOTAL	%
High School or equivalent	0	0	13	2	15	3.2%
Vocational/Technical School (2 year)	0	0	11	5	16	3.4%
Some College	0	0	42	28	70	15.0%
Bachelor's Degree	8	3	58	87	156	33.5%
Master's Degree	11	45	21	77	154	33.0%
Doctoral Degree	11	1	0	33	45	9.7%
Professional Degree	2	1	2	5	10	2.1%
Total	32	50	147	237	466	

Participants were next asked about their environment, with most (259) identifying as Suburban, some (127) identifying as Urban, and the remainder (80) identifying as Rural. Participants were also asked to give their income, which was well-distributed across all sources (see Table 33).

Table 33: Income by Source

Income	ASIS&T	RUSA	TURK	UNC	TOTAL	%
Under $10,000	1	0	6	3	10	2.1%
$10,000 - $19,999	3	2	22	4	31	6.7%
$20,000 - $29,999	0	0	15	7	22	4.7%
$30,000 - $39,999	1	2	25	16	44	9.4%
$40,000 - $49,999	0	6	17	22	45	9.7%
$50,000 - $74,999	1	14	33	50	98	21.0%
$75,000 - $99,999	5	9	15	28	57	12.2%
$100,000 - $150,000	11	9	6	64	90	19.3%
Over $150,000	3	5	2	22	32	6.9%
Rather not say	5	3	6	17	31	6.7%
Unsure	2	0	0	4	6	1.3%
Total	**32**	**50**	**147**	**237**	**466**	

This demographic information was primarily collected to use in describing the participants. Most of it is not used in any other statistical testing done on the data.

6.3.4 History Related to Online Search Expertise

Participants were next asked a series of questions about their experiences related to online search expertise. Historical questions like these are often used to describe users and also used here to examine the role experience might play in online search expertise. The instrument began with questions about general experience similar to those used in current research and selected based upon that prior use. The questions specifically asked about:

- Experience with Internet search tools, in years
- Frequency of searching on various devices
- Prior training in searching
- Holding a degree in LS or IS
- Searching on behalf of friends or relatives
- Searching for work
- Training others in searching

The first of these general questions asked how long the participant had been using Internet search tools. The results in Table 34 show participants overwhelmingly had more than 11 years of experience searching online, with many having more than 15 years of experience.

This is particularly interesting because of the use of this question in prior research and the lack of participants who reported on the lower end of the spectrum, which indicates that this statistic might not be useful for discriminating among participants.

Table 34: Experience with Internet Search Tools by Group

Experience	ASIS&T	RUSA	TURK	UNC	TOTAL	%
1 to 2 years	0	0	2	0	2	0.4%
3 to 4 years	0	0	2	1	3	0.6%
5 to 7 years	0	0	15	3	18	3.9%
8 to 10 years	4	2	14	17	37	7.9%
11 to 15 years	5	9	38	57	109	23.4%
More than 15 years	23	39	76	159	297	63.7%
Total	**32**	**50**	**147**	**237**	**466**	

Participants were next asked about how frequently they used search using several different devices, which showed extensive daily use of their phones, personal laptops, and work laptops, perhaps reflecting the ubiquity of those technologies (see Table 35). On the other hand, few reported daily searching using a shared computer. Numbers for tablets and personal computers skewed slightly towards more infrequent use.

Table 35: Frequency of Search by Device

Device	Never	Less than once a month	Monthly	Weekly	Daily
Phone	51	16	20	84	295
Tablet	146	68	47	105	100
Personal Laptop	71	23	28	87	257
Personal Computer	214	37	24	59	132
Shared Computer	231	149	50	25	11
Work Computer	67	19	13	54	313

Participants were then asked a series of questions regarding their training and education related to searching online. Some of these questions were given only when certain selections had been made on previous questions. Other questions were seen by all participants. The first question in this group asked participants where and how they had received training in searching online. Participants were allowed to select as many choices as they liked. Participants overwhelmingly selected ‘Self-Taught’ as one of their choices on this question. This reinforces the idea that many learn how to search online through trial and error, although certainly there are other ways in which to be self-taught. For this question participants were also given a text entry field in order to capture any training not listed. Many indicated training through their work or profession, including vendor-sponsored training, professional society training and conferences, workshops, and online tutorials or webinars. Another group mentioned degrees in Library Science or Information Science, which also happened to be the next question asked on the instrument.

This item was difficult to statistically examine since it allowed the participant to select multiple answers. These answers were examined individually for the effect of cohort and some significant associations were found. The relationship between Self-Taught and cohort was significant, X^2 (3, N = 466) = 27.499, p < .01, with the TURK and UNC groups more likely to have selected this type of training, but the fact that 95% of all participants selected this choice makes the item less useful. The relationship between College Course and cohort was also significant, X^2 (3, N = 466) = 73.175, p < .01, with the TURK and UNC groups more likely to have selected this type of training. The relationship between Course at Library and cohort was also significant, X^2 (3, N = 466) = 39.157, p < .01, with the ASIS&T and RUSA groups more likely to have selected this type of training. These results are difficult to interpret, however, since participants selected multiple answers.

Table 36: Training by Source (N = 466)

Training	ASIS&T	RUSA	TURK	UNC	Total
Self-Taught	27	42	143	232	444
Learned from friend or relative	3	12	34	47	96
High School Course	1	6	17	26	50
College Course	15	34	23	41	113
Course at library	8	13	1	21	43

The next question was only displayed if the participant selected 'Training: College Course' in the previous question. The high number of participants from the RUSA and ASIS&T groups who selected 'Yes' here supports the use of these groups as expected experts in online search. The relationship between LIS Degree and cohort was significant, X^2 (3, N = 113) = 69.110, p < .01, with the ASIS&T and RUSA groups more likely to hold LIS degrees. This is unsurprising given the nature of the two cohorts, but still provides further support for treating these two groups as experts.

Table 37: Degree from a Library or Information Science program? (N = 113)

Answer	ASIS&T	RUSA	TURK	UNC	TOTAL
Yes	11	33	3	5	52
No	4	1	20	36	61
Total	15	34	23	41	113

All participants then answered the next question (see Table 38) regardless of their answers to the previous questions. This question asked about their experience performing searches for information online for friends or relatives. Participants overwhelmingly selected 'Yes' for this question.

Table 38: Performed Searches Online for Friends or Relatives (N = 466)

Answer	ASIS&T	RUSA	TURK	UNC	TOTAL
Yes	32	50	133	230	445
No	0	0	14	7	21
Total	32	50	147	237	466

The next question asked about searching for others as a specific part of their jobs (see Table 39). Participants were able to select multiple answers to this question. The most common answer was related to searching for specific types of information as part of their job, followed by answering ‘No.’

Table 39: Is performing online searches for others a specific part of your job description? (check all that apply)

Answer	ASIS&T	RUSA	TURK	UNC	TOTAL
Yes, in my current job I search to answer questions from clients.	10	44	31	43	128
Yes, in my current job I search to answer questions from coworkers.	8	38	23	85	154
Yes, in my current job I search for a specific type of information as part of my job.	15	35	31	123	204
Not in my current job, but it was part of a prior job.	4	3	17	7	31
No.	11	0	78	90	179
Total	48	120	180	348	696

Chi square tests were performed for the effect of cohort on each of the ‘Yes’ answers for this question. The relationship between cohort and selecting ‘Yes, in my current job I search to answer questions from clients.’ was significant, X^2 (3, N = 466) = 105.533, p < .01. The relationship between cohort and selecting ‘Yes, in my current job I search to answer questions from coworkers.’ was significant, X^2 (3, N = 466) = 63.596, p < .01. The relationship between cohort and selecting ‘Yes, in my current job I search for a specific type of information as part of my job.’ was significant, X^2 (3, N = 466) = 51.191, p < .01.

The three ‘Yes’ responses were additionally examined as a group in order to gain more understanding of the differences between cohorts. Each ‘Yes’ response to the question regarding searching as required by their job was given a +1 and the scores were then summed and compared by cohort (see Table 40).

Table 40: Summed Results - Is performing online searches for others a specific part of your job description?

Source	N	Mean	Std. Deviation
ASIS&T	32	1.03	1.204
RUSA	50	2.34	0.895
TURK	147	0.58	0.914
UNC	237	1.06	1.064
Total	466	1.04	1.126

The large difference in means between the TURK participants and all other groups are interesting, with the TURK participants having a much lower mean score. The RUSA group on the other hand has a much higher mean score, providing some evidence that the group could be used as experts for this research. The UNC and ASIS&T groups are very similar, perhaps indicating that the UNC group might contain faculty and staff who are proficient in searching. There was a significant effect of cohort on the summed results of performing searches for others as part of job description at the $p < .01$ level [$F(3, 462) = 37.728$, $p = .000$]. Pairwise differences were significant between the RUSA cohort and all the other cohorts and between the UNC and TURK cohorts. This item is similar to the item regarding prior training in search in that it allowed multiple selections and is therefore difficult to analyze. Still, these results do indicate that there may be some difference in cohort related to searching as part of a job.

Answers to this question also determined whether the participants would be given the following questions which asked for more information regarding their experiences at their jobs (see Tables 41 and 42). In both current jobs and previous jobs, most of the participants who were given the question reported that they searched for others daily.

Table 41: Frequency of performing searches for others as part of current occupation?

Answer	ASIS&T	RUSA	TURK	UNC	TOTAL
Less than Once a Month	0	1	2	9	12
Once a Month	1	0	2	10	13
2-3 Times a Month	1	1	5	17	24
Once a Week	3	0	4	20	27
2-3 Times a Week	7	3	12	39	61
Daily	5	43	28	48	124
Total	17	48	53	143	261

Table 42: Frequency of performing searches for others as part of prior occupation?

Answer	ASIS&T	RUSA	TURK	UNC	TOTAL
Less than Once a Month	0	0	2	1	3
2-3 Times a Month	0	0	0	2	2
Once a Week	0	1	1	1	3
2-3 Times a Week	0	0	5	3	8
Daily	4	2	9	0	15
Total	4	3	17	7	31

This section of the instrument ended with questions related to training others in search. Participants were first asked whether they had specifically trained others in how to search for information online (see Table 43). Those who answered one of the positive answers were then given further questions to determine whether that training was a specific part of their job (see Table 44) and the frequency of that training (see Table 45). Participants primarily answered ‘No’ to the first question regarding training others in classes or training sessions. Those who did train others in search did so as a specific part of their job and did this training primarily more than 2-3 times a week. The relationship between Training Others and cohort was also significant, X^2 (9, N = 466) = 188.126, p < .01, with the ASIS&T and RUSA groups more likely to be currently training others.

Table 43: Have you specifically trained others in how to search for information online, either in a class or training session?

Answer	ASIS&T	RUSA	TURK	UNC	TOTAL
Yes, I am doing it currently.	11	42	10	9	72
Yes, I did less than 5 years ago.	5	0	11	12	28
Yes, but more than 5 years ago.	3	5	7	11	26
No	13	3	119	205	340
Total	32	50	147	237	466

Table 44: Is training others in how to search a specific part of your occupation?

	Source				
Answer	ASIS&T	RUSA	TURK	UNC	Total
Yes	10	39	6	4	59
No	1	3	4	5	13
Total	11	42	10	9	72

Table 45: How frequently do you train others in how to search for information online?

	Source				
Answer	ASIS&T	RUSA	TURK	UNC	Total
Less than Once a Month	0	1	1	0	2
Once a Month	0	3	1	1	5
2-3 Times a Month	3	4	0	2	9
Once a Week	1	3	0	1	5
2-3 Times a Week	5	16	2	0	23
Daily	1	12	2	0	15
Total	10	39	6	4	59

The section ended with a validation question that asked participants to select ‘unsure’ to continue. Those who did not select it properly were routed to the disqualification message.

6.3.5 Comparing the Four Participant Groups

Responses to some of the questions in the prior section are summarized in Table 46. The four groups exhibit a clear split between the RUSA and ASIS&T on one side with formal training in search and LIS degrees and the TURK and UNC Staff groups on the other side. The differences seen here support the use of the RUSA and ASIS&T participants as known experts, but they do not support a group of known low ability participants, with the UNC Staff and Amazon Turk participants having broader levels of search ability.

Table 46: Comparison of Participant Groups

Descriptive	RUSA	ASIS&T	TURK	UNC Staff
Age	Widest range		Slightly younger	
Gender	Predominately female	Predominately female	Equal split of male and female	Predominately female
Education	Master's degree, LIS degree	Master's degree, Doctoral degree, LIS degree	Largest number without college or LIS degree	Mostly bachelor's or Master's, no LIS degree
Income	Mid to High (above $50,000)	High income (above $100,000)	Low to middle (below $75,000)	Mid to High (above $50,000)
Search Training	College course, Course at Library	College course, Course at Library	Less formal training in search	Less formal training in search
Occupation	Frequently had search as part of job description		Rarely had search as part of job description	
Other	Overwhelmingly train others in how to search online	Greater use of WorldCat	Overwhelmingly did not train others in how to search	Greater use of PubMed Overwhelmingly did not train others in search

As noted above, Chi square tests were performed on the categorical variables to examine the effect of group membership and verify the effects noted above. Significant results were found for the relationship of cohort with education, LIS degree, searching for others at work, and training others. The Search Training item results were significant as well, but also more speculative due to the ability to select multiple responses The results do, however, indicate that there may be a relationship between Search Training and cohort, especially regarding formal training like college courses or courses at a library. These results also provide more evidence that the ASIS&T and RUSA groups can be considered experts for this study.

6.3.6 Specific Search History

This section of the instrument asked participants about their experiences searching for specific types of information as well as their familiarity with some online databases and tools. Participants were first asked about searching online for specific types of information, including news or current events, information about a hobby, legal information, health information, ancestry or genealogical information, financial information, government information, historical information, and leisure or entertainment information. Results can be seen in Tables 47 to 55, broken down by group.

All respondents unsurprisingly primarily reported daily searches for news or current events and leisure or entertainment. Information about hobbies was also reported as frequently searched by all groups. Both legal and genealogical information was reported as infrequently searched by all groups. All other categories were more similar between groups.

Table 47: How frequently do you search online for News/Current Events?

	Source				
Answer	**ASIS&T**	**RUSA**	**TURK**	**UNC**	**Total**
Never	1	0	1	2	4
Less than Once a Month	0	2	7	9	18
Once a Month	0	1	9	10	20
2-3 Times a Month	1	1	6	14	22
Once a Week	3	1	19	20	43
2-3 Times a Week	10	8	43	60	121
Daily	17	37	62	122	238
Total	32	50	147	237	466

Table 48: How frequently do you search online for Information about a Hobby?

Answer	Source				Total
	ASIS&T	RUSA	TURK	UNC	
Never	0	1	7	2	10
Less than Once a Month	3	2	14	27	46
Once a Month	2	5	12	12	31
2-3 Times a Month	4	6	25	34	69
Once a Week	7	7	27	44	85
2-3 Times a Week	15	19	45	85	164
Daily	1	10	17	33	61
Total	32	50	147	237	466

Table 49: How frequently do you search online for Legal information?

Answer	Source				Total
	ASIS&T	RUSA	TURK	UNC	
Never	6	6	22	42	76
Less than Once a Month	12	16	67	136	231
Once a Month	7	8	22	26	63
2-3 Times a Month	5	11	19	19	54
Once a Week	1	2	12	6	21
2-3 Times a Week	0	6	4	3	13
Daily	1	1	1	5	8
Total	32	50	147	237	466

Table 50: How frequently do you search online for Health Information?

Answer	Source				Total
	ASIS&T	RUSA	TURK	UNC	
Never	0	0	6	5	11
Less than Once a Month	9	2	37	58	106
Once a Month	7	11	30	61	109
2-3 Times a Month	9	17	30	62	118
Once a Week	5	6	25	21	57
2-3 Times a Week	1	9	15	18	43
Daily	1	5	4	12	22
Total	32	50	147	237	466

Table 51: How frequently do you search online for Ancestry/Genealogical information?

Answer	Source				Total
	ASIS&T	RUSA	TURK	UNC	
Never	16	18	68	126	228
Less than Once a Month	13	13	47	96	169
Once a Month	1	5	11	5	22
2-3 Times a Month	2	7	13	7	29
Once a Week	0	2	6	1	9
2-3 Times a Week	0	4	1	0	5
Daily	0	1	1	2	4
Total	32	50	147	237	466

Table 52: How frequently do you search online for Financial Information?

Answer	Source				Total
	ASIS&T	RUSA	TURK	UNC	
Never	1	3	12	28	44
Less than Once a Month	16	6	34	67	123
Once a Month	4	9	25	44	82
2-3 Times a Month	7	13	21	45	86
Once a Week	2	4	19	26	51
2-3 Times a Week	2	13	24	18	57
Daily	0	2	12	9	23
Total	32	50	147	237	466

Table 53: How frequently do you search online for Government information?

Answer	Source				Total
	ASIS&T	RUSA	TURK	UNC	
Never	0	1	15	27	43
Less than Once a Month	13	5	49	86	153
Once a Month	6	9	28	51	94
2-3 Times a Month	9	10	21	44	84
Once a Week	2	8	19	15	44
2-3 Times a Week	2	12	9	7	30
Daily	0	5	6	7	18
Total	32	50	147	237	466

Table 54: How frequently do you search online for Historical information?

Answer	Source				Total
	ASIS&T	RUSA	TURK	UNC	
Never	1	1	9	23	34
Less than Once a Month	10	3	32	59	104
Once a Month	6	5	28	50	89
2-3 Times a Month	8	11	31	44	94
Once a Week	2	9	20	28	59
2-3 Times a Week	4	13	21	27	65
Daily	1	8	6	6	21
Total	32	50	147	237	466

Table 55: How frequently do you search online for Leisure/Entertainment?

Answer	Source				Total
	ASIS&T	RUSA	TURK	UNC	
Never	0	0	0	1	1
Less than Once a Month	0	1	5	6	12
Once a Month	3	1	9	10	23
2-3 Times a Month	3	3	13	17	36
Once a Week	4	4	27	27	62
2-3 Times a Week	11	14	43	74	142
Daily	11	27	50	102	190
Total	32	50	147	237	466

In addition to examining this data by type of information, it was also examined by source group to see if any patterns or differences might exist (see Tables 56 to 59). ASIS&T participants reported frequent searching for only news, hobbies, and leisure, with all other categories reported at much lower usage. By contrast, RUSA participants, while echoing frequent searching for news, hobbies, and leisure, searched more frequently for financial, government and historical information. TURK participants reported more balanced searching for financial and historical information than the other groups. All groups reported searching at similar levels for health information.

Table 56: Search frequency for ASIS&T Participants

Answer	News	Hobbies	Legal	Health	Ancestry	Financial	Gvmt	History	Leisure
Never	1	0	6	0	16	1	0	1	0
Less than Once a Month	0	3	12	9	13	16	13	10	0
Once a Month	0	2	7	7	1	4	6	6	3
2-3 Times a Month	1	4	5	9	2	7	9	8	3
Once a Week	3	7	1	5	0	2	2	2	4
2-3 Times a Week	10	15	0	1	0	2	2	4	11
Daily	17	1	1	1	0	0	0	1	11

Table 57: Search frequency for RUSA Participants

Answer	News	Hobbies	Legal	Health	Ancestry	Financial	Gvmt	History	Leisure
Never	0	1	6	0	18	3	1	1	0
Less than Once a Month	2	2	16	2	13	6	5	3	1
Once a Month	1	5	8	11	5	9	9	5	1
2-3 Times a Month	1	6	11	17	7	13	10	11	3
Once a Week	1	7	2	6	2	4	8	9	4
2-3 Times a Week	8	19	6	9	4	13	12	13	14
Daily	37	10	1	5	1	2	5	8	27

Table 58: Search frequency for TURK Participants

Answer	News	Hobbies	Legal	Health	Ancestry	Financial	Gvmt	History	Leisure
Never	1	7	22	6	68	12	15	9	0
Less than Once a Month	7	14	67	37	47	34	49	32	5
Once a Month	9	12	22	30	11	25	28	28	9
2-3 Times a Month	6	25	19	30	13	21	21	31	13
Once a Week	19	27	12	25	6	19	19	20	27
2-3 Times a Week	43	45	4	15	1	24	9	21	43
Daily	62	17	1	4	1	12	6	6	50

Table 59: Search frequency for UNC Participants

Answer	News	Hobbies	Legal	Health	Ancestry	Financial	Gvmt	History	Leisure
Never	2	2	42	5	126	28	27	23	1
Less than Once a Month	9	27	136	58	96	67	86	59	12
Once a Month	10	12	26	61	5	44	51	50	23
2-3 Times a Month	14	34	19	62	7	45	44	44	36
Once a Week	20	44	6	21	1	26	15	28	62
2-3 Times a Week	60	85	3	18	0	18	7	27	142
Daily	122	33	5	12	2	9	7	6	190

Participants were also asked about searching online for information related to college course requirements (see Table 60). This item was asked separately from the previous item in order to include additional historical options. Perhaps surprisingly, the only group that reported a high percentage of current searching related to a college course was the ASIS&T group. The RUSA group reported doing this type of searching within 5 or 10 years, while the other two groups skewed towards reporting no searching of this kind or searching more than five years ago. The relationship between searching for college and cohort was significant, X^2 (9, N = 466) = 60.437, $p < .01$.

Table 60: Have you ever searched online to fulfill college course requirements?

Answer	Source				Total
	ASIS&T	RUSA	Turk	UNC	
Yes, I am doing it currently.	10	6	5	25	46
Yes, I did less than 5 years ago.	4	15	24	43	86
Yes, but more than 5 years ago.	13	23	32	64	132
No.	5	6	86	105	202
Total	32	50	147	237	466

The second part of this section of the instrument asked participants to report their frequency of using various online resources, including search engines like Google, Yahoo, or Bing (see Table 61); the Web of Science database (see Table 62); the PubMed database (see Table 63); the LexisNexis database (see Table 64); the WorldCat database (see Table 65); and the Dialog databases (see Table 66). These resources were selected based upon previous research using experience with online databases as a basis for determining search expertise and also based upon the search experts' mention of them. All participant groups reported extremely frequent use of search engines and much lower usage of the other resources. This supports Nielsen's (2011) caution that the ubiquity of the Internet and the constant use of Google have changed how we perceive and interact with information. It also indicates that the past use of experience with databases in research is no longer a practical way to discriminate between users.

Table 61: Frequency of searching online using Search Engine like Google, Yahoo, or Bing?

	Source				
Answer	**ASIS&T**	**RUSA**	**TURK**	**UNC**	**Total**
Never	0	0	0	0	0
Formerly used but not now	0	0	0	0	0
Less than Once a Month	0	0	0	0	0
Once a Month	0	0	0	0	0
2-3 Times a Month	0	0	0	1	1
Once a Week	0	0	1	1	2
2-3 Times a Week	0	0	12	12	24
Daily	32	50	134	223	439
Total	32	50	147	237	466

Table 62: How frequently do you search online using Web of Science?

	Source				
Answer	**ASIS&T**	**RUSA**	**TURK**	**UNC**	**Total**
Never	11	19	124	167	321
Formerly used but not now	4	5	5	24	38
Less than Once a Month	3	8	2	16	29
Once a Month	2	4	6	5	17
2-3 Times a Month	4	7	3	10	24
Once a Week	1	2	3	7	13
2-3 Times a Week	5	1	3	6	15
Daily	2	4	1	2	9
Total	32	50	147	237	466

Table 63: How frequently do you search online using PubMed?

	Source				
Answer	**ASIS&T**	**RUSA**	**TURK**	**UNC**	**Total**
Never	11	7	114	94	226
Formerly used but not now	5	4	9	21	39
Less than Once a Month	1	13	11	39	64
Once a Month	4	6	5	12	27
2-3 Times a Month	4	7	2	22	35
Once a Week	2	7	3	19	31
2-3 Times a Week	3	3	2	18	26
Daily	2	3	1	12	18
Total	32	50	147	237	466

Table 64: How frequently do you search online using LexisNexis?

Answer	Source				Total
	ASIS&T	RUSA	TURK	UNC	
Never	15	10	110	175	310
Formerly used but not now	7	9	26	35	77
Less than Once a Month	5	9	2	13	29
Once a Month	2	4	3	2	11
2-3 Times a Month	1	6	0	3	10
Once a Week	2	7	1	5	15
2-3 Times a Week	0	3	1	4	8
Daily	0	2	4	0	6
Total	32	50	147	237	466

Table 65: How frequently do you search online using WorldCat?

Answer	Source				Total
	ASIS&T	RUSA	TURK	UNC	
Never	7	2	124	196	329
Formerly used but not now	4	0	8	16	28
Less than Once a Month	9	6	8	7	30
Once a Month	3	2	2	5	12
2-3 Times a Month	5	6	1	4	16
Once a Week	0	9	2	4	15
2-3 Times a Week	3	14	1	4	22
Daily	1	11	1	1	14
Total	32	50	147	237	466

Table 66: How frequently do you search online using Dialog?

Answer	Source				Total
	ASIS&T	RUSA	TURK	UNC	
Never	23	39	133	228	423
Formerly used but not now	7	10	4	6	27
Less than Once a Month	0	1	5	2	8
Once a Month	1	0	0	1	2
2-3 Times a Month	0	0	0	0	0
Once a Week	1	0	2	0	3
2-3 Times a Week	0	0	3	0	3
Daily	0	0	0	0	0
Total	32	50	147	237	466

The results from these questions were also organized by group in order to see each group's usage over all the resources. The ASIS&T group's use of these resources skews heavily towards never using them except for WorldCat (see Table 67), which shows more similar use between cohorts.

The RUSA group reported some use of almost all the resources except for Dialog (see Table 68). In contrast, the TURK group reported almost no use of these resources apart from search engines (see Table 69). The UNC group is similar, except for reporting more use of PubMed (see Table 70). These results do show some clear differences in the groups in how they use online resources.

Table 67: How frequently do ASIS&T participants search using?

Answer	Search Engine	Web of Science	PubMed	Lexis Nexis	World Cat	Dialog
Never	0	11	11	15	7	23
Formerly used but not now	0	4	5	7	4	7
Less than Once a Month	0	3	1	5	9	0
Once a Month	0	2	4	2	3	1
2-3 Times a Month	0	4	4	1	5	0
Once a Week	0	1	2	2	0	1
2-3 Times a Week	0	5	3	0	3	0
Daily	32	2	2	0	1	0

Table 68: How frequently do RUSA participants search using?

Answer	Search Engine	Web of Science	PubMed	Lexis Nexis	World Cat	Dialog
Never	0	19	7	10	2	39
Formerly used but not now	0	5	4	9	0	10
Less than Once a Month	0	8	13	9	6	1
Once a Month	0	4	6	4	2	0
2-3 Times a Month	0	7	7	6	6	0
Once a Week	0	2	7	7	9	0
2-3 Times a Week	0	1	3	3	14	0
Daily	50	4	3	2	11	0

Table 69: How frequently do TURK participants search using?

Answer	Search Engine	Web of Science	PubMed	Lexis Nexis	World Cat	Dialog
Never	0	124	114	110	124	133
Formerly used but not now	0	5	9	26	8	4
Less than Once a Month	0	2	11	2	8	5
Once a Month	0	6	5	3	2	0
2-3 Times a Month	0	3	2	0	1	0
Once a Week	1	3	3	1	2	2
2-3 Times a Week	12	3	2	1	1	3
Daily	134	1	1	4	1	0

Table 70: How frequently do UNC participants search using?

Answer	Search Engine	Web of Science	PubMed	Lexis Nexis	World Cat	Dialog
Never	0	167	94	175	196	228
Formerly used but not now	0	24	21	35	16	6
Less than Once a Month	0	16	39	13	7	2
Once a Month	0	5	12	2	5	1
2-3 Times a Month	1	10	22	3	4	0
Once a Week	1	7	19	5	4	0
2-3 Times a Week	12	6	18	4	4	0
Daily	223	2	12	0	1	0

The data from this section suggests that many participants primarily use search engines to find information regarding news and current events or leisure and entertainment, along with slightly lower frequencies of searching for information about a hobby. While this is not surprising, it does show the current environment for many of these participants.

6.3.7 Search Experience Score

Many of the items related to a searcher's history have been used in prior research to sort participants into high and low search ability categories. While this has been useful, it has not allowed for the comparison of participants along a continuum. One purpose of this research is to create continuous measures for aspects of search expertise to represent related categorical variables. The data from this research was examined above for items that showed significant differences between cohorts and that could potentially be used to create a continuous score to represent aspects of prior history that could increase online search expertise.

The results of the demographics and search history chi square tests were used alongside descriptive data to inform the selection of variables from those sections of the instrument. Those results indicate that Education was significantly different between cohorts, with advanced degrees more likely for ASIS&T and RUSA participants. They also indicated a similar effect for

LIS degrees. Currently training others was another significant difference between cohorts, with the ASIS&T and RUSA participants more likely to be currently training others. The item related to searching as part of one's job description also showed significant differences between the cohorts. Training others in search as part of your occupation also showed a significant difference between cohorts. The item asking participants about their training in search allowed multiple answers, so it was difficult to examine statistically. As noted previously, examination of each answer individually using chi square did indicate some differences between cohorts, especially in the choices Self-Taught, College Course, and Course at Library. The self-taught selection was made by virtually every participant (95%), so it was discarded, but the other selections appear useful for this calculation.

From these results and from the descriptive data seen previously, the items with potential discriminatory power for this data include:

- Level of Education (Bachelor's Degree, Master's Degree, and Doctoral Degree)
- Training in Search (College Course, Course at Library)
- LIS Degree (Note that this was expected based upon cohort selection.)
- Searching as Part of Job Description
- Training Others in Search
- Searching for College (Current and less than 5 years ago)
- Frequency of Searching (Hobby, Legal, Ancestry/Genealogical, Financial, Government, Historical)
- Searching Online (PubMed, Lexis/Nexis, WorldCat)

These scores can be further examined alongside one another. It should be noted that the groups are not expected to be completely homogenous, especially the TURK and UNC groups.

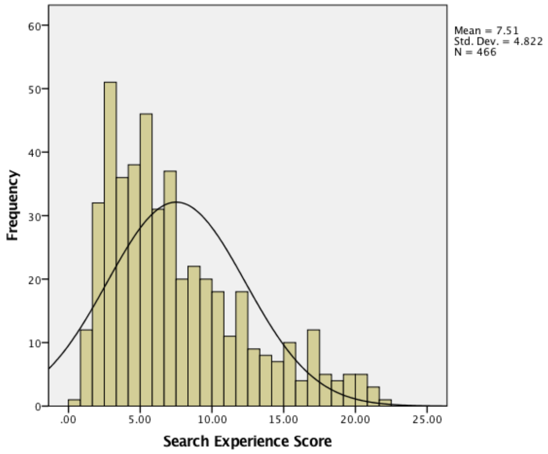
Table 71 shows the items proposed for scoring and the proposed scores. Note that these values are arbitrary and primarily represent simply the inclusion of the item into the overall calculation using simple summations. The items under ‘Frequency of searching for’ were scored on a scale from 0 to 6 based upon the answer of the participant minus one, then divided by the total number of types of searches used from that item (6 types used) to obtain what is essentially an average score for that item. A similar process was used for search sources.

Table 71: Values for use in Search Experience Score

Item	Scoring
Level of education: Bachelor’s Degree	1
Level of Education: Master’s Degree	2
Level of Education: Doctoral Degree	4
Training: College Course	2
Training: Course at Library	1
LIS Degree (113 participants answered)	2
Search as part of Job Description	1-3
Training others in search (all Yes choices)	2
Searching for college (Currently and less than 5 years ago)	1
Frequency of Search: Hobby	(Value – 1)/6
Frequency of Search: Legal	(Value – 1)/6
Frequency of Search: Ancestry/Genealogical	(Value – 1)/6
Frequency of Search: Financial	(Value – 1)/6
Frequency of Search: Government	(Value – 1)/6
Frequency of Search: Historical	(Value – 1)/6
Searching Online: PubMed	(Value – 1)/3
Searching Online: Lexis/Nexis	(Value – 1)/3
Searching Online: WorldCat	(Value – 1)/3

The values shown here are for the purposes of demonstration only – further tests are needed with future iterations of the instrument to determine the best levels. For these values, the minimum is 0 and the maximum is 31. The distribution of the Search Experience Score is shown below in Figure 26. The mean for this score is 7.51 with a standard deviation of 4.82. The curve has skewness of 0.977 (SE = 0.113), skewed to the right, and kurtosis of 0.242 (SE = 0.226).

Figure 26: Search Experience Score



Initial tests based upon this score give significant results pairwise between all four participant groups (see Table 72).

Table 72: Search Experience Score by Participant Group

Source	N	Mean	Std. Deviation	Minimum	Maximum	Pairwise
ASIS&T	32	10.9427	4.56055	2.83	21.17	> T, U < R
RUSA	50	16.0467	3.40835	6.00	22.17	> A, T, U
TURK	147	5.0215	3.54597	0.50	17.33	< A, R, U
UNC	237	6.7904	3.38855	1.17	20.83	> T < A, R
Total	466	7.5107	4.82230	0.50	22.17	

Even with ad hoc scoring of experience items, the Search Experience score shows clear differences between the groups. This score then represents an additional possibility moving forward as a continuous dimension to online search expertise, giving researchers more possibilities for categorizing and comparing participants.

6.3.8 Self-Rated Search Ability

The questions in this section of the instrument asked the participants to report their abilities using various search tools and techniques. Participants were asked about their familiarity with some tools used in search – specifically truncation (see Table 73), quotes (see Table 74), Boolean logic (see Table 75), exclusion of certain sites (see Table 76), and limiting search based upon date (see Table 77), location (see Table 78), type of information (see Table 79), and price (see Table 80). As discussed previously, measuring self-efficacy to gauge search skill has had mixed results in prior research. Some of these items also ask about familiarity with specific techniques, which is different from asking about their confidence in accomplishing a task. These items will therefore be designated self-rated rather than self-efficacy. The results from this section will be compared to the skills section to see how well participants' self-rated abilities correlate to their actual skills.

Familiarity with truncation (see Table 73) as a search tool was distinctly different between the groups of users, with 56% of the ASIS&T participants and 76% of the RUSA participants reporting that they were 'Extremely Familiar' and only 7% of the TURK group and 19% of the UNC participants reporting the same level of familiarity. The ANOVA for this item was significant [$F(3,462)=59.992$, $p < 0.01$], with pairwise differences between the ASIS&T and RUSA cohorts with higher means and the TURK and UNC cohorts with lower means.

Table 73: When searching, how familiar are you with Truncation?

	Source				
Answer	**ASIS&T**	**RUSA**	**TURK**	**UNC**	**Total**
Not at all Familiar	2	0	65	83	150
Not Very Familiar	3	0	23	37	63
Somewhat Familiar	4	3	30	50	87
Reasonably Familiar	5	9	18	47	79
Extremely Familiar	18	38	11	20	87
Total	32	50	147	237	466
Mean (SD)	4.06 (1.294)	4.70 (0.580)	2.23 (1.330)	2.51 (1.364)	2.76 (1.513)

Familiarity with quotes (see Table 74) showed a similar, although smaller break, with ASIS&T group at 88% and RUSA at 92% for 'Extremely Familiar'. The other two groups reported lower levels of familiarity at 39% for TURK and 36% for UNC. The ANOVA for this item was significant [$F(3,462)=20.163$, $p < 0.01$], with pairwise differences between the ASIS&T and RUSA cohorts with higher means and the TURK and UNC cohorts with lower means.

Table 74: When searching, how familiar are you with Quotes?

	Source				
Answer	**ASIS&T**	**RUSA**	**TURK**	**UNC**	**Total**
Not at all Familiar	0	0	20	27	47
Not Very Familiar	0	0	5	15	20
Somewhat Familiar	1	0	21	43	65
Reasonably Familiar	3	4	44	66	117
Extremely Familiar	28	46	57	86	217
Total	32	50	147	237	466
Mean (SD)	4.84 (0.448)	4.92 (0.274)	3.77 (1.360)	3.71 (1.322)	3.94 (1.298)

Again, a break was seen between the groups reporting their familiarity with Boolean logic (see Table 75), with ASIS&T reporting 81% at 'Extremely Familiar' and RUSA at 86%. The other two groups reported at 28% for both TURK and UNC. The ANOVA for this item was significant [$F(3,462)=36.334$, $p < 0.01$], with pairwise differences between the ASIS&T and RUSA cohorts with higher means and the TURK and UNC cohorts with lower means.

Table 75: When searching, how familiar are you with Boolean logic (AND OR NOT)?

	Source				
Answer	**ASIS&T**	**RUSA**	**TURK**	**UNC**	**Total**
Not at all Familiar	0	0	47	67	114
Not Very Familiar	2	1	18	20	41
Somewhat Familiar	0	2	33	32	67
Reasonably Familiar	4	4	25	52	85
Extremely Familiar	26	43	24	66	159
Total	32	50	147	237	466
Mean (SD)	4.69 (0.780)	4.78 (0.616)	2.73 (1.473)	3.13 (1.595)	3.29 (1.593)

A clear division for Limit by publish date (see Table 76) was found at 'Extremely Familiar,' with ASIS&T 75%, RUSA 80%, TURK 20%, and UNC 27%. The ANOVA for this item was significant [$F(3,462)=28.291$, $p < 0.01$], with pairwise differences between the ASIS&T and RUSA cohorts with higher means and the TURK and UNC cohorts with lower means.

Table 76: When searching, how familiar are you with Limit by publish date?

	Source				
Answer	**ASIS&T**	**RUSA**	**TURK**	**UNC**	**Total**
Not at all Familiar	0	0	37	41	78
Not Very Familiar	3	1	19	27	50
Somewhat Familiar	2	1	30	45	78
Reasonably Familiar	3	8	32	61	104
Extremely Familiar	24	40	29	63	156
Total	32	50	147	237	466
Mean (SD)	4.50 (0.984)	4.74 (0.600)	2.98 (1.469)	3.33 (1.424)	3.45 (1.463)

The division exists still for Limit by location (see Table 77) but is slightly narrower for this item, with ASIS&T 66%, RUSA 80%, TURK 26%, and UNC 22%. The ANOVA for this item was significant [$F(3,462)=23.446$, $p < 0.01$], with pairwise differences between the ASIS&T and RUSA cohorts with higher means and the TURK and UNC cohorts with lower means.

Table 77: When searching, how familiar are you with Limit by location?

	Source				
Answer	**ASIS&T**	**RUSA**	**TURK**	**UNC**	**Total**
Not at all Familiar	1	1	29	35	66
Not Very Familiar	1	1	17	41	60
Somewhat Familiar	4	1	30	50	85
Reasonably Familiar	5	7	33	60	105
Extremely Familiar	21	40	38	51	150
Total	32	50	147	237	466
Mean (SD)	4.37 (1.040)	4.68 (0.794)	3.23 (1.457)	3.22 (1.356)	3.46 (1.415)

Limit by type of information (see Table 78) also shows a split between the groups, with ASIS&T 69%, RUSA 78%, TURK 24%, and UNC 22%. The ANOVA for this item was significant

[*F*(3,462)=25.106, $p < 0.01$], with pairwise differences between the ASIS&T and RUSA cohorts with higher means and the TURK and UNC cohorts with lower means.

Table 78: When searching, how familiar are you with Limit by type of information?

Answer	Source				Total
	ASIS&T	RUSA	TURK	UNC	
Not at all Familiar	0	0	29	34	63
Not Very Familiar	4	1	17	37	59
Somewhat Familiar	2	3	40	54	99
Reasonably Familiar	4	7	26	61	98
Extremely Familiar	22	39	35	51	147
Total	32	50	147	237	466
Mean (SD)	4.38 (1.070)	4.68 (0.683)	3.14 (1.424)	3.24 (1.340)	3.44 (1.395)

Limit by price (see Table 79) breaks the pattern somewhat, with a much more limited distinction between the four groups, with ASIS&T 34%, RUSA 54%, TURK 30%, and UNC 27%. The ANOVA for this item was significant [*F*(3,462)=4.935, $p < 0.01$], but with no significant pairwise differences between cohorts. This could be because of participants' experience with faceted systems shopping online.

Table 79: When searching, how familiar are you with Limit by price?

Answer	Source				Total
	ASIS&T	RUSA	TURK	UNC	
Not at all Familiar	3	3	26	47	79
Not Very Familiar	3	3	18	22	46
Somewhat Familiar	3	6	20	38	67
Reasonably Familiar	12	11	39	67	129
Extremely Familiar	11	27	44	63	145
Total	32	50	147	237	466
Mean (SD)	3.78 (1.289)	4.12 (1.206)	3.39 (1.469)	3.32 (1.461)	3.46 (1.446)

Familiarity with excluding specific sites (see Table 80) also had a smaller break between groups, with ASIS&T 44%, RUSA 52%, TURK 19%, and UNC 9%. The ANOVA for this item was significant [*F*(3,462)=29.709, $p < 0.01$], with pairwise differences between the ASIS&T and

RUSA cohorts with higher means and the TURK and UNC cohorts with lower means. This item also showed pairwise differences between the means of the TURK and UNC cohorts, with the TURK cohort having a higher mean.

Table 80: When searching, how familiar are you with Exclude specific sites?

	Source				
Answer	**ASIS&T**	**RUSA**	**TURK**	**UNC**	**Total**
Not at all Familiar	4	1	34	80	119
Not Very Familiar	2	5	25	64	96
Somewhat Familiar	4	6	34	34	78
Reasonably Familiar	8	12	26	37	83
Extremely Familiar	14	26	28	22	90
Total	32	50	147	237	466
Mean (SD)	3.81 (1.401)	4.14 (1.107)	2.93 (1.429)	2.40 (1.338)	2.85 (1.470)

Overall, the differences in the reported familiarities here distinguish the cohorts into two sets of participants, with the ASIS&T and RUSA groups having higher means for most of the items. Of course, individual participants in the TURK and UNC cohorts can have similar levels of online search expertise to individual participants in the RUSA and ASIS&T cohorts, but the differences overall again provide evidence for treating the ASIS&T and RUSA groups as experts.

This section of the instrument continued with a few more questions about the participants' confidence performing certain actions, again based upon the Search Self-Efficacy Scale. The results are shown in Table 81, Table 82, and Table 83. Unlike the previous questions in this section of the instrument, these questions did not ask about a particular tool but instead focused on a person's confidence that they could complete various actions. The first item in this section asked participants to report their confidence in finding articles similar in quality to those that would be obtained by a professional searcher. The participants selected 'Extremely Confident' for this item at an overall rate of 17%, with ASIS&T at 44%, RUSA at 44%, TURK at 13%, and UNC at 10% (see Table 81). The ANOVA for this item was significant [$F(3,462)=33.840$, $p < 0.01$], with pairwise differences between the ASIS&T and RUSA cohorts with higher means and the TURK and UNC cohorts with lower means.

Table 81: If you needed to perform an online search, how confident are you that you could find articles similar in quality to those obtained by a professional searcher?

	Source				
Answer	**ASIS&T**	**RUSA**	**TURK**	**UNC**	**Total**
Not at all Confident	1	0	7	18	26
Not Very Confident	3	1	22	48	74
Somewhat Confident	1	9	49	67	126
Reasonably Confident	13	18	50	81	162
Extremely Confident	14	22	19	23	78
Total	32	50	147	237	466
Mean (SD)	4.56 (0.759)	4.76 (0.591)	3.36 (1.128)	3.48 (1.068)	3.65 (1.134)

The answers given by participants to this question regarding finding every useful document were markedly different, with ASIS&T at 19%, RUSA at 34%, TURK at 13%, and UNC at 5% (see Table 82). The ANOVA for this item was significant [$F(3,462)=22.358$, $p < 0.01$], with pairwise differences between the ASIS&T and RUSA cohorts with higher means and the TURK and UNC cohorts with lower means. This item also showed pairwise differences between the means of the TURK and UNC cohorts, with the TURK cohort having a higher mean. Interestingly, the ASIS&T cohort here reported a much lower level of confidence than on previous questions, while the TURK and UNC cohorts do not show a similar reduction in confidence. This could indicate an issue with the question, or it could indicate that some more experienced participants see this task as more difficult to perform.

Table 82: If you needed to perform an online search, how confident are you that you could create a query that would return every useful document?

	Source				
Answer	**ASIS&T**	**RUSA**	**TURK**	**UNC**	**Total**
Not at all Confident	1	0	13	29	43
Not Very Confident	4	4	31	70	109
Somewhat Confident	4	9	47	75	135
Reasonably Confident	17	20	37	52	126
Extremely Confident	6	17	19	11	53
Total	32	50	147	237	466
Mean (SD)	3.72 (1.023)	4.00 (0.926)	3.12 (1.152)	2.77 (1.069)	3.08 (1.151)

For the final question in this section, on being able to retrieve a few very useful documents, the responses return to similar levels of confidence as the first item in this section, with higher confidence again reported by the ASIS&T and RUSA groups. The groups responded 'Extremely Confident' to this item with ASIS&T at 69%, RUSA at 82%, TURK at 16%, and UNC at 19% (see Table 83). The ANOVA for this item was significant [$F(3,462)=18.692$, $p < 0.01$], with pairwise differences between the ASIS&T and RUSA cohorts with higher means and the TURK and UNC cohorts with lower means.

Table 83: If you needed to perform an online search, how confident are you that you could create a query that would return only a few very useful documents?

	Source				
Answer	**ASIS&T**	**RUSA**	**TURK**	**UNC**	**Total**
Not at all Confident	0	0	11	9	20
Not Very Confident	1	1	20	34	56
Somewhat Confident	2	1	44	73	120
Reasonably Confident	7	7	49	77	140
Extremely Confident	22	41	23	44	130
Total	32	50	147	237	466
Mean (SD)	4.13 (1.070)	4.22 (0.815)	3.35 (1.039)	3.18 (1.099)	3.41 (1.110)

It is interesting to note the differences in confidence here versus the previous question. Some members of the ASIS&T and RUSA cohorts rate recall a much more difficult task than precision, while other cohorts do not.

The overall means and standard deviations for all these items can be compared in Table 84. The overall means are all close to either side of 3, the center choice. The total of all 10 items is a mean of 36.79 for the entire section, or a mean of means of 3.3445, just above the center point. The standard deviations for all items are similar, although all three items in the self-efficacy section show lower mean values than some of the other items, perhaps indicating less usefulness in discrimination. This is quite apparent on the item asking them to compare their ability to find articles similar in quality to those obtained by a professional searcher. This result suggests that something about this question may be perceived or understood differently by the members of the different cohorts, perhaps because the ASIS&T and RUSA groups understand what it means to be a professional searcher.

Table 84: Means and Standard Deviations for Self-Rated Search Ability

Skill Section Items	Mean	Std. Dev.
When searching, how familiar are you with Truncation?	2.76	1.513
When searching, how familiar are you with Quotes?	3.94	1.298
When searching, how familiar are you with BOOLEAN logic (AND OR NOT)?	3.29	1.593
When searching, how familiar are you with Limit by publish date?	3.45	1.463
When searching, how familiar are you with Limit by location?	3.46	1.415
When searching, how familiar are you with Limit by type of information?	3.44	1.395
When searching, how familiar are you with Limit by price?	3.46	1.446
When searching, how familiar are you with Exclude specific sites?	2.85	1.470
If you needed to perform an online search, how confident are you that you could Find articles similar in quality to those obtained by a professional searcher?	3.65	1.134
If you needed to perform an online search, how confident are you that you could Create a query that would return every useful document?	3.08	1.151
If you needed to perform an online search, how confident are you that you could Create a query that would return only a few very useful documents?	3.41	1.110

Responses to these self-rated ability items were then examined using exploratory factor analysis. Factor analysis is often used in instrument development to determine the underlying relationships between measured variables (Costello & Osborne, 2005), although it has few absolute guidelines in its use. Some factor analysis is performed to discover whatever relationships might exist – this is called exploratory factor analysis. While strict rules for sample sizes needed for exploratory factor analysis do not exist, DeVellis (2012) states that a sample size of 300 is sufficient for most applications.

The self-rated search ability items were examined with exploratory factor analysis using maximum likelihood, which provides a wide range of indexes provided that the population of the study are normally distributed. Factors with eigenvalues greater than one were initially retained for comparisons. The factor analysis for the self-rated search ability items is shown in Table 85.

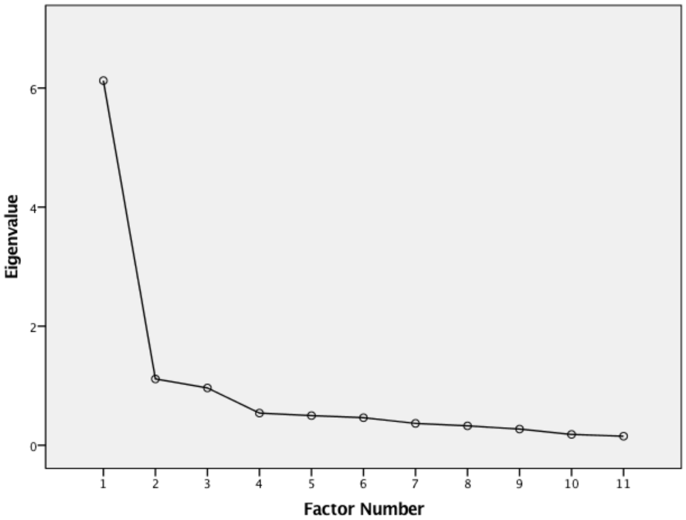
Table 85: Factor Analysis of Self-Rated Search Ability

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Factor	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	6.124	55.669	55.669	5.652	51.380	51.380
2	1.114	10.125	65.794	.797	7.243	58.623
3	.962	8.749	74.543			
4	.541	4.914	79.457			
5	.498	4.525	83.982			
6	.463	4.213	88.194			
7	.367	3.336	91.531			
8	.325	2.959	94.490			
9	.272	2.475	96.965			
10	.182	1.652	98.616			
11	.152	1.384	100.000			

Extraction Method: Maximum Likelihood. Eigenvalue=1.

From Table 85, it is clear that these items cluster on two factors. The factors were then examined using Scree tests to plot the eigenvalues of the factors so that a natural bend could be located where the curve begins to flatten. This method is considered to be more accurate than eigenvalues alone (Costello & Osborne, 2005). The resulting Scree plot was then examined for the shape of the curve (see Figure 27). Both curve and table indicate that a large amount of variance is explained by only one factor, with the second factor contributing only slightly.

Figure 27: Scree Plot – Self-Rated Search Ability



The factor matrix table was then examined to determine the factor loadings for both factors (see Table 86). All items have loadings above 0.5 (Nunnally, 1978) for factor 1, although the lowest loadings are from two of the items from the self-efficacy section. Several items do also load on factor 2, but only one item loads at more than 0.5 for factor 2. These results indicate that one factor is sufficient for these items (Costello & Osborne, 2005), although cross-loading items with scores on factor 2 of .32 or better (Tabachnick & Fidell, 2001) could be considered for removal from future instruments. Using one factor leads to the following factor loadings (see Table 87) with all items loading above 0.5 on the factor. This provides support for treating these items from the instrument as components of a single underlying construct. Since all of these items ask about familiarity with specific search tools or confidence in manipulating search results, this construct will be named Self-Rated Search Ability.

Table 86: Factor Matrix Table – Self-Rated Search Ability, 2 Factors

Items	Factor	
	1	2
When searching, how familiar are you with Truncation?	.631	.384
When searching, how familiar are you with Quotes?	.613	.451
When searching, how familiar are you with Boolean logic?	.637	.528
When searching, how familiar are you with Limit by publish date?	.876	-.016
When searching, how familiar are you with Limit by location?	.896	-.168
When searching, how familiar are you with Limit by type of information?	.902	-.193
When searching, how familiar are you with Limit by price?	.699	-.273
When searching, how familiar are you with Exclude specific sites?	.710	.012
How confident - create query return only a few good results?	.512	.080
How confident - create query that would return every useful result?	.599	.050
How confident - find articles in quality same as expert searcher?	.688	.132

Extraction Method: Maximum Likelihood. Eigenvalue=1.
a. 2 factors extracted. 5 iterations required.

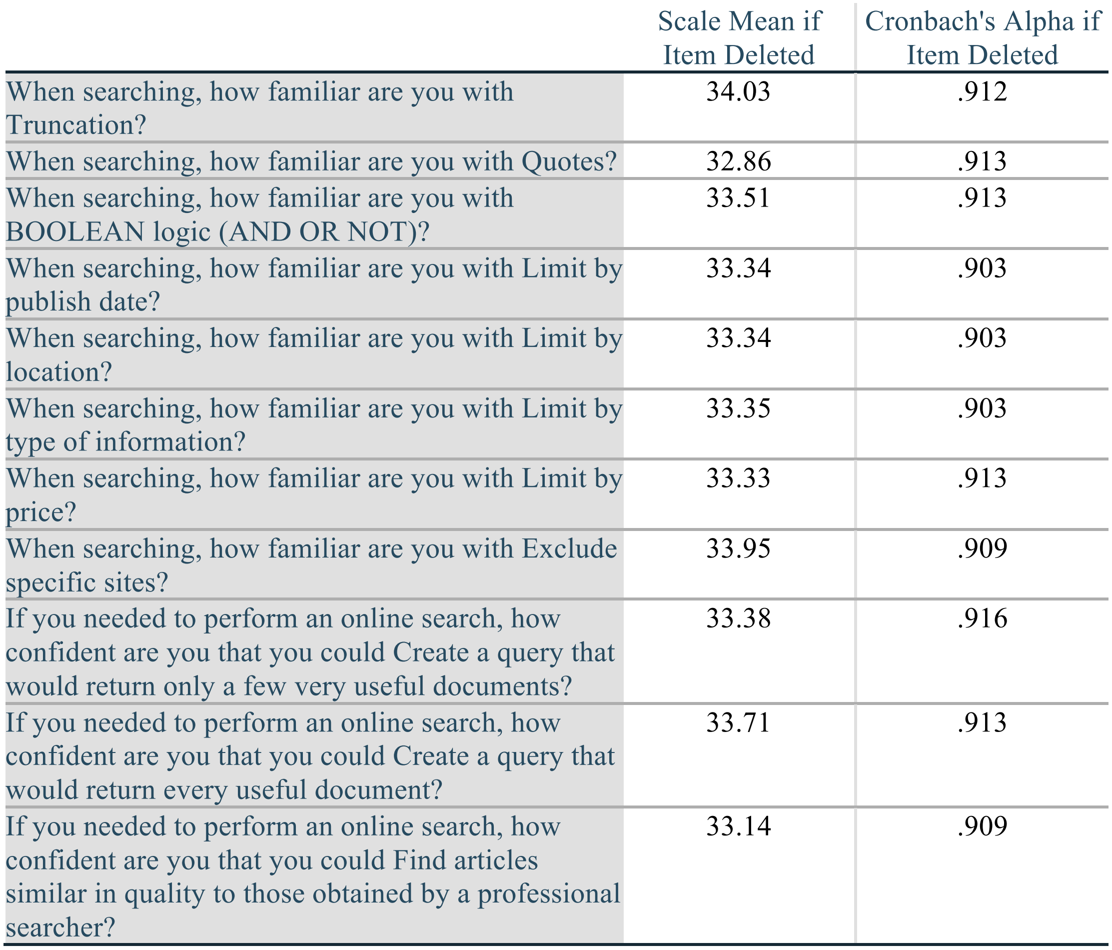
Table 87: Factor Matrix Table – Self-Rated Search Ability, 1 Factor

Items	Factor
	1
When searching, how familiar are you with Truncation?	.611
When searching, how familiar are you with Quotes?	.588
When searching, how familiar are you with Boolean logic?	.603
When searching, how familiar are you with Limit by publish date?	.877
When searching, how familiar are you with Limit by location?	.897
When searching, how familiar are you with Limit by type of information?	.898
When searching, how familiar are you with Limit by price?	.704
When searching, how familiar are you with Exclude specific sites?	.714
How confident - create query return only a few good results?	.521
How confident - create query that would return every useful result?	.607
How confident - find articles in quality same as expert searcher?	.691

Extraction Method: Maximum Likelihood. Eigenvalue = 2.
a. 1 factors extracted. 5 iterations required.

The results for these items were then combined and tested for reliability using Cronbach's alpha, giving an overall alpha of .917 for the 11 items. Individual items were also examined to determine the alpha scores if they were deleted (see Table 88). For all of these items, alpha goes down if they were removed. DeVellis (2012) specifies that scale items should be discarded only when their removal would elevate the overall Cronbach's alpha and also when their removal would substantially reduce the number of items in the scale. Using those criteria, all items should remain until further testing indicates otherwise.

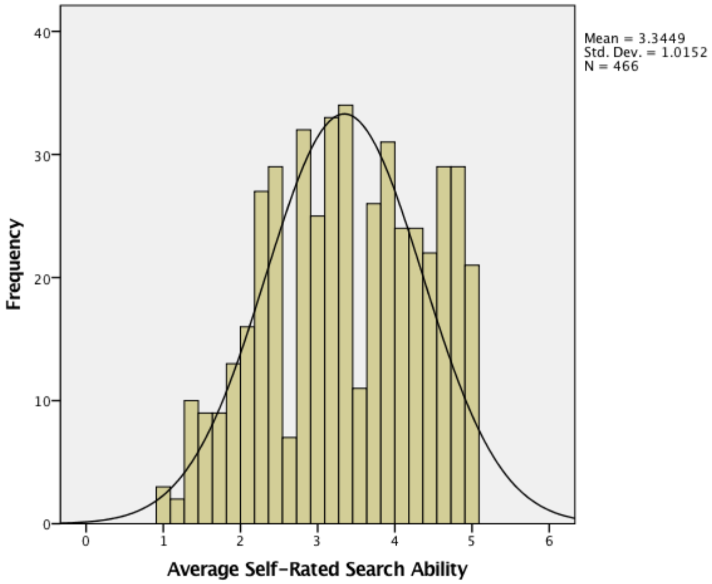
Table 88: Skill Item Cronbach’s Alpha Scores If Item Deleted



	Scale Mean if Item Deleted	Cronbach's Alpha if Item Deleted
When searching, how familiar are you with Truncation?	34.03	.912
When searching, how familiar are you with Quotes?	32.86	.913
When searching, how familiar are you with BOOLEAN logic (AND OR NOT)?	33.51	.913
When searching, how familiar are you with Limit by publish date?	33.34	.903
When searching, how familiar are you with Limit by location?	33.34	.903
When searching, how familiar are you with Limit by type of information?	33.35	.903
When searching, how familiar are you with Limit by price?	33.33	.913
When searching, how familiar are you with Exclude specific sites?	33.95	.909
If you needed to perform an online search, how confident are you that you could Create a query that would return only a few very useful documents?	33.38	.916
If you needed to perform an online search, how confident are you that you could Create a query that would return every useful document?	33.71	.913
If you needed to perform an online search, how confident are you that you could Find articles similar in quality to those obtained by a professional searcher?	33.14	.909

The high Cronbach’s alpha scores also provide support for gathering these scores together into a Self-Rated Search Ability score. This was done by summing the 11 scores together for each participant, then dividing by 11. The distribution of this average score is shown in Figure 28, showing a reasonably normal distribution. These Self-Rated Search Ability scores have a skewness of -0.210 (SE = 0.113), mostly normal/symmetric with a slight left skew. They have a kurtosis of -0.896 (SE = 0.226), indicating a light tailed distribution.

Figure 28: Self-Rated Search Ability Score Distribution



The Self-Rated Search Ability scores were also examined using a one-way Analysis of Variance (ANOVA) to examine the effect of group membership, with the result giving a significant effect at the $p < .01$ level [$F(3, 462)$, $p = 1.1954\text{E-}27$]. Each pairwise combination of groups was then examined for significant differences using Bonferroni post-hoc tests (see Table 88).

Table 89: Self-Rated Search Ability by Group

Source	N	Mean	Std. Deviation	Minimum	Maximum	Pairwise
ASIS&T	32	4.26	0.653	2.8182	5	> TURK, UNC
RUSA	50	4.52	0.477	3.0909	5	> TURK, UNC
TURK	147	3.11	0.998	1	5	< ASIS&T, RUSA
UNC	237	3.12	0.905	1.0909	5	< ASIS&T, RUSA
Total	466	3.34	1.105	1	5	

The results show a clear division between the RUSA and ASIS&T cohorts on one side and the TURK and UNC cohorts on the other side.

6.3.9 Skills

Unlike the previous section that asked for self-ratings of their abilities, this section of the instrument asked participants to select the proper tools or techniques to complete each task. The items in this section were all set up with the same listing of tools and techniques and allowed participants to select as many as they wished. Participants were instructed that they might choose as many as they wished but were also asked not to guess. The choices for each item were:

- Not sure
- Truncation
- Quotes
- Boolean AND
- Boolean OR
- Capitalize query terms
- Use dash/underscore
- Limit by publish date
- Limit by location
- Limit by type of information
- Limit by operating system
- Exclude specific sites
- Adding search terms
- Deleting search terms

Each item was initially intended to have one correct answer, but as seen in the cognitive interviews, there were alternative ways to answer the problems as posed. This illustrates the difficulty in creating skill challenges for online search without being specific on every aspect of the tool, the information need, and the context of that need. Rather than attempt to frame questions artificially, each question was re-examined for possibly correct answers. Those answers were also scored as correct. This resulted in items that had one, two, three, and six correct responses.

The items were scored based upon the participants' ability to select the correct responses and also their ability to avoid the incorrect responses. The scoring was a simple ratio with the number of correct responses selected by the participant divided by the sum of the total number of correct responses plus the number of incorrect responses selected by the participant. This ratio measures accuracy and scores the maximum 1 when the participant selects all available correct responses. Incorrect responses cause the score to decline rapidly, then level out somewhat. Failing to select all of the correct responses also causes the score to decline. Failing to choose any correct answer results in a score of zero no matter how many incorrect choices were selected. The score therefore has a range between zero and one.

This progression can be seen in Figures 29 – 32, with each figure showing the scoring progression based upon how many incorrect answers have been selected. Each line on the graphs represents the number of correct answers selected by the participant from the correct answers available. The scores for each skill item were added together to create the Search Skill Score. This will be examined for its use as a continuous variable after examination of the individual items. Note how selection of incorrect responses rapidly decreases the score, then levels out.

Figure 29: Scoring Curve for Items with One Correct Answer

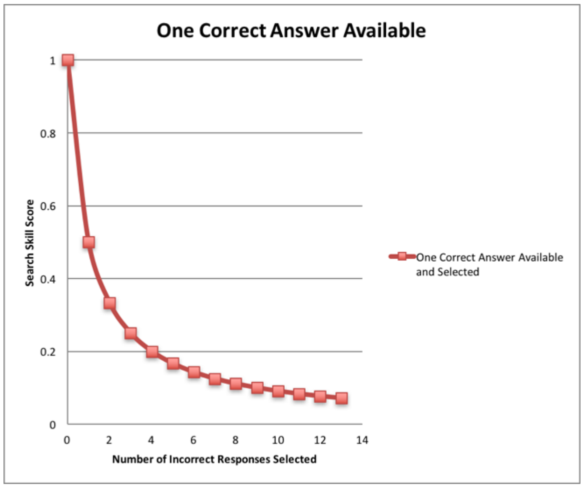


Figure 30: Scoring Curve for Items with Two Correct Answers

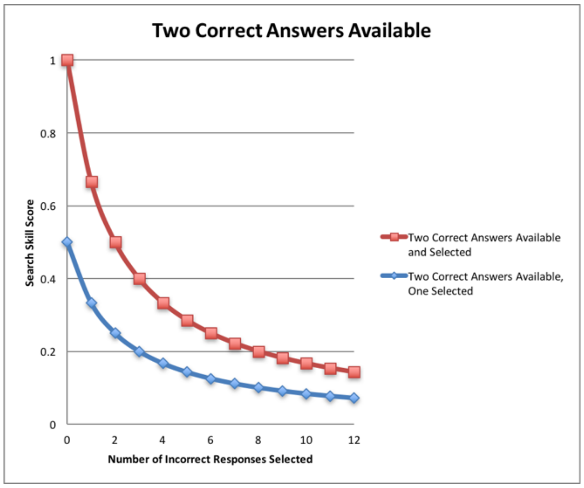


Figure 31: Scoring Curve for Items with Three Correct Answers

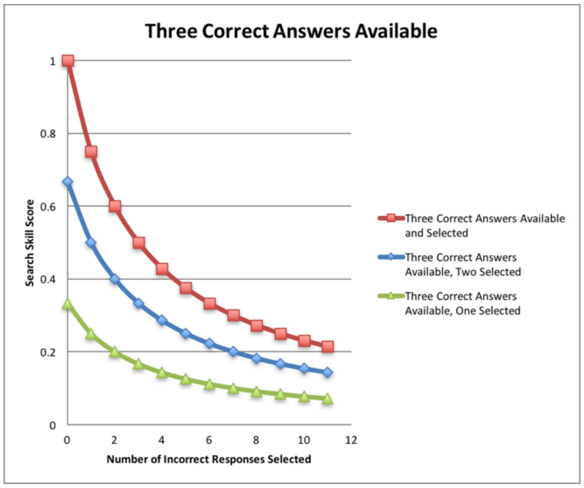
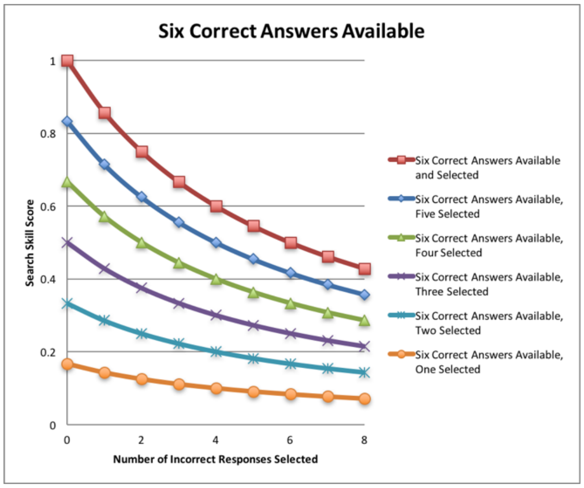


Figure 32: Scoring Curve for Items with Six Correct Answers



SKILL ITEM 1: Select the tools or techniques you would use to make sure that all the results contained both words typed into the search box. (select all that apply)

- Two correct answers: Boolean AND, Quotes

The RUSA cohort had the highest mean for this item and the TURK cohort had the lowest mean (see Table 90). The ANOVA for this item was significant [$F(3,462)=10.792$, $p < 0.01$], with pairwise differences: ASIS&T and RUSA with significantly higher means than TURK (p<.01), RUSA with a significantly higher mean than UNC (p<.01), and UNC with a significantly higher mean than TURK (p<.05).

Table 90: Scoring for Skill Item 1

Source	N	Mean	Std. Deviation
ASIS&T	32	.6688	.25498
RUSA	50	.6850	.28337
TURK	147	.4297	.32165
UNC	237	.5309	.33062
Total	466	.5250	.32836

SKILL ITEM 2: Select the tools or techniques you would use to make sure that you search for all forms of a word. (select all that apply)

- Two correct answers: Truncation, Adding search terms

The RUSA cohort had the highest mean and the TURK cohort had the lowest mean. The difference between those two groups appears even more pronounced here (see Table 91). The ANOVA for this item was significant [$F(3,462)=39.588$, $p < 0.01$], with pairwise differences: ASIS&T and RUSA with significantly higher means than both TURK and UNC (p<.01), and UNC with a significantly higher mean than TURK (p<.01).

Table 91: Scoring for Skill Item 2

Source	N	Mean	Std. Deviation
ASIS&T	32	.4271	.18422
RUSA	50	.4483	.11026
TURK	147	.1218	.19249
UNC	237	.2257	.24148
Total	466	.2307	.23724

SKILL ITEM 3: Select the tools or techniques you would use to search for words in a specific order. (select all that apply)

- One correct answer: Quotes

The highest mean was again with the RUSA cohort and the lowest with the TURK cohort (see Table 92). The ANOVA for this item was significant [$F(3,462)=19.514$, $p < 0.01$], with pairwise differences: ASIS&T and RUSA with significantly higher means than TURK and UNC (p<.01).

Table 92: Scoring for Skill Item 3

Source	N	Mean	Std. Deviation
ASIS&T	32	.7969	.37801
RUSA	50	.8383	.35412
TURK	147	.3505	.44995
UNC	237	.4699	.48190
Total	466	.4942	.47963

SKILL ITEM 4: Select the tools or techniques you would use to expand your results to include more choices. (select all that apply)

- Three correct answers: Boolean OR, Deleting search terms, Adding Search Terms (added in analysis)

This item is particularly interesting in that many of the participants selected Adding Search Terms as one of their answers. This was examined during analysis and determined to be an additional correct response due to possible use of synonyms. The means for this item appear much closer and the ANOVA was not significant. This item should be re-examined should it be included in future versions of the instrument.

Table 93: Scoring for Skill Item 4

Source	N	Mean	Std. Deviation
ASIS&T	32	.3305	.21606
RUSA	50	.3457	.21245
TURK	147	.3516	.23227
UNC	237	.3396	.22626
Total	466	.3434	.22545

SKILL ITEM 5: Select the tool or technique you would use to narrow your results to better choices. (select all that apply)

- Six correct answers: Adding search terms, Limit by publish date, Limit by location, Limit by type of information, Limit by operating system, Exclude specific sites

This item had many answers that could be correct, depending on the context. For this reason, the item should be reviewed before being included in future versions of the instrument. It is interesting to note that skill items four and five both involve adding or deleting search terms and that answers could differ depending on whether an AND or an OR are implied in the search interface. Although the RUSA cohort has the largest mean for this item, all of the means appear relatively close together. The ANOVA for this item was not significant.

Table 94: Scoring for Skill Item 5

Source	N	Mean	Std. Deviation
ASIS&T	32	.3370	.30924
RUSA	50	.4651	.29641
TURK	147	.3927	.29207
UNC	237	.3523	.27717
Total	466	.3761	.28764

The number of possibly correct answers on this item led to further analysis, examining the frequency in which the ‘Limit by’ answers were selected. It was anticipated that most participants who selected one of those ‘Limit by’ answers would also select the others, since they demonstrated their understanding of how limits were used in search. The results do show clearly that participants primarily selected either zero of the ‘Limit by’ choices or all four of the ‘Limit by’ choices (see Table 95 and Figure 33). Still, 38.5% of all participants selected choices other than all or none, suggesting that they did not perceive those responses to be similar.

Examining these items by group revealed that this result was not based upon group membership but true across all participants (see Table 96). This result could indicate that many participants viewed these as separate answers for this item rather than answers that were all related based upon understanding limits in search.

Table 95: Frequency of Number of 'Limit By' Answers for Skill Item 5

# of Choices Selected	Frequency	Percent
0	156	33.5
1	47	10.1
2	38	8.2
3	94	20.2
4	131	28.1
Total	466	100.0

Figure 33: Frequency of Number of 'Limit By' Answers for Skill Item 5

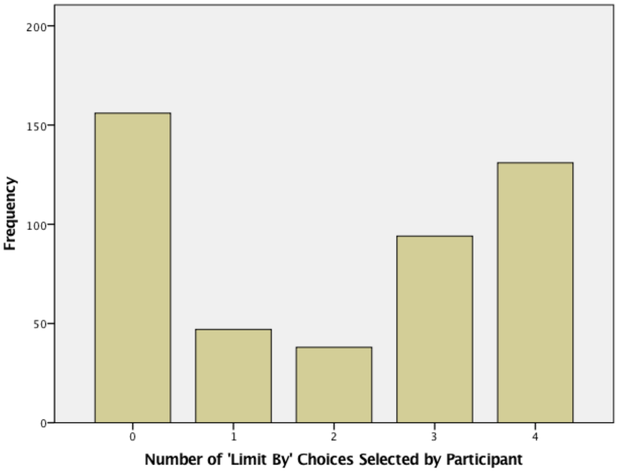
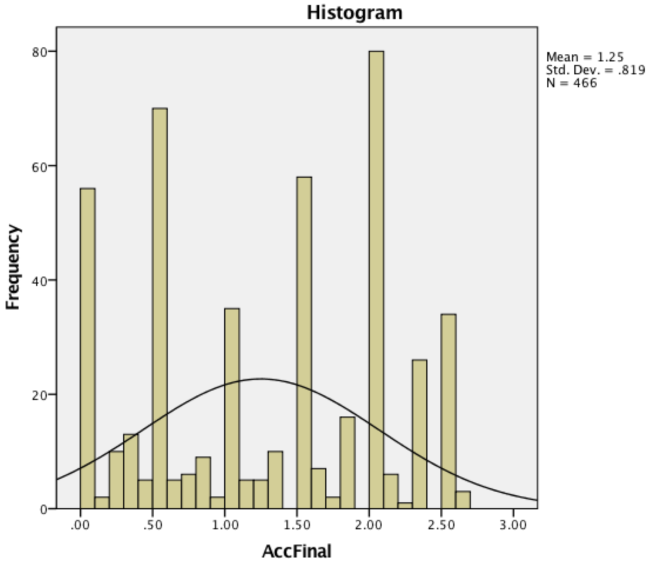


Table 96: Frequency of Number of 'Limit By' Answers for Skill Item 5, by Group

	ASIS&T	RUSA	TURK	UNC
0	13	13	45	85
1	3	5	10	29
2	2	4	16	16
3	7	11	32	44
4	7	17	44	63

Factor analysis was used to examine the five items further using maximum likelihood and no rotation. The first three skill items loaded together on one factor with loadings of 0.581, 0.595, and .692 respectively. The last 2 skill items did not load together. The first three skill items were then examined for internal consistency using Cronbach's alpha, with a score of 0.518 for those 3 items. The results of the ANOVAs, the internal consistency test, and the factor analysis led to the use of the first three skill items as the bases of a summated score, with the item scores added together into a Search Skill Score with 3 as the highest possible value and 0 as the lowest possible value. The shape of the distribution is not normal (see Figure 34), with spikes at scores that correspond to partially or completely correct answers on 1, 2, or 3 or the items.

Figure 34: Search Skill Score Distribution



The distributions were also examined across the four groups of participants (see Table 97). The table clearly shows that the RUSA and ASIS&T cohorts are different from the TURK and UNC cohorts in mean score. The ANOVA for this score was significant [$F(3,462)=34.554$, $p < 0.01$], with pairwise differences: ASIS&T and RUSA with significantly higher means than TURK and UNC ($p<.01$) and UNC with a significantly higher mean than TURK ($p<.01$). No significant difference was found between the means of the ASIS&T and RUSA cohorts. These findings offer additional evidence that the ASIS&T and RUSA groups can be considered experts based upon their group membership.

Table 97: Search Skill Score by Group

Source	N	Mean	Std. Deviation	Min	Max	Pairwise
ASIS&T	32	1.8927	.53740	.50	2.67	> TURK, UNC
RUSA	50	1.9717	.55318	.00	2.50	> TURK, UNC
TURK	147	0.9020	.74355	.00	2.50	< ASIS&T, RUSA, UNC
UNC	237	1.2265	.79787	.00	2.67	> TURK < RUSA, ASIS&T
Total	466	1.2498	.81925	.00	2.67	

The items from the self-rated search ability section and the skill item section included similar concepts, so the scores for these two sections were examined for correlation. Since the Search Skill Score is not normally distributed, Spearman's rho was used for this examination. The results indicate that there is a moderate correlation between Search Skill Score and Self-Rated Search Ability score [$r_s = 0.485$, $p < .01$].

The individual items from the Skill section and the Self-Rated Search Ability section were also examined pairwise where possible to evaluate how accurate a person's self-ratings were. For these examinations, the self-rated score was compared to whether the participant had selected the correct answer. The first skill item allowed two correct answers, Boolean AND or Quotes. For Boolean AND, Table 98 shows a clear progression for participants who selected the correct answer (1) as well as the reverse progression for those who did not (0). The Pearson's chi-square test for independence gives a significant ($p < .01$) value of 210.077 with 4 degrees of freedom.

Table 98: Comparison of Skill Item 1 and Self-Rated Search Ability: Boolean Logic

		When searching, how familiar are you with Boolean logic?					
		Not at all Familiar	Not Very Familiar	Somewhat Familiar	Reasonably Familiar	Extremely Familiar	Total
Skill Item 1: Boolean AND Selected?	0	96	25	19	16	7	163
	1	18	16	48	69	152	303
Total		114	41	67	85	159	466

Boolean logic was also used in skill item 4, where Boolean OR was allowed as a correct answer. Table 99 shows the progressions for those participants that selected Boolean OR as their answer (1) as well as those who did not (0). Far fewer participants selected Boolean OR as their answer than in the previous question regarding Boolean AND. This was true across all of the high familiarity categories but reversed for those with self-rated low familiarity. This could indicate increased difficulty for this question. The Pearson's chi-square test for independence was not significant.

Table 99: Comparison of Skill Item 4 and Self-Rated Search Ability: Boolean Logic

		When searching, how familiar are you with Boolean logic?					
		Not at all Familiar	Not Very Familiar	Somewhat Familiar	Reasonably Familiar	Extremely Familiar	Total
Skill Item 4: Boolean OR Selected?	0	76	24	43	50	88	281
	1	38	17	24	35	71	185
Total		114	41	67	85	159	466

For Quotes, Table 100 shows the progressions for those participants who selected Quotes as their answer (1) for skill item 1 and those who did not (0). Although the progression is not as clear as in the prior example of Boolean AND, the Pearson's chi-square test for independence gives a significant ($p < .01$) value of 152.581 with 40 degrees of freedom.

Table 100: Comparison of Skill Item 1 and Self-Rated Search Ability: Quotes

		When searching, how familiar are you with Quotes?					
		Not at all Familiar	Not Very Familiar	Somewhat Familiar	Reasonably Familiar	Extremely Familiar	Total
Skill Item 1: Quotes Selected	0	37	10	26	57	91	221
	1	10	10	39	60	126	245
Total		47	20	65	117	217	466

Skill item 3 also allowed Quotes as a correct answer. For this question, those expressing low levels of familiarity obviously did not select the correct answer of Quotes, while those with high level of familiarity did select Quotes (see Table 101). Those reporting Somewhat and

Reasonably Familiar were split. The Pearson's chi-square test for independence gives a significant ($p < 0.01$) value of 95.908 with 4 degrees of freedom. With both skill items regarding quotes reporting significant chi-square values related to the self-rated familiarity with quotes, these items appear to reasonably correlate.

Table 101: Comparison of Skill Item 3 and Self-Rated Search Ability: Quotes

		When searching, how familiar are you with Quotes?					
		Not at all Familiar	Not Very Familiar	Somewhat Familiar	Reasonably Familiar	Extremely Familiar	Total
Skill Item 3: Quotes Selected	0	39	20	39	58	53	209
	1	8	0	26	59	164	257
Total		47	20	65	117	217	466

Moving on to truncation, it was an allowed answer for only skill item 2. Table 102 shows a clear progression for participants who selected the correct answer (1) as well as the reverse progression for those who did not (0). The Pearson's chi-square test for independence gives a significant ($p < 0.01$) value of 178.935 with 4 degrees of freedom.

Table 102: Comparison of Skill Item 2 and Self-Rated Search Ability: Truncation

		When searching, how familiar are you with Truncation?					
		Not at all Familiar	Not Very Familiar	Somewhat Familiar	Reasonably Familiar	Extremely Familiar	Total
Skill Item 2: Truncation Selected?	0	140	46	47	25	11	269
	1	10	17	40	54	76	197
Total		150	63	87	79	87	466

The last skill item allowed a number of correct answers. While not all of the correct answers for this skill item were also part of the self-rated ability section, several pairs can be examined. These are Limit by Publish Date, Limit by Location, Limit by Type of Information, and Exclude Specific Sites. None of the Pearson's chi-square tests for independence for these answers were significant**.** Since all of these were allowable correct answers for the same item, and since participants did not consistently select either all or none of these, the results from these tests must be considered inconclusive. This could indicate that participants were just guessing on this item, or it could be a result of the difficulty in testing for limiting items in search.

Use of the Search Skill Score in future versions of the instrument is indicated based upon the significant results above, but it should be cautioned that this scoring method is preliminary and will need further examination and validation.

6.3.10 Personality

A number of personality related questions were used from the International Personality Item Pool (IPIP). All items used the same Likert scale from 1 (Very Inaccurate) to 5 (Very Accurate). All negative items were reversed by subtracting the value from six. All values shown are the resulting positive values. Table 103 shows a list of all the subscales that were used in this research, the number of items in each subscale, the Cronbach's Alpha reported for the subscales on the IPIP website, and the Cronbach's Alpha for the data in this study.

Table 103: Reliability of Personality Subscales

Subscale (Construct from Experts)	Items	Source	IPIP Alpha	Alpha from Instrument
Resourcefulness (Analytical)	10	6FPQ	0.81	0.853
Low Self-Efficacy (Confidence)	9	TCI	0.77	0.843
Creativity/Originality (Creativity)	8	VIA	0.85	0.897
Inquisitiveness (Curiosity)	10	HEXACO	0.78	0.812
Efficiency (Efficient)	11	AB5C	0.907	0.914
Quickness (Flexibility)	10	AB5C	0.84	0.874
Diligence (Motivation)	10	HEXACO	0.81	0.877
Organization (Organized)	12	AB5C	0.78	0.858
Industry/Perseverance/Persistence (Persistence)	7	VIA	0.81	0.825
Competence (Problem Solver)	9	TCI	0.75	0.863

The alphas in this research support the values from the IPIP website, giving evidence of reliability for the subscales. None of the alphas from this research were lower than those previously reported. These values were also used to test reliability over all of the personality section, with a Cronbach's Alpha score of 0.918.

The scores for each individual subscale item were summed then divided by the number of items in that subscale to create an overall mean score for that subscale (see Table 104). The scores for these items range from 1 to 5, with value 3 for the middle choice. The Organization subscale is interesting in that its minimum value is noticeably larger than the other subscales. This difference could indicate that participants considered themselves as having more of that quality or that the items from that subscale elicit higher ratings. These mean scores were examined across cohorts (see Table 105), but there were no statistically significant differences from that ANOVA. These mean scores were also examined by comparing them to the Search Skill scores, but there were no significant correlations between them. They were then compared to the Self-Rated Search Ability scores, but again there were no significant correlations.

Table 104: Personality Subscale Means

Construct	Items	Mean	Std. Deviation	Minimum	Maximum
Resourcefulness (Analytical)	10	4.0197	.56576	1.00	5.00
Low Self-Efficacy (Confidence)	9	3.8693	.67102	1.56	5.00
Creativity/Originality (Creativity)	8	3.8694	.72346	1.00	5.00
Inquisitiveness (Curiosity)	10	3.8946	.63469	1.20	5.00
Efficiency (Efficient)	11	3.8121	.72731	1.18	5.00
Quickness (Flexibility)	10	4.1785	.55939	1.60	5.00
Diligence (Motivation)	10	4.2052	.60679	1.40	5.00
Organization (Organized)	12	4.3646	.46250	2.42	5.00
Industry/Perseverance/Persistence (Persistence)	7	4.0941	.60973	1.00	5.00
Competence (Problem Solver)	9	4.2406	.54823	1.22	5.00

Table 105: Personality Subscale Means by Cohort

	Total	ANOVA df 3,462	ASIS&T (n=32)		RUSA (n=50)		TURK (n=147)		UNC (n=237)	
IPIP Subscale	**Mean (St. Dv.)**	***F* Sig.**	**Mean (St. Dv.)**	**Min. Max.**	**Mean (St. Dv.)**	**Min. Max.**	**Mean (St. Dv.)**	**Min. Max.**	**Mean (St. Dv.)**	**Min. Max.**
Resourcefulness	4.0197 (.56576)	.507 .678	4.0031 (.57389)	2.40 4.90	4.0540 (.60245)	2.60 5.00	3.9748 (.52575)	1.60 5.00	4.0426 (.58222)	1.00 5.00
Low Self-Efficacy	3.8693 (.67102)	.291 .832	3.9479 (.59064)	2.33 4.89	3.9022 (.70618)	2.11 5.00	3.8382 (.69696)	1.78 5.00	3.8711 (.66004)	1.56 5.00
Creativity/ Originality	3.8694 (.72346)	.308 .820	3.8867 (.60937)	2.25 4.88	3.7775 (.87602)	1.00 5.00	3.8869 (.65743)	2.00 5.00	3.8755 (.74411)	1.13 5.00
Inquisitiveness	3.8946 (.63469)	.060 .981	3.8906 (.51328)	2.80 4.90	3.8760 (.78755)	1.20 5.00	3.9122 (.60158)	2.00 4.90	3.8882 (.63728)	1.20 5.00
Efficiency	3.8121 (.72731)	1.885 .131	3.5597 (.84876)	1.45 5.00	3.9200 (.71053)	2.18 5.00	3.7817 (.68061)	2.18 5.00	3.8423 (.73732)	1.18 5.00
Quickness	4.1785 (.55939)	.264 .852	4.2531 (.46834)	3.20 5.00	4.1860 (.67067)	2.50 5.00	4.1571 (.54810)	2.80 5.00	4.1802 (.55448)	1.60 5.00
Diligence	4.2052 (.60679)	1.297 .275	4.1187 (.75067)	1.60 5.00	4.3220 (.58599)	3.00 5.00	4.2422 (.53851)	2.60 5.00	4.1692 (.62824)	1.40 5.00
Organization	4.3646 (.46250)	.844 .471	4.3568 (.42504)	3.67 5.00	4.3700 (.48712)	2.92 5.00	4.4121 (.42868)	2.83 5.00	4.3351 (.48217)	2.42 5.00
Industry/ Perseverance/ Persistence	4.0941 (.60973)	.745 .525	4.0536 (.72458)	1.43 5.00	4.2143 (.54168)	2.43 5.00	4.0807 (.55178)	2.43 5.00	4.0826 (.64089)	1.00 5.00
Competence	4.2406 (.54823)	.248 .863	4.2326 (.59693)	2.67 5.00	4.2378 (.57231)	2.78 5.00	4.2721 (.48974)	2.78 5.00	4.2227 (.57276)	1.22 5.00

6.3.11 Factor Analysis of Personality Subscales

Factor analysis was used to verify the loadings for the Personality subscales and also to examine the self-rated ability items for underlying constructs. The personality subscales were examined using confirmatory factor analysis, which examines relationships that have already been detailed or used previously. The items from the IPIP subscales were examined using maximum likelihood, which as previously noted provides a wide range of indexes, provided that the population of the study are normally distributed. Factors with eigenvalues greater than one were initially retained for comparisons, then examined using Scree tests to plot the eigenvalues of the factors so that a natural bend could be located where the curve begins to flatten. Rotations are used within factor analysis to simplify the data structure, although they do not change the underlying variance of the items (Costello & Osborne, 2005). Extracted factors were first examined with no rotation and then examined using the common varimax rotation where indicated. Factor loadings for individual items used a threshold of 0.5 throughout, based upon Nunnally's (1978) guidelines, although this limit is not a hard and fast rule.

First, all personality items were examined using eigenvalues at the default (1) and maximum likelihood. A partial table is shown in Table 106. Full results are in Appendix K in Table 125.

Table 106: Partial Results – Factor Analysis of Personality Items

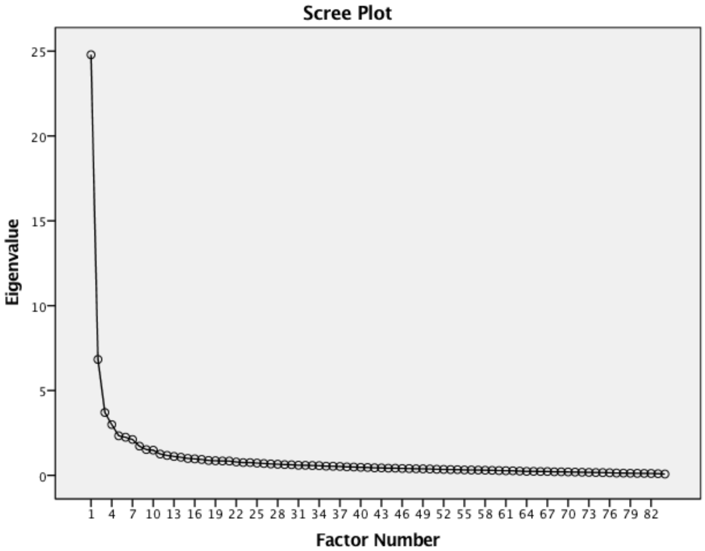
Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Factor	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	24.786	29.508	29.508	24.252	28.872	28.872
2	6.830	8.131	37.638	6.184	7.362	36.233
3	3.707	4.413	42.051	3.146	3.745	39.978
4	2.991	3.561	45.612	2.572	3.062	43.040
5	2.331	2.775	48.388	1.736	2.067	45.107
6	2.245	2.673	51.060	1.910	2.273	47.380
7	2.113	2.516	53.576	1.709	2.035	49.415
8	1.721	2.049	55.624	1.426	1.697	51.112
9	1.518	1.807	57.432	1.272	1.514	52.626
10	1.486	1.770	59.201	1.257	1.496	54.122
11	1.258	1.497	60.699	.747	.889	55.011
12	1.174	1.397	62.096	.837	.997	56.008
13	1.114	1.326	63.422	.745	.887	56.895
14	1.065	1.268	64.690	.565	.672	57.568

Extraction Method: Maximum Likelihood. Eigenvalue=1.

The resulting Scree plot was then examined (see Figure 35) for the shape of the curve. It was expected that this examination would result in ten factors, since there were ten known subscales used from IPIP. Looking at the table above, the difference in variance explained goes from a delta of 1.496 between 9 and 10 factors to a delta of 0.889 between 10 and 11 factors. The scree plot shows a greater change in the curve between 4 and 7, but an eigenvalue of 1.4 was selected to fit the data from the table as well as the number of known subscales.

Figure 35: Scree Plot – Personality Items



The factor analysis was run again, this time using eigenvalue=1.4, maximum likelihood, and the varimax rotation. This resulted in 10 total factors explaining a total of 53.838% of the variance. A partial table is shown in Table 107. Full results are in Appendix K in Table 126.

Table 107: Partial Results: Factor Analysis of Personality Items, Eigenvalue 1.4

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Factor	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	24.786	29.508	29.508	24.158	28.760	28.760	8.360	9.952	9.952
2	6.830	8.131	37.638	6.180	7.358	36.117	5.144	6.124	16.076
3	3.707	4.413	42.051	3.032	3.610	39.727	5.048	6.010	22.086
4	2.991	3.561	45.612	2.622	3.122	42.849	4.832	5.752	27.837
5	2.331	2.775	48.388	1.792	2.134	44.983	4.540	5.404	33.242
6	2.245	2.673	51.060	1.907	2.270	47.253	3.940	4.690	37.932
7	2.113	2.516	53.576	1.737	2.068	49.321	3.912	4.657	42.589
8	1.721	2.049	55.624	1.437	1.711	51.032	3.818	4.546	47.134
9	1.518	1.807	57.432	1.106	1.316	52.348	3.585	4.268	51.402
10	1.486	1.770	59.201	1.251	1.489	53.838	2.046	2.435	53.838

Extraction Method: Maximum Likelihood. Eigenvalue=1.4. Varimax Rotation.

Rather than examine these ten factors for the items loading on them, as in exploratory factor analysis, for confirmatory factor analysis, the resulting rotated factor matrix was then examined by individual subscale. This process is used to verify that the subscales represent the underlying construct as expected. The subscales will be examined in factor order for clarity, although the number of the factor does not imply any hierarchy. Throughout the presentation of these results, the highest loading for each item is shaded, even when it does not meet the 0.5 threshold.

The first subscale to be examined was Efficiency, which had eight of its eleven items loading on factor 1 (see Table 108) using the 0.5 threshold. Two of the items loaded with higher values on factor 10 but also loaded on factor 1 with values of .516 and .482 respectively. One item, shared with the Diligence subscale, did not reach the threshold for any factor. This provides some evidence that these items could represent the Efficiency construct.

All eight items from the Creativity/Originality subscale loaded on factor 2 above the .5 threshold (see Table 109), giving strong support that the items represent that construct.

All 10 items from the Inquisitiveness subscale had their highest loadings on factor 3, although only three of them loaded above the .5 threshold (see Table 110). There is limited evidence here to support these items as representing the Inquisitiveness construct.

Many of the 10 items from the Diligence subscale load on factor 4 above the .5 threshold, but the other items from this subscale have scattered high values on multiple factors (see Table 111). This result could indicate a lack of support for these items taken together as representing an underlying construct.

Table 108: Rotated Factors: Efficiency Subscale Items

Items	Factor									
	1	2	3	4	5	6	7	8	9	10
I finish what I start.	.482	.081	.123	.355	.137	.081	.192	.101	.045	.514
I follow through with my plans.	.516	.117	.094	.212	.140	.068	.201	.091	.115	.597
I get chores done right away.	.662	.032	.003	.007	.002	.127	.136	.024	.003	.212
I make plans and stick to them.	.551	.065	.105	.007	.071	.069	.093	.123	.124	.472
I find it difficult to get down to work. (Reverse)	.647	.046	-.017	.235	.106	.135	.063	.048	.054	.068
I frequently forget to do things. (Reverse)	.600	-.019	.118	.079	.056	.052	.004	.223	.089	.052
I have difficulty starting tasks. (Reverse)	.826	.052	.019	.124	.153	.216	.089	.062	.059	-.091
I need a push to get started. (Reverse)	.714	.041	.124	.240	.159	.203	.096	.098	.029	-.083
I postpone decisions. (Reverse)	.690	.109	.060	.143	.098	.286	.075	.034	.006	.021
I waste my time. (Reverse)	.728	.085	.000	.192	.062	.220	.133	.020	.050	-.017
I am exacting in my work. (also on Diligence subscale)	.189	.080	.123	.159	.041	-.097	.249	.420	.056	.122

Extraction Method: Maximum Likelihood. Rotation Method: Varimax with Kaiser Normalization. a. Rotation converged in 8 iterations.

Table 109: Rotated Factors: Creativity/Originality Subscale Items

Items	Factor									
	1	2	3	4	5	6	7	8	9	10
I am able to come up with new and different ideas.	.081	.712	.247	.023	.244	.121	.202	.090	.164	.064
I am an original thinker.	.124	.774	.260	-.003	.139	.079	.143	.114	.185	.057
I come up with new ways to do things.	.043	.727	.225	.089	.250	.127	.153	.095	.138	.046
I have an imagination that stretches beyond that of my friends.	.057	.619	.162	-.054	.173	-.019	-.025	.041	.112	.015
I like to think of new ways to do things.	.066	.707	.238	.034	.203	.148	.144	.093	.127	.059
I am not considered to have new and different ideas. (Reverse)	.063	.509	.197	.220	.101	.166	-.019	.101	.132	.028
I don't pride myself on being original. (Reverse)	.057	.575	.175	.151	.069	.084	.020	.105	.062	-.017
I have no special urge to do something original. (Reverse)	.036	.554	.258	.175	.054	.011	.126	.062	.049	-.002

Extraction Method: Maximum Likelihood. Rotation Method: Varimax with Kaiser Normalization. a. Rotation converged in 8 iterations.

Table 110: Rotated Factors: Inquisitiveness Subscale Items

Items	Factor									
	1	2	3	4	5	6	7	8	9	10
I am interested in Science.	.000	.082	.423	-.058	.046	.140	.078	-.021	.016	.014
I enjoy intellectual games.	.035	.120	.472	.024	.163	.086	.148	.110	.142	.147
I find political discussions interesting.	.050	.163	.496	.004	.008	-.149	.126	-.021	.011	-.041
I have a rich vocabulary.	.026	.219	.474	.024	.151	-.031	.027	.193	.223	.040
I love to read challenging material. (also on Quickness subscale)	.102	.179	.711	-.033	.088	.001	.161	.061	.116	.106
I would love to explore strange places.	-.062	.312	.349	.014	.198	.115	.075	-.036	-.064	.121
I avoid difficult reading material. (Reverse) (also on Quickness subscale)	.131	.080	.694	.087	.056	.077	.018	.153	.142	.085
I don't bother worrying about political and social problems. (Reverse)	-.085	.125	.425	.287	-.045	-.112	.054	.024	.056	-.059
I don't know much about history. (Reverse)	.099	.154	.469	.133	.068	.046	-.029	.048	-.005	-.038
I will not probe deeply into a subject. (Reverse)	-.044	.266	.500	.156	.046	.032	-.002	.142	.075	-.018

Extraction Method: Maximum Likelihood. Rotation Method: Varimax with Kaiser Normalization. a. Rotation converged in 8 iterations.

Table 111: Rotated Factors: Diligence Subscale Items

Items	Factor									
	1	2	3	4	5	6	7	8	9	10
I complete tasks successfully. (also on Organization Subscale)	.271	.157	.124	.166	.280	.106	.260	.204	.296	.279
I get started quickly on doing a job.	.695	.114	-.027	.082	.152	.128	.208	.136	.089	.085
I push myself very hard to succeed.	.325	.169	.139	.300	.101	.018	.551	.151	.079	.065
I work hard.	.313	.120	.137	.388	.077	-.001	.651	.120	.104	.039
I do just enough work to get by. (Reverse)	.180	.096	.078	.603	-.002	.071	.329	.061	.003	-.015
I do too little work. (Reverse)	.352	.113	.002	.586	.062	.127	.176	.095	.071	.066
I hang around doing nothing. (Reverse)	.364	.099	.051	.517	-.014	.131	.222	.047	.016	-.029
I quickly lose interest in the tasks I start. (Reverse)	.474	.071	.103	.485	.115	.128	.104	.107	.042	.119
I stop when work becomes too difficult. (Reverse)	.309	.128	.121	.589	.172	.238	.115	.073	.037	.202
I am exacting in my work. (also on Efficiency subscale)	.189	.080	.123	.159	.041	-.097	.249	.420	.056	.122

Extraction Method: Maximum Likelihood. Rotation Method: Varimax with Kaiser Normalization. a. Rotation converged in 8 iterations.

Six of the 10 items from the Resourcefulness subscale loaded together on factor 5 using the .5 threshold value (see Table 112). Of the four items that did not load with the rest, three of them were shared with other subscales used in this research, and two of the items still loaded at .301 and .387 on this subscale. This result provides limited support that the items could represent the Resourcefulness construct.

Four of the 9 items on the Low Self-Efficacy subscale loaded on factor 6 above the .5 threshold (see Table 113). Two of the three items that did not meet the threshold criteria were items shared with the Resourcefulness subscale and show higher loadings for that subscale. This gives some limited evidence that at least some of the items in this subscale could represent the same underlying construct.

The seven items from the Industry/Perseverance/Persistence subscale did not load above the .5 threshold on any one particular factor (see Table 114). This result could indicate that the items do not represent an underlying construct when taken together.

Four of the 12 items from the Organization subscale load on factor 8 above the .5 threshold and other items have their highest values for factor 8 (see Table 115). Still, the scattered nature of the remaining items indicates very limited support that these items together represent some construct.

The Quickness subscale had four items with their highest values on factor 3, but four other items loaded on factor 9 (see Table 116). Further examination shows that two of the items loading on factor 3 are shared with the Inquisitiveness subscale. Still, there is only very limited evidence that the items in this subscale together represent some underlying construct.

Table 112: Rotated Factors: Resourcefulness Subscale Items

Items	Factor									
	1	2	3	4	5	6	7	8	9	10
I am good at many things.	.117	.301	.121	-.023	.601	.146	.086	.075	.133	.012
I can handle lots of information. (also on Quickness subscale)	.147	.174	.210	.001	.682	.065	.015	.129	.271	-.013
I can manage many things at the same time. (also on Low Self-Efficacy subscale)	.227	.114	.055	.089	.606	.070	.074	.108	.194	.041
I can perform a wide variety of tasks. (also on Competence subscale)	.061	.200	.104	.133	.774	.056	.041	.149	.147	.051
I can tackle anything. (also on Low Self-Efficacy subscale)	.199	.257	.090	.014	.535	.173	.118	.032	.116	.085
I can work under pressure.	.122	.150	.160	.211	.511	.236	.244	.034	.170	.134
I like to solve complex problems. (also on Competence subscale)	.002	.281	.421	.044	.387	.229	.214	.035	.217	-.004
I need things explained only once.	.200	.144	.207	-.012	.301	.141	.013	.079	.333	.041
I don't pay attention. (Reverse) (also on Organization subscale)	.435	-.009	.099	.224	.031	.022	-.128	.207	.065	.083
I give up easily. (Reverse) (also on Industry/Perseverance/ Persistence and Competence subscales)	.258	.125	.249	.343	.209	.251	.095	.176	.046	.193

Extraction Method: Maximum Likelihood. Rotation Method: Varimax with Kaiser Normalization. a. Rotation converged in 8 iterations.

Table 113: Rotated Factors: Low Self-Efficacy Subscale Items

Items	Factor									
	1	2	3	4	5	6	7	8	9	10
I am afraid of many things. (Reverse)	.151	.066	.130	.149	.090	.626	-.035	.049	.039	-.004
I am often down in the dumps. (Reverse)	.291	.116	.012	.150	.117	.695	.097	.034	.067	.078
I become overwhelmed by events. (Reverse)	.267	.108	.076	.105	.127	.742	-.020	.007	.004	.036
I feel that I am unable to deal with things. (Reverse)	.310	.113	.072	.202	.168	.723	.034	.070	.078	.077
I need reassurance. (Negative)	.313	.069	-.012	.041	.040	.485	.025	-.004	.155	-.013
I readily overcome setbacks.	.196	.259	.116	.079	.174	.364	.225	.040	.171	.160
I think quickly.	.161	.248	.217	-.087	.296	.176	.148	.061	.455	-.012
I can manage many things at the same time. (also on Resourcefulness subscale)	.227	.114	.055	.089	.606	.070	.074	.108	.194	.041
I can tackle anything. (also on Resourcefulness subscale)	.199	.257	.090	.014	.535	.173	.118	.032	.116	.085

Extraction Method: Maximum Likelihood. Rotation Method: Varimax with Kaiser Normalization. a. Rotation converged in 8 iterations.

Table 114: Rotated Factors: Industry/Perseverance/Persistence Subscale Items

Items	Factor									
	1	2	3	4	5	6	7	8	9	10
I am a goal-oriented person.	.384	.131	.116	.169	.136	.079	.551	.071	.073	.104
I am a hard worker.	.295	.119	.096	.431	.086	.007	.609	.182	.070	.064
I don't get sidetracked when I work.	.552	.007	-.002	.133	.088	.100	.207	.033	.052	.044
I don't quit a task before it is finished.	.445	.036	.000	.193	.005	.067	.254	.125	.092	.290
I finish things despite obstacles in the way.	.283	.103	.197	.329	.183	.204	.365	.196	.120	.314
I don't finish what I start. (Reverse)	.307	.026	.113	.529	.042	.168	.139	.145	.122	.325
I give up easily. (Reverse) (also on Resourcefulness and Competence subscales)	.258	.125	.249	.343	.209	.251	.095	.176	.046	.193

Extraction Method: Maximum Likelihood. Rotation Method: Varimax with Kaiser Normalization. a. Rotation converged in 8 iterations.

Table 115: Rotated Factors: Organization Subscale Items

Items	Factor									
	1	2	3	4	5	6	7	8	9	10
I demand quality.	.102	.091	.166	.176	.086	-.069	.443	.402	.077	.081
I detect mistakes.	.050	.122	.127	.039	.133	.023	.120	.561	.113	.074
I follow through on my commitments.	.340	.096	.055	.222	.089	.127	.234	.261	.187	.332
I have an eye for detail.	.194	.114	.068	.042	.103	.069	.051	.861	.085	.041
I make well-considered decisions.	.294	.057	.170	.184	.141	.107	.207	.310	.117	.204
I pay attention to details.	.185	.063	.024	.128	.062	.038	.140	.810	.099	.033
I set high standards for myself and others.	.132	.198	.128	.161	.218	.040	.490	.377	.100	.125
I think ahead.	.223	.177	.117	.100	.161	.112	.263	.317	.141	.086
I put little time and effort into my work. (Reverse)	.120	.033	.133	.562	.003	.048	.101	.113	.037	-.060
I seldom notice details. (Reverse)	.068	.122	.067	.432	.055	.130	-.038	.620	.147	-.107
I complete tasks successfully. (also on Diligence subscale)	.271	.157	.124	.166	.280	.106	.260	.204	.296	.279
I don't pay attention. (Reverse) (also on Resourcefulness subscale)	.435	-.009	.099	.224	.031	.022	-.128	.207	.065	.083

Extraction Method: Maximum Likelihood. Rotation Method: Varimax with Kaiser Normalization. a. Rotation converged in 8 iterations.

Table 116: Rotated Factors: Quickness Subscale Items

Items	Factor									
	1	2	3	4	5	6	7	8	9	10
I am able to find out things by myself.	-.059	.193	.202	.203	.274	.034	.086	.175	.433	.062
I am quick to understand things.	.133	.190	.183	.116	.358	.096	.060	.179	.678	.040
I can handle complex problems.	.086	.224	.348	.121	.413	.166	.271	.121	.382	.057
I catch on to things quickly.	.148	.201	.167	.065	.232	.087	.111	.155	.818	.074
I quickly get the idea of things.	.115	.247	.166	.091	.261	.095	.133	.169	.803	.094
I don't understand things. (Reverse)	.124	.190	.394	.217	.212	.175	-.094	.123	.245	.072
I try to avoid complex people. (Reverse)	.026	.112	.603	.176	.102	.142	.008	.007	.066	.036
I love to read challenging material. (also on Inquisitiveness subscale)	.102	.179	.711	-.033	.088	.001	.161	.061	.116	.106
I avoid difficult reading material. (Reverse) (also on Inquisitiveness subscale)	.131	.080	.694	.087	.056	.077	.018	.153	.142	.085
I can handle lots of information. (also on Resourcefulness subscale)	.147	.174	.210	.001	.682	.065	.015	.129	.271	-.013

Extraction Method: Maximum Likelihood. Rotation Method: Varimax with Kaiser Normalization. a. Rotation converged in 8 iterations.

The nine items in the Competence subscale do not show evidence of an underlying construct (see Table 117).

Table 117: Rotated Factors: Competence Subscale Items

Items	Factor									
	1	2	3	4	5	6	7	8	9	10
I accept challenging tasks.	.197	.285	.383	.155	.229	.294	.377	.125	.235	.125
I feel up to any task.	.300	.221	.201	.061	.288	.374	.259	.050	.166	.112
I know how to apply my knowledge.	.184	.134	.305	.141	.278	.233	.311	.235	.224	.082
I meet challenges.	.231	.186	.284	.157	.309	.351	.412	.154	.192	.196
I don't put my mind on the task at hand. (Reverse)	.261	.048	.111	.434	.140	.161	.070	.163	.048	.218
I don't see things through. (Reverse)	.339	-.002	.101	.508	.103	.199	.111	.177	.065	.341
I can perform a wide variety of tasks. (also on Resourcefulness subscale)	.061	.200	.104	.133	.774	.056	.041	.149	.147	.051
I like to solve complex problems. (also on Resourcefulness subscale)	.002	.281	.421	.044	.387	.229	.214	.035	.217	-.004
I give up easily. (Reverse) (also on Industry/Perseverance/Persistence and Competence subscales)	.258	.125	.249	.343	.209	.251	.095	.176	.046	.193

Extraction Method: Maximum Likelihood. Rotation Method: Varimax with Kaiser Normalization. a. Rotation converged in 8 iterations.

The results are summarized in Table 118. The subscale for Creativity is the only subscale to provide strong support for construct validity, although limited support is indicated for the subscales of Efficiency, Inquisitiveness, Resourcefulness, and Low Self-Efficacy. The remaining subscales had no or very limited support for construct validity.

Table 118: Subscale Item Factor Analysis Results

Subscale from IPIP	Factor	Construct Validity Support
Efficiency	1	limited support
Creativity	2	strong support
Inquisitiveness	3	limited support
Diligence	4	very limited support
Resourcefulness	5	limited support
Low Self-Efficacy	6	limited support
--	7	
Organization	8	very limited support
Quickness	9	very limited support
--	10	
Industry/Perseverance/Persistence	--	no support
Competence	--	no support

Since the subscales and items examined in this factor analysis were previously examined by the IPIP organization, the Goodness-of Fit Test was also conducted for this confirmatory factor analysis, returning a Chi-square value of 5217.190 with 2691 degrees of freedom and a *p*-value less than .001. This result indicates some support that the 10-factor model based upon both the scree plot and the IPIP number of subscales fits the data, although as noted above, the factors do not seem to line up as expected with the subscales.

Factors 7 and 10 from the analysis were further examined since none of the expected constructs loaded there. Factor 7 had two items from the Diligence subscale and two items from the Industry/Perseverance/Persistence subscale, all four items related to hard work. Factor 10 lists only two items from the Efficiency subscale, both related to finishing or following through with plans. It should be noted that all items were displayed to all participants in the same order. This could have led to additional patterns in the data that were confounding and unexpected.

Once the examination of the Personality items was completed, the items from the Self-Rated Search Ability section were added to the factor analysis in order to examine their effects. Note that these items all loaded above the threshold when examined separately and gave strong indication that they represented an underlying construct. A partial table of the factor analysis including both the personality and self-rated items is shown in Table 119. Full results are in Appendix K in Table 127.

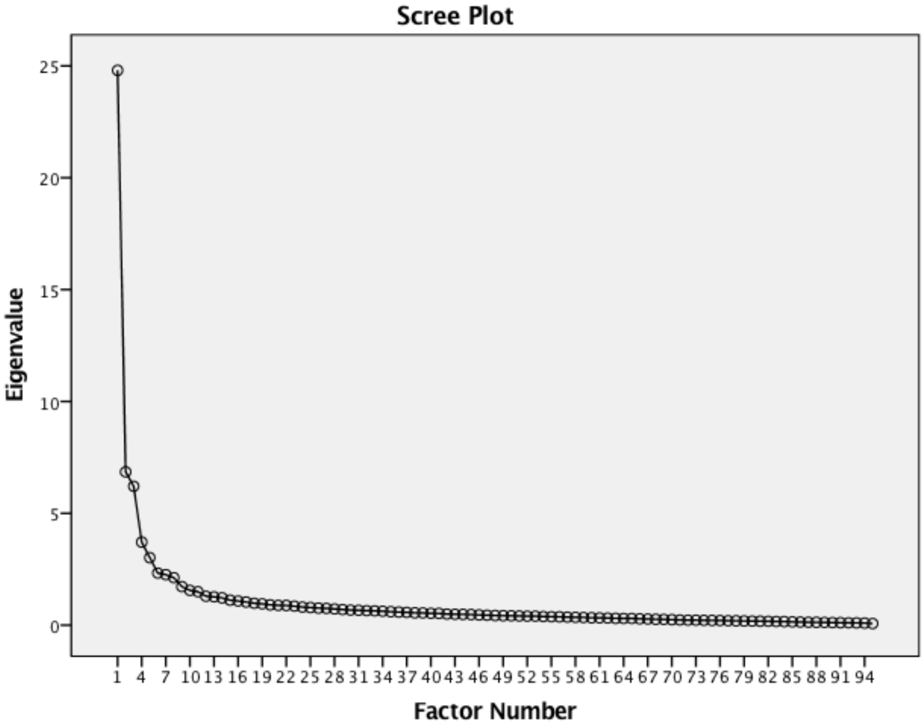
Table 119: Partial Results – Factor Analysis of Personality and Self-Rated Search Ability Items

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Factor	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	24.801	26.106	26.106	24.269	25.546	25.546
2	6.851	7.212	33.318	5.848	6.155	31.701
3	6.210	6.537	39.855	6.189	6.515	38.216
4	3.712	3.908	43.763	3.185	3.352	41.568
5	3.019	3.178	46.940	2.554	2.689	44.257
6	2.328	2.450	49.391	1.751	1.843	46.100
7	2.257	2.376	51.766	1.908	2.008	48.108
8	2.122	2.234	54.000	1.665	1.752	49.861
9	1.724	1.815	55.815	1.468	1.546	51.406
10	1.554	1.636	57.451	1.324	1.393	52.800
11	1.495	1.574	59.025	1.289	1.357	54.156
12	1.291	1.359	60.383	.928	.976	55.133
13	1.265	1.332	61.715	.733	.772	55.904
14	1.221	1.285	63.000	.795	.837	56.741
15	1.119	1.178	64.178	.852	.897	57.638
16	1.080	1.136	65.314	.757	.797	58.435
17	1.035	1.089	66.404	.567	.597	59.032

Extraction Method: Maximum Likelihood. Not rotated. Eigenvalue at default = 1

The resulting Scree plot was then examined (see Figure 36) for the shape of the curve. The table values were also examined and an eigenvalue of 1.3 was selected. This choice was based both upon the curve and also the place where the difference in explained variance dropped between 1.285 and 1.332.

Figure 36: Scree Plot – Personality and Self-Rated Search Ability



The factor analysis was run again, this time using eigenvalue=1.3, maximum likelihood, and the varimax rotation. This resulted in 11 total factors explaining a total of 53.711% of the variance. A partial table is shown in Table 120. Full results are in Appendix K in Table 128. These results are interesting when compared to the results for just the Personality questions, again showing 10 factors for just the Personality items and the addition of a single factor representing the self-rated search ability items. The resulting rotated factor matrix is partially shown in Table 121 (see Appendix K, Table 129 for full results).

Table 120: Partial Results – Factor Analysis of Personality and Self-Rated Search Ability Items, Eigenvalue = 1.3

	Initial Eigenvalues			Rotation Sums of Squared Loadings		
Factor	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	24.801	26.106	26.106	9.068	9.545	9.545
2	6.851	7.212	33.318	5.681	5.980	15.525
3	6.210	6.537	39.855	5.208	5.483	21.008
4	3.712	3.908	43.763	5.142	5.413	26.421
5	3.019	3.178	46.940	4.758	5.009	31.430
6	2.328	2.450	49.391	4.574	4.815	36.244
7	2.257	2.376	51.766	3.814	4.014	40.259
8	2.122	2.234	54.000	3.787	3.986	44.245
9	1.724	1.815	55.815	3.727	3.923	48.168
10	1.554	1.636	57.451	3.468	3.651	51.819
11	1.495	1.574	59.025	1.797	1.892	53.711

Extraction Method: Maximum Likelihood. Eigenvalue = 1.3

Table 121: Partial Rotated Factor Matrix for Personality and Self-Rated Search Ability

Items	Factors										
	1	2	3	4	5	6	7	8	9	10	11
When searching, how familiar are you with Truncation?	.019	.614	-.028	-.046	-.034	-.016	-.013	-.011	.012	-.004	-.003
When searching, how familiar are you with Quotes?	.024	.595	-.063	-.003	-.036	.034	-.027	-.003	-.031	-.016	.026
When searching, how familiar are you with Boolean logic?	-.003	.611	.010	-.076	-.042	.050	-.023	.055	-.015	-.027	-.011
When searching, how familiar are you with Limit by publish date?	-.026	.873	-.006	.013	.030	-.062	.023	.031	-.026	.027	-.012
When searching, how familiar are you with Limit by location?	-.002	.893	.014	.017	-.019	-.091	.009	-.031	.029	.027	.000
When searching, how familiar are you with Limit by type of information?	.010	.892	.008	.005	.034	-.105	.012	-.027	-.018	.023	-.017
When searching, how familiar are you with Limit by price?	-.012	.697	.006	.066	.076	-.097	.053	-.061	.028	.015	-.004
When searching, how familiar are you with Exclude specific sites?	-.052	.709	-.039	-.021	.023	-.098	.015	-.040	.013	-.002	.027
How confident - create query return only a few good results?	-.030	.527	.083	-.067	.023	.041	-.006	.053	.018	-.023	-.027
How confident - create query that would return every useful result?	-.033	.614	.012	-.037	-.008	.078	.003	.003	.046	.030	.016
How confident - find articles in quality same as expert searcher?	.022	.700	-.005	-.031	-.063	.091	.010	.056	-.053	.031	-.028

Extraction Method: Maximum Likelihood. Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 9 iterations.

As before, the individual items from the Self-Rated Search Ability part of the instrument loaded together on a single factor, in this case factor 2. No personality items loaded on factor 2. The entire Table can be examined in Appendix K. This result gives strong support that the self-rated items are distinct from the personality items, even the self-efficacy personality items. The self-rated items were also compared to the self-efficacy items directly and no correlation was found.

The personality items were explicitly listed by the search experts in phases 1 and 2 of this research and were therefore expected to show some usefulness in measuring online search expertise. These results, however, do not support that expectation. This lack of support could have been due to the length of the instrument and fatigue on the part of the participants. The personality items came at the end for all participants and were much longer than the rest of the instrument. It is also possible that the operationalizations from the IPIP website were not suitable for this environment or these participants. Certainly, it is also possible that some or all of these items are not as important to online search expertise as the search experts believed them to be.

The lack of support for the personality items in this research suggests that this area needs further work to determine what, if any, impact it might have on online search expertise. Examining different ways to operationalize these latent abilities is certainly indicated. Additionally, given the greater support seen here regarding the self-rated and skill-based items, operationalizing specific related practical abilities like analytical abilities or critical thinking abilities is also indicated, especially since both of these were also specifically mentioned by the search experts.

6.4 Summary

The data from Phase 4 was examined and described by item, using statistical methods where applicable. The items were also gathered together into summated scores representing search history, self-rated search ability, and search skill. These consolidated scores are intended to be used to compare individual participants as well as specific groups of participants within research. While these scores are all preliminary and based upon an initial version of the online search expertise instrument, the intent is for them to grow and adapt alongside the instrument.

Another summated score was intended to represent the personality components that discriminated between cohorts, but the results here did not support the measures used in this research. Additional research will be needed to determine what, if any, summated measure can or should be created to measure these components.

The means and standard deviations of the three summated scores are compared in Table 122. A comparison of the differences in means and standard deviations indicates that the search skill score might have somewhat less discriminatory power than the other two measures. Specifically, with the UNC and TURK cohorts, the standard deviation, when added to their mean score, places them in the same range as the other two cohorts. Therefore, while this measure is certainly useful, additional research is indicated. This measure also contains only three individual items, so the testing and addition of other items is also indicated.

Examination of the significant pairwise differences between cohorts found for these measures is in Table 123. The Search Experience Score has the greatest number of significant pairwise differences, with every cohort having significantly different results. The other two measures, the Self-Rated Search Ability Score and the Search Skill Score primarily distinguish between the RUSA and ASIS&T cohorts on the upper end and the UNC and TURK cohorts on the lower end. Still, all three measures do significantly discriminate between at least some of the cohorts, indicating their usefulness in further research.

Table 122: Summated Scores Means and Standard Deviations

Source	N	Search History Mean (SD)	Self-Rated Search Ability Mean (SD)	Search Skill Score Mean
ASIS&T	32	10.94 (4.56)	4.26 (0.65)	1.89 (0.54)
RUSA	50	16.05 (3.41)	4.52 (0.48)	1.97 (0.55)
TURK	147	5.02 (3.55)	3.11 (1.00)	0.90 (0.74)
UNC	237	6.79 (3.39)	3.12 (0.91)	1.23 (0.80)
Total	466	7.51 (4.82)	3.34 (1.11)	1.25 (0.82)

Table 123: Summated Scores Pairwise Comparisons of Cohorts

Source	N	Search Experience Score Pairwise	Self-Rated Search Ability Score Pairwise	Search Skill Score Pairwise
ASIS&T	32	> TURK, UNC < RUSA	> TURK, UNC	> TURK, UNC
RUSA	50	> ASIS&T, TURK, UNC	> TURK, UNC	> TURK, UNC
TURK	147	< ASIS&T, RUSA, UNC	< ASIS&T, RUSA	< ASIS&T, RUSA, UNC
UNC	237	> TURK < ASIS&T, RUSA	< ASIS&T, RUSA	> TURK < RUSA, ASIS&T
Total	466			

CHAPTER 7: Discussion and Conclusions

The purpose of this research was to build a conceptual foundation for online search expertise by creating a definition and model, and then to operationalize online search expertise by creating an instrument to measure it. The specific questions addressed in this research were:

- Q1: What is a current, usable, and applicable definition of online search expertise in the Internet age?
- Q2: Using this definition of online search expertise, how should it be quantified, observed, and measured?

Online search expertise is a critical skill in the modern, fast-changing information environment (Hargittai & Hsieh, 2012), an environment that embeds information activities in every aspect of daily life (Marchionini & Komlodi, 1998). The ability to locate information efficiently and effectively is an important part of everyday life in the Information Age (Hargittai, 2005). Measuring that ability will allow educators and researchers to study and understand it as well as to develop effective training for online searchers.

This chapter will discuss how the research questions were addressed, the limitations of this research, and anticipated future work. The chapter will start with a discussion of the proposed working definition of online search expertise, including a brief summary of how this research fits into prior research. It will then discuss the key findings, including updates to the proposed model. The tested instrument will then be evaluated, and a working version will be presented and discussed, including a discussion of overall scores and how to use them. This will be followed by the discussion of limitations, the discussion of future research, and the closing conclusions.

7.1 Defining Online Search Expertise

Previous research was rich with its examination of different aspects of search expertise, adding many viewpoints for consideration in defining the concept. It has considered both the effects of innate talents and learned skills and cautioned that *deliberate practice* (Ericsson et al., 1993) mattered more than simple measures of time spent or frequency of use. Cognitive and affective states (Palmquist & Kim, 2000; Kuhlthau, 1988) and the personality of the searcher (Bellardo, 1985) were also examined for their influence on search expertise. Throughout, however, search expertise was viewed practically, as a way of solving information problems (Marchionini et al., 1990; Hölscher & Strube, 2000), often stressing the end result of the search more than the searcher.

In contrast, the search experts interviewed for this research stressed the importance of certain aspects of the searcher, personality traits that they categorized as necessary in order to become an expert in searching online. Experience and training were also noted by the search experts as important, but these aspects were not sufficient by themselves. Their focus on the searcher rather than the search highlighted the need to re-conceptualize this construct, while their inclusion of many aspects of experience reinforced the idea of deliberate practice being the key to expertise. Combining their ideas with the results from prior research, online search expertise is defined as follows:

> *Online search expertise is an ability based upon skills learned from past search experiences, past experiences with platforms or tools, past experiences with corpuses or topics, past experiences working in domains, vocabulary, training and education, and*

other learned skills. Online search expertise is an active ability that must be used to be meaningful, and can also be modified by additional factors such as personality or analytical abilities.

This working definition of online search expertise is firmly based upon the way prior research emphasized its practical nature, as something practiced rather than something described (Vakkari, 1997). It therefore includes research in problem solving as the basis for expertise (Feltovitch et al., 2006; Zhang, 2005; Sternberg, 2006; White et al., 2009; Smith, 2014). As an ability, it also includes skills that can be taught and learned, tying it to past research that considered it to be an attainable skill (Chi, 2011). However, unlike some prior research, which assumed that there were no fundamental differences in mental capabilities between novices and experts (Chi, 2006), this definition specifically includes the possibility that personality traits and analytical ability could also be factors. This definition is thus tied to past research into the psychological processes that are related to search expertise (Bates, 1979; Marchionini, 1989; Turner, Kaske, & Baker, 1990) as well as aspects of personality related to searching (Ericsson & Lehmann, 1996; Hoffman, 1996; Feldon, 2006, Bellardo, 1985; O'Brien, 2008).

The proposed definition is usable and specific and includes aspects of the current environment while being grounded in the past traditions of using experience, personality, behavior, and cognition as the bases of online search expertise. As an ability, it includes the talents and skills needed to perform a task (http://psychology.wikia.com/wiki/Ability) and therefore connects back to past research that focused on its practice. As noted in Q1, it is current, usable, and applicable to many different contexts. This definition was used to create a working model for online search expertise as well.

7.2 Evolution of Proposed Model

The creation of a model for online search expertise was necessary to satisfy the research goal of creating a usable definition as well as to create a framework by which to satisfy the second research goal of measuring it. It was expected that this research would obtain support at some level for all of the factors included in this model, especially for the factors of prior experience. The results from the interviews and focus groups indeed did show broad support for factors of prior experience, as expected.

One of the interesting observations from the interviews and focus groups, in fact, was the preponderance of items that related to prior experience – when many researchers have actually rejected the assumption that experience leads to expertise (Shanteau et al., 2002) or stated that the effect of systematic experience on expertise is difficult to define (Cothey, 2002). It is also interesting that, while prior experience as an overall category dominated in terms of number of items, the search experts expressed a hesitancy to support those items as definitely necessary to be an expert searcher. Still, with so many items falling into subcategories of prior experience, there is sufficient support to continue to consider it as one of the key aspects of online search expertise. The expert searchers also placed a lot of emphasis on prior education and training, so much so that this category was added to the model as another explicit factor feeding into Prior Experience.

Interestingly, there were a number of items that arose out of the data from the expert interviews and focus groups that specified important aspects of search expertise that were not implicitly included in the original model. These were grouped into the category of personality traits and were noted at that time for their difference from the personality states in the original model, especially items related to personality traits and analytical abilities.

7.2.2 Support for Personality Traits

Items sorted by the participants as personality traits, including persistence, flexibility, curiosity, adaptability, and humility, were given strong support in interviews as necessary qualities of the expert searcher. The proposed model originally did not emphasize specific personality traits, although it did include aspects of cognitive and affective states as important contributors to online search expertise, based on the prior use of motivation, self-efficacy, and satisfaction (Ericsson, Krampe & Tesche-Romer, 1993). This omission was in part due to the inconclusive evidence found in prior research on the effect of personality traits on search expertise (Bellardo, 1985). The experts in this research, however, discussed and agreed upon the importance of personality traits as a positive influence on search expertise. The shift from considering cognitive and affective states to personality traits is important in that one set is by its nature fleeting while the other is more durable.

The idea that personality characteristics influence search is not a new one, although it has not been extensively used or included in any instruments that measure search expertise. Parker and Paisley (1966) stressed the need to understand the psychology of individual searchers, although they also specified strictly behavioral methods. Bellardo (1985) used Interpersonal Disposition Inventory scores to measure personality traits, and the Khatena-Torrance Creative Perception Inventory to measure creative orientations. While her results showed no clear indication that cognitive or personality traits could be used to predict search success, there were indications that both creativity and analytical ability could influence search results. Dervin and Nilan (1986) called for a focus on individual users, including their context and cognitive states, instead of the prevailing focus on systems. Borgman (1989) combined concepts of inherent individual personality differences with training in systems use and suggested that, while technical aptitude played a role in executing search strategies, personality could influence the actual selection of those strategies.

Examination of the experts' opinions thus led to a change in the proposed model after the conclusion of the expert interviews and focus groups to include and emphasize specific personality traits. This change led to the measurement of those traits using the existing inventory of subscales from the IPIP, whereas in contrast, cognitive and affective states are by nature more fleeting and changeable and therefore would be more difficult to include in a persistent score. The results of phase 4, however, provided little support for using measures of personality traits as components of online search expertise, at least insofar as they were measured by the IPIP subscales. None of the subscales show any statistical significance based upon group membership. Additionally, only the subscale for Creativity was strongly supported by factor analysis, although limited support was seen for the subscales Efficiency, Inquisitiveness, Resourcefulness, and Low Self-Efficacy.

Clearly, the exploration of personality traits has led to mixed results and measuring unobservable traits is difficult. Still, the emphasis of these traits by the search experts consulted for this research clearly indicated that measurement of these traits should be included in the instrument. The lack of support for the measures of personality traits used in this research could indicate a failure in operationalization or implementation. Future research is needed to determine what, if any, role personality traits play in online search expertise. The limited support for the IPIP personality subscales suggests that, while measures of personality should be considered when examining online search expertise, the IPIP measure might not be the best choice for this task. Creating a new measure of online search expertise that includes measurable aspects of personality may in fact allow for greater understanding of this important ability, but the results of the factor analysis and correlations using the known groups in this research do not support the use of the IPIP measures for this purpose. Further testing is needed to locate, refine, and winnow the personality subscales and items in order to discover which may be of use in future versions of the instrument.

7.2.3 Support for Results Manipulation and Critical Thinking

Early results related to critical thinking or analytical abilities were not grouped together but instead were split into skills based upon results manipulation and also with specific personality traits like problem solving. This was in part due to the gathering of evidence to support the model. Many of the items mentioned by the experts during their interviews were grouped under Platform/Tool experience during the initial examination of the model, but were later regrouped in a category that focused on the manipulation of results from searches. This group of items includes tool use as more of a means to an end, with the focus being on using the skills effectively in problem solving or analytical examination. The importance of these skills has grown as searchers move from the idea of the ‘perfect search’ (Bates, 1984) towards a more process-oriented approach where initial searches are meant as starting points.

The remainder of the items related to analytical abilities or critical thinking were sorted into personality traits, an important difference from the initial model. These were represented by problem solving and later operationalized as the IPIP subscale Competence. The lack of support for that subscale, as well as the other personality subscales, indicates a need to re-examine both the items included in the results manipulation category as well as the abilities included under personality. Additionally, recent research shows support for critical thinking ability as a positive influence upon information retrieval skills (Ishita et al., 2017). For that research, critical thinking was not rigorously defined, although it was described as essential in research. Unfortunately, this is not unusual; *critical thinking* as a concept suffers from many of the same issues surrounding online search expertise. Still, it is often considered to be "the mental process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and evaluating information to reach an answer or conclusion" (http://www.dictionary.com/browse/critical-thinking?). Using that loose definition connects it to both analytical skills and problem solving, which have been identified as important attributes of a searcher that should be considered when examining information retrieval (Marchionini, 1997). While none of the personality measures used in this research specifically targeted critical thinking, the recent support for critical thinking (Ishita et al., 2017) in other research, combined with the emphasis on results manipulation from the search experts, suggests that this could be useful in further development of this instrument.

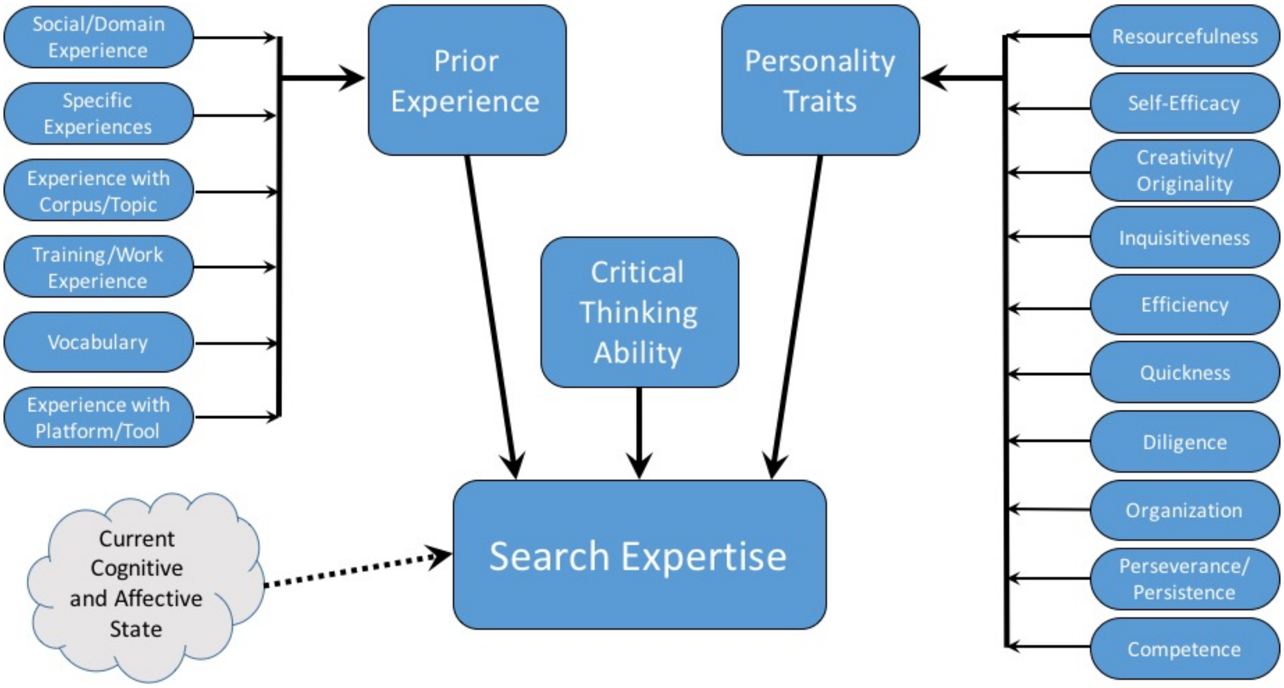
As noted previously, the concepts discussed by the search experts as analytical or problem solving abilities were initially grouped into a new category, Results Manipulation, feeding into Prior Experience. However. those individual items from the search experts, including the ability to conduct systematic searches, the ability to fine tune a search, an understanding of what cannot be found or when a need cannot be satisfied, and understanding implications of search results, all support the idea that problem solving, analytical thinking, or critical thinking is important enough in online search expertise to warrant a more central position in the model. The use of problem-solving skills as a factor in information seeking has also been used in prior research on search expertise (Marchionini, 1997), and its inclusion in the model provides more conceptual support for the use of the skill items in future versions of the instrument. In some ways, these skills bridge the gap between experience and personality in that they contain both logical abilities and also an aspect of experience with a system.

It is also interesting to note that some expert searchers in this research grouped these skills in categories like Analytical Skills and Evaluating Results, providing more support for adding this category to the model (see Figure 37). The category is named Critical Thinking Ability in the model to align with current research, although a more rigorous definition of this concept will be needed for future research. Critical Thinking Ability has thereby been added to the model to contain the various results manipulation and logical abilities mentioned by the expert searchers as well to align with other current research in search expertise. Note that Prior Experience and Personality Traits both could influence Critical Thinking Ability as well as directly influencing search expertise. Inclusion of these indirect pathways unnecessarily complicates the model, however, and is also not supported by this research.

7.2.4 Updated Model for Online Search Expertise

The primary update for the model after phase 4 is the addition of the Critical Thinking Ability category in place of the Results Manipulation category that was previously shown as feeding into Prior Experience. This places Critical Thinking Ability between Prior Experience and Personality Traits both physically in the model and conceptually as well. It should be noted that it is understood that some or all of these categories interact in a complex manner, but displaying all of those interactions in the model would only serve to complicate it and make it hard to understand.

Figure 37: Updated Model for Online Search Expertise



7.3 Evaluation of Instrument Items

The instrument used in this research was composed of many different items, some of which can be classified as demographic or descriptive in nature, some of which involved exercise of skill by the participants, and some of which represented latent variables of personality and self-rated abilities. These items were all examined statistically and evaluated here for inclusion in future versions of the instrument. This is particularly important for this instrument due to its length and considering that 104 participants abandoned the instrument before completion. Additionally, research shows that shorter online skill indexes are more reliable and consistent as compared to longer versions (Hargittai & Hsieh, 2012). A shorter instrument could also potentially lower the number of participants failing validation checks. The updated and recommended instrument is located in Appendix M.

7.3.1 Demographic Items

There were 6 demographic items on the instrument, including age, gender, ability with English, level of education, income, and environment. For this research, age and ability with English were used as validation items and it is anticipated that they will be useful moving forward. There were noticeable differences between participant groups in level of education, indicating that variable should be retained. The remaining items can be eliminated as desired, although the age and gender items have been retained for use in categorization.

7.3.2 History Related to Online Search Experience

There were 12 general online experience items on the instrument, including experience with Internet search tools, frequency of searching on various hardware platforms, prior training in searching, holding an LIS degree, searching on behalf of friends or relatives, searching for work, and training others in how to search online. Some items in this section were only seen by participants when a specific answer had been selected on a prior item. There was little distinction between participants for some of these items, but the items involving prior training, searching for others as part of a job, training others, and having an LIS degree were statistically significant against the Search Skill score. The remaining items should be eliminated. It should be noted that many of these items might be redundant on certain groups of users, as in those with LIS degrees who can be assumed to have experience searching for others.

7.3.3 Specific Search History

There were 16 online search experience items on the instrument, including a set of questions about searching for different types of information, a set of questions about searching using specific online sites, and a single question asking about searching for a college course. Searching for a college course, a hobby, legal information, ancestry/genealogical information, government information, historical information, PubMed, LexisNexis, and WorldCat were retained in the recommended version of the instrument. These items were combined prior items into a Search Experience Score that significantly distinguished between all four cohorts.

7.3.4 Self-Rated Search Ability Items

There were 11 self-rated search ability items on the instrument, including a set of items related to familiarity with tools and techniques and a set of self-efficacy items about searching online. It is particularly interesting to note the normal curve of the summated score for this section, especially in light of how many summated scales skew positive as a result of social desirability bias (King & Bruner, 2000). It should also be noted here that prior research has shown that searchers often overestimate their search abilities (Gross & Latham, 2013; Brennan et al., 2016), making further investigation of these items important.

As noted above, many of these items were changed after the cognitive interviews to parallel the search skill items so that they could be evaluated against them. This is important because high self-efficacy beliefs do not always guarantee positive outcomes (Pajares, 1996) and because searchers with low evaluations of their skills could actually have higher levels of actual skill (Aula & Nordhausen, 2006). The factor analysis for these revised items indicated their loading on a single factor. Further analysis indicated that overall reliability would go down if any of these items were removed. Therefore, these items should remain intact if used for any further testing, provided that they are also evaluated against any appropriate search skill items.

The Self-Rated Search Ability score was examined for its ability to distinguish between the four known cohorts of participants. The post hoc tests showed significant differences between the RUSA and ASIS&T cohorts on the high end and the TURK and UNC cohorts on the lower end. This supports both the previously noted split between participants into essentially two groups, but also the possible predictive value of the Self-Rated Search Ability score in predicting online search expertise so long as the measure is also examined for potential bias or over-estimation. Additionally, research has shown that specific self-rated skill items have more predictive ability of actual skill than do general self-rated skill items (Hargittai, 2009), so all items should be examined for specificity when used.

7.3.5 Search Skill Items

There were 5 search skill items on the instrument, all of which used the same format where participants marked all of the tools or techniques they considered to be effective at completing the tasks. These items were scored using a simple ration of the number of correct answers selected divided by the total of all answers selected, both correct and incorrect. The results from three of those items indicated usefulness in further iterations of the instrument and in fact seem to be useful in assessing online search expertise when summed together. The data from the fourth and fifth items were not statistically significant and so those items were not included in the Search Skill Score.

The Search Skill Score shows significant differences between the RUSA and ASIS&T cohorts on the higher end and the TURK and UNC cohorts on the lower end. It also shows a significant difference between the UNC and TURK cohorts. However, this measure is not distributed normally and has more variation than the other measures. It also consists of only three items in this research. Additional research is needed to collect more data and to potentially include more items.

7.3.6 Correlation Between Summated Scores

The use of a continuous measures based upon summing a set of items is supported by prior research. Support for the use of specific skill items to assess expertise is given by De Groot (1946/1978). Aula and Nordhausen (2006) reported that measures of search expertise could be treated as continuous variables rather than the specific states used in prior research.

The Self-Rated Search Ability Score was compared to the Search Skill Score using a Spearman's rho correlation. The results indicate that there is a moderate correlation between Search Skill Score and Self-Rated Search Ability score [$r_s = 0.485$, $p < .01$]. In light of the length of the instrument, there might be applications where the use of only one of these sets of items is indicated. The Search Experience Score has a moderate correlation with the Self-Rated Search Ability Score (see Table 124). The Search Experience Score also correlates with the Search Skill Score (see Table 124). These results indicate that further research should be done to further examine their usefulness as representing parts of Online Search Expertise. The relatively low correlation between the Search Skill Score and the Self-Rated Search Ability Score also indicate that these could measure two different underlying constructs.

Table 124: Summary of Correlations of Summated Scores

Spearman's rho (N = 466)		Search Experience Score	Self-Rated Search Ability	Search Skill Score
Search Experience Score	Correlation Coefficient	1.000	.612**	.352**
	Sig. (2-tailed)	.	.000	.000
Self-Rated Search Ability	Correlation Coefficient	.612**	1.000	.485**
	Sig. (2-tailed)	.000	.	.000
Search Skill Score	Correlation Coefficient	.352**	.485**	1.000
	Sig. (2-tailed)	.000	.000	.

**. Correlation is significant at the 0.01 level (2-tailed).

7.3.7 Personality Items

There were 86 personality items on the instrument from 9 different subscales selected from the IPIP website, although some of the items were used by more than one subscale. The average scores on these subscales were not significant across the four participant groups, nor did the factor analysis support the items predictably loading on the original subscales. The subscales that did load together were Efficiency (8 of 11 items loading), Creativity (8 of 8 items loading), Inquisitiveness (10 of 10 items loading), Resourcefulness (6 of 10 items loading), and Self-Efficacy (6 of 9 items loading). None of the subscales scores significantly predicted cohort membership, indicating that these particular subscales might not be useful for this task. This decision does not question the importance of personality traits taken from the expert interviews, but rather acknowledges that they are difficult to measure and that alternatives should be explored.

7.3.8 Online Search Expertise Instrument v1.0

As already noted, the suggested version of the instrument is included in Appendix M. This instrument is based solely upon tested items that have been supported through the data in this research. No additional items have been added to this version of the instrument, although current research does indicate the possible value of including items designed to measure problem solving or critical thinking. The Critical Thinking Disposition Scale (Sosu, 2013) is one possible measure that will be tested in future research. The instrument in Appendix M is offered to other researchers and educators for non-profit use through the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License. To view a copy of this license, visit http://creativecommons.org/licenses/by-nc-sa/4.0/ or send a letter to Creative Commons, PO Box

1866, Mountain View, CA 94042, USA. It is recommended that future uses of the instrument make use of random ordering of the questions across all categories, especially the skill questions. Suggestions for scoring the instrument are provided below, although such scores should be examined for reliability and validity.

7.4 Scoring the Instrument

Part of the value of an instrument to measure online search expertise is being able to compare and rank participants based upon their answers to that instrument. Certainly, any summation of scores is a simplification of the data gathered by the instrument, but it is still a useful way of examining experimental interventions or instructional techniques. As already discussed, the three summated scores developed here are recommended for use moving forward. The scores can be further examined and ratified with other known groups in further research.

Additional methods of scoring can also be tested, especially for the Search History items and the Search Skill items, both of which used preliminary scoring methods. Testing and validating the scoring for all three measures is a critical part of continuing research. Scores can also be normalized so as to be more easily relatable to one another.

As noted in the preceding section, the performance of the personality items on the instrument does not support their continued use as is in further development. However, if other personality measures or critical thinking measures are selected, they should contain a similar method by which they are reported as a single score or set of scores that can be used with the Search Skill score and Search Experience score. The use of summed, continuous scores will allow for searchers to be compared more granularly in the future. This will also allow testing of interventions and training to evaluate their effectiveness in raising online search expertise.

7.5 Limitations

Online search expertise is a complicated ability, as evidenced by the difficulties researchers have had in both conceptualizing and operationalizing it. This complicated nature makes it difficult to study, and this research is not immune to that difficulty. The primary limitations of this research are:

- The use of and length of an online survey as a method of data collection.
- The limits to content validity, including the use of the RUSA and ASIS&T groups for evidence of content validity.
- The use of trained librarians as search experts.
- The use of self-reported data.
- The omission of domain expertise.
- The effect of order.
- The limitations of focus group design.

The instrument analyzed in Phase 4 of this research was administered online to four distinct groups of participants with a total of 136 individual items, some of which had multiple parts. The overall length of the survey could therefore be a limitation. Pre-testing indicated that the survey would take an average of 15 minutes to complete and this was validated by an average time of 13 minutes, 46 seconds from all participants who completed it. However, 104 participants abandoned the instrument before completion. The overall time to complete the instrument could have also contributed to the lower than expected response from the Amazon Mechanical Turk group. The length of time it took to complete the survey could have self-selected certain types of participants and deselected others. However, when developing a measure for a construct that does not have a viable measure already in existence, it is prudent to be inclusive in early versions of the instrument. This practice follows standard scale creation techniques that winnow items from use after they have been examined. Future iterations of the instrument will continuously be working on this winnowing in order to create a succinct measure.

The length of the instrument was due in part to the many aspects of search expertise reported by the search experts, especially those aspects related to personality. The list of aspects was quite lengthy and was examined for usable items during phase 3 of this research. Because of this length, not all items mentioned by the experts were tested in the instrument used in this research. The unused items generally included items specific to a certain context or items that depended upon longer answers from the participant that would be difficult to assess. The content validity established for this instrument was from the examination of items in the focus groups, yet not all of those items were represented in the instrument. This is not an unusual issue considering the large body of information in many domains, and usually domain sampling is done to select a group of representative items (Nunnally, 1978). Still, the instrument is being refined and therefore must be examined after each refinement process to ensure that content validity has been maintained.

Evidence for content validity was also gathered through the use of trained librarians as search experts in the initial phases of this research. These librarians were selected to represent expert searchers based upon availability and connections to prior research, but did not represent the full range of searchers in the current online environment. It was important to begin this research from a known, established position but also important to extend this work by including other types of search experts. As an illustration, some of the items mentioned by the experts in this research might be more properly viewed as aspects of a good research librarian rather than those of an expert searcher. This limitation also extends to their use in providing content validity for the items used in the instrument. While it is clear from the data that there are significant differences between the RUSA/ASIS&T cohorts and the TURK/UNC cohorts, the use of similar experts in earlier phases could have made those results more likely. Additional expert searchers should be consulted in future work, especially work tied to a particular domain.

This instrument also made use of self-reported data from participants. Some research has demonstrated that participants can report higher levels of search expertise than they reliably demonstrate on other measures (Gross & Latham, 2013; Brennan et al., 2016), casting into doubt the reliability of such measures without supplementing them with other types of data. Certainly, the use of only one method of data collection is not ideal. The inclusion of the skill items in the instrument alleviates this concern, at least in part. However, it is also acknowledged that an ability like online search expertise is difficult to observe, as evidenced by the large body of research where it has been operationalized behaviorally. This research seeks to create a succinct, reusable measure of online search expertise, and such a measure will contain some self-reported items. However, the skill items will continue to be used to examine and validate the self-reported items wherever possible.

The use of the search skill items should be carefully monitored in future testing, however, both to ensure their appropriateness to the current online environment and to examine the stopping behaviors of participants. Answering these types of items might take more effort on the part of the participant. This could become especially problematic in longer versions of the instrument. It was notable in this research how many of the abandoned and invalidated surveys occurred around the skill items and the validation item in that section. Influencing stopping behavior might also affect lower skill participants more than others. This can certainly be managed with shorter surveys in the future.

Domain expertise, specifically the parts of the model titled Social/Domain Experience and Experience with Corpus/Topic, were explicitly not tested as part of this research. Both of these categories rely heavily upon context and as such cannot easily be measured in a more general instrument. However, future iterations of this instrument can include specific items related to a domain to ground it for a particular use. This is expected and even encouraged.

This instrument was given to all participants the same way, in the same order. The effects of order upon response are well-known in research (Babbie, 2007). The length of the instrument could have caused fatigue effects in the participants. This could have been especially true for the personality subscales, which came at the end of the instrument and were the largest section. Order effect could also have impacted the choices of participants for the five skill items, each of which had the same set of choices available in the same order. This limitation is difficult to avoid in the initial stages of instrument design but should not be ignored as the instrument is modified and moves forward. For future versions of the instrument, randomly ordered items should be used and examined to see if order effect is indeed present.

As noted, the design of the focus group also had some limitations, some of which influenced the exclusion of some items. The focus groups worked on items from the lists of the three participants in each group only, rather than an overall list. While this did allow for the scheduling of the groups in a timely manner and also allow participants to comment on their own items, it did limit participants from examining items from the other groups. This could have led to the focus on personality by two of the groups, which in turn led to changes in the proposed model. The third group specifically sorted items into analytical abilities, but these were later categorized as results manipulation skills and the personality trait of problem solving. This limitation led to testing the personality subscales but not a subscale for analytical abilities.

7.6 Future Research

This research has established a conceptual foundation for online search expertise, proposed and updated a model highlighting important aspects of online search expertise, and created and tested an instrument that can be used to measure online search expertise. From this foundation, there are many possible directions. These include:

- Testing a new version of the instrument with critical thinking or problem solving items.
- Testing the instrument within a specific domain.
- Validating the new instrument with search experts and structural equation modeling.

7.6.1 Testing a New Version of the Instrument

The data collected in the research supported parts of the instrument from phase 4, but it also revealed some limitations. Specifically, the personality questions had very limited support for their use in predicting online search expertise and additionally were 86 of the 136 items on the instrument. Additionally, the items in the subscales did not load on the same factor for many of the subscales.

These results indicate a strong need to find and employ items from another source. Unfortunately, items measuring the specific aspects of personality stressed by the expert searchers are not generally available for public use. Still, there are paths open for further investigation. One path involves taking the individual items from the IPIP and putting them together into new subscales that specifically target the personality traits mentioned by the expert searchers. This strategy might involve further analysis of the current data, as well as examination of the bank of items on the IPIP website. The items could then be tested using new participants to learn how well they factor together. Progress along this path will take some time, for testing new subscales must involve testing and retesting. However, the sheer number of items needed would again introduce a limitation for the instrument based upon its length.

A second possible path is to concentrate on the construct of critical thinking or analytical abilities. Other research (Bellardo, 1985) has tested the use of analytical abilities as predictors of search expertise with limited success. Additionally, recent research has preliminarily identified a related concept, critical thinking, as a positive influence on information retrieval ability (Ishita et al., 2017). That research used items to represent critical thinking that are not available in English, but could be translated and adapted to represent both the concept of critical thinking and potentially analytical ability. Should those items not be available or usable, other measures of critical thinking or problem solving could also be tested. One such measure, The Critical Thinking Disposition Scale (Sosu, 2013), is recommended for that testing, but others could be used as well.

The personality section is not the only work that can be done to further evolve and evaluate the instrument. The skill questions were somewhat successful at predicting group membership for the participants in this research, but are in need of additional items. The existing items should also be examined and edited for clarity and tested again. The use of subsets of items could also be tested in order to create a very succinct instrument usable for other research. This subset of items could be short enough so that it did not place an undue burden on participants and serve to help gather data from many different sources on the reliability of the items.

The updated instrument focuses on just those items that performed well in this initial testing in order to keep it as short as possible. However, it should also add items to represent aspects of personality, especially analytical abilities, in order to further examine the effects of personality traits upon online search expertise.

7.6.2 Testing the Instrument Within a Specific Domain

One major part of the proposed model for online search expertise is the influence of domain or topic, represented by the categories Social/Domain Experience, Vocabulary, and Experience with Corpus/Topic. Domain expertise has been the subject of a large amount of research in information science, and some hold that expertise does not extend beyond a particular domain (Ericsson & Charness, 1994). Domain experts are thought to have an advanced ability to understand and process knowledge as well as the ability to recall that knowledge (Solomon, 1992; Feltovitch et al., 2006). Domain knowledge includes substantive expertise, including training, experience, and knowledge, but also includes normative expertise, the social and communication aspects to working in a particular field (Meyer & Booker, 1990). The importance of domain upon online search expertise is represented by the number of categories representing it in the model. These categories reflect the social or normative expertise of working in a domain, the topic knowledge related to that domain, and the vocabulary necessary in order to find information related to that domain.

The testing performed for this research purposefully did not include any domain as part of the instrument, although participants were asked about their use of specific online sites that represent searching in domains like law and medicine. This was done to prevent any confounding effect between domain and the other aspects of online search expertise, a necessary step in establishing a generalizable measure. The intent for this instrument is for future researchers to add items related to domain as desired in the particular use and context.

Adding domain items to the instrument is not a trivial matter, and doing so with one or more domains could produce, at minimum, suggested guidelines for future adaptations. The selected domain will ideally already have an established set of items used to determine domain expertise, items that can be taken and used in the instrument. Care will need to be taken that these items are validated by experts in that domain as representative, using a process that is similar to the process used in this research. This could lead to a set of scores similar to:

- Search Skill score: XX
- Self-Rated Search Ability score: XX
- Search Experience score: XX
- Analytical Thinking score: XX (Note that this is speculative depending on the results from the testing described above.)
- Domain score: XX (Note that there could be one or more of these scores, depending on the domain.)

The scores representing the domain might coalesce into a single score or might require more than one score to adequately represent them. Certainly, it is anticipated that, with at least some domains, the vocabulary will be an important part of expertise and therefore an important part of assessing online search expertise within those domains (White et al., 2008).

It will be difficult to properly represent some domains using the items from the modified scale, notably items involving history that specify the use of specific sites. It is recommended that even in those cases the items be left as is as much as possible so that those scores could be compared to other applications of the instrument. The instrument used in this research will be examined for the usefulness of these items before the next iteration and only those deemed important will remain. Parallel items could also be added to supplement the existing items.

It is also important to remember that items related to domain expertise are often used in the training of novices within that domain and that the use of the instrument in a domain could likely involve educational motivations. Testing of the instrument in a domain would thus likely be best if it could involve the same participants over time in a longitudinal study.

7.6.3 Validating the new Instrument with Search Experts and Structural Equation Modeling

The validity of the instrument is an ongoing concern that should be addressed each time major changes are made as well as periodically, for technology changes constantly and the information available online changes as well. Validity can be reexamined with search experts by sharing the instrument with them and asking questions about how well it represents online search expertise. The feedback from search experts can then be used to establish content validity and, where needed, make any necessary changes to that version of the instrument. It should be noted that the instrument is not designed to cover every aspect of online search expertise, but is instead meant to be a representative sampling of the construct (Nunnally, 1978). This sampling need not address all aspects of the construct, but should be viewed by the experts as being a reasonable sampling of the skills needed for online search expertise.

Construct validity should also be examined when the next version of the instrument is finalized and tested. This examination can be done as it was done in this research, using factor analysis, but it can also be extended to include structural equation modeling to confirm that the proposed model does in fact represent the interactions that occur within the data. Structural equation modeling (SEM) is a group of statistical techniques used to examine the relationships between several latent variables and to compare a proposed model against collected data (Nachtigal et al., 2003). SEM accomplishes this by using path analysis and factor analysis and is largely confirmatory rather than exploratory (Nachtigal et al., 2003).

The modified model for online search expertise is a good candidate for the use of SEM. Data from the new instrument can be examined statistically and the structure compared to the model. This technique was used by researchers recently to examine a similar dataset and that research suggested the use of critical thinking ability as part of the model (Ishita et al., 2017). It should be noted that, in that case, SEM was used in an exploratory fashion rather than a confirmatory one, a less common approach in research. Use of SEM in a confirmatory fashion will provide support for that construct as part of online search expertise as well as examining the relationships throughout the model. This information can then be used to help guide further modifications to both the model and the instrument.

The instrument should also be tested for its ability to predict search effectiveness, including accuracy, speed, and quality of results. This testing could help to identify and include other types of search experts based upon their ability to perform specific tasks in a controlled environment.

7.7 Contribution and Conclusion

The importance of understanding expertise is not in question and that importance is underscored by the large body of research in psychology, education, sociology, and information science. But the study of expertise has proven to be challenging and has often limited researchers to study only small parts of expertise, like the cognition of experts or the tasks that experts are good at performing. Much of the research concentrated on a debate between nature and nurture, innate talent and experience (Galton, 1869; Bramwell, 1948; Fleishman, 1972; Ceci & Liker, 1986; Ackerman, 1988; Ericsson & Lehmann, 1996; Sternberg, 2006). Other researchers have examined different developmental aspects of expertise, with emphasis on teaching and learning skills and abilities as well as problem solving (Chi, 2006; Kinchin et al., 2008; Chi, 2011). The one commonality in this research is a focus on the person, often termed experts or novices, and a lack of clear results. Expertise remains mysterious, at least in part. This is no less true when one examines online search expertise.

The advent of self-service library catalogs signaled an end to the former system of trained searchers acting as intermediaries to end users. From that moment onwards, information available to online users has continually grown and understanding of online search expertise has lagged behind. This is certainly not unusual, for technologies change and understanding of them must perforce come later. In the case of online search expertise, the change has been more than a technological one, but a sociological one as well. We have moved from limitations on available information to being embedded in information throughout our lives (Marchionini & Komlodi, 1998). The importance of locating usable, factual, and timely information efficiently and effectively is one of the central challenges of our lives (Hargittai, 2005). And yet, we do not fully understand why some people are better at locating information than others.

This research continues the conversations in research about what online search expertise might be, and more importantly how we can investigate it and teach it to searchers who need it. Much of the previous conversation occurred in the very early days of searching online and so, in many ways, our understanding of online search expertise must begin anew. In order to begin that conversation, online search expertise must be newly conceptualized and modeled, tasks that have both been accomplished in this research. That conceptualization must now be used in different contexts with different sets of searchers in order to fully examine it so that it might be updated.

Beyond conceptualization and modeling, it is important to remember that online search expertise is an active ability that is in use at every moment. It is imperative to find a way to help online searchers locate the information they need. This research provides an instrument that can be modified for multiple settings and used to assess the level of ability of individual searchers so that they might receive the needed assistance. This instrument can also be used to test experimental changes to the environment so as to assess whether they assist or harm the searchers' ability to locate information. The practical and active nature of online search expertise cannot be ignored, and this research provides a tool that can be used to assess it.

The instrument used in this research contains personality items related to latent constructs. Those items were tested for reliability using Cronbach's alpha and found to be internally consistent, although these items were not included in the suggested instrument detailed in Appendix M, nor are they recommended for future use as they stand. Validity for the instrument used here was examined using a number of different methods to gather evidence.

Evidence of content validity was gathered in early stages of this research through the involvement of search experts to suggest, group, discuss, and approve of the items included in the instrument. While not all items suggested by the experts were used, this is not uncommon practice, and representative sampling of the construct (Nunnally, 1978) is expected, so long as it is viewed by the experts as being a reasonable subset of the construct. The emphasis from the search experts on aspects of personality, especially those involved with results manipulation and analytical ability indicates a need for some representation of those abilities in future versions, but the poor results from the IPIP subscales do not indicate their value in future versions. This combined with new research including critical thinking into a search ability model indicates that the instrument needs those aspects to be truly representative. Future work should concentrate on locating and verifying items to measure analytical abilities and critical thinking.

Evidence for criterion-related validity is difficult without established measures. For this research, evidence was found through the use of a known group of experts who were used as benchmarks for the scoring of the Search Skill score, the Self-Rated Search Ability score, and the Search Experience score.

Evidence for construct validity was gathered through exploratory factor analysis of the personality items and the self-rated search ability items. The self-rated search ability items did provide evidence of validity, loading on a single factor, and are recommended for future use and additional testing. The personality items as a whole had very limited support for construct validity, with some loading on multiple factors, and thus were removed from the suggested instrument in Appendix M.

The instrument developed here can be used by multiple researchers to provide a baseline set of characteristics for their searchers. This baseline can later be used to compare research and build it into a body of work. The instrument developed here also allows for online search expertise to be measured as a set of continuous variables rather than the common method of simply categorizing searchers as high and low ability. This allows for a more granular investigation of individual differences as well as the changes made by experimental interventions. There are regrettably few instruments designed to measure Internet skills (Hargittai & Hsieh, 2012), and they are quickly outdated by changes in technology. This instrument is designed to be adapted as new technology occurs, with new items taking the place of outdated ones.

This research began with a desire to understand online search expertise so that the results could assist searchers and those who study online searching. Much of the prior research focused on the practical nature of obtaining good search results, and the conceptualization of search expertise was less often considered beyond that goal. Much of what was known was either directly observed through the behavior of searchers or lacked strong results. This was not a lack of effort on the part of researchers but rather a testament to the complexity of the construct.

This complexity is, if anything, becoming greater as the Information Age continues. The ubiquity of easily discovered information and the Google tool have changed the search process irrevocably. The idea of *deliberate practice* is central to some theories of expertise (Ericsson et al., 1993), yet online searching through Google does not seem to qualify as deliberate practice, instead calling to mind the “Principle of Least Effort” (Zipf, 1949). Search is often not the goal of the online searcher but only a means to an end. In this environment where some information is less ‘nutritious’ than other information, perhaps the cost of acquiring it is the only measure that matters (Pirolli & Card, 1995). Yet clearly online searchers are in need of assistance, if only in locating valid information in the sea of misinformation. It is not enough to provide the ‘perfect search’ (Bates, 1984) any longer – online searchers must possess a larger set of skills and abilities. In order to provide those skills and abilities, we must first understand them.

APPENDIX A: EXPERT INTERVIEW PLAN

The interview was semi-structured, using only those questions needed to help guide as well as to get more details. Experts received a short guide before the interview along with an interview reminder to give them time to consider the topic.

Initial Email Scheduling the Interview

Dear Participant Name,

Thank you for your participation in this research. I am attaching an information sheet about this study outlining your rights as a research participant. Please let me know if you have questions about this sheet. If you don't have any concerns and agree to participate, we can then schedule your participation. You will sign a copy of this form at your first interview to indicate your consent to participate.
To schedule your first session, please respond to this email with your availability over the next week. Remember that this first session will be a one-on-one interview that will take approximately 60 minutes. This interview can take place in your office or in Manning Hall on campus, whichever you prefer.

Thank you again for your participation.

Regards,
Earl Bailey
Primary Investigator

Reminder Message and Guide for the Interview

For the interview, scheduled for [date and time] at [location], please consider your experiences around online search. I will be asking you to discuss what online search expertise means to you, as well as different aspects of online search expertise that you consider to be important.

As a reminder, you have already been sent a form outlining your rights as a research participant. Please be sure to read over this form before coming to the interview.

Thank you again and see you [date and time] at [location].

Interview Script

Hello, my name is Earl Bailey and I will be asking you a few questions today about search expertise. During this interview, I will be using this script. I will also be recording your responses as well as taking handwritten notes. I have sent you a copy of the information and consent form for this study. Please indicate your consent by signing the form now. (give form, continue after they sign).

May I begin? (start recorder) Your responses will be used only for this research and will not be identified with your name or any other information about you. No personal information about you will be discussed during this interview. Now, in the reminder email I asked you to consider online search expertise. Let's start by thinking about an expert searcher.

Section 1: Defining the Expert Searcher

Main Question: What do you think it means to be an expert searcher?

- Clarifiers Used when/if these concepts have been mentioned
    - Is that based upon a particular system?
    - Does the type of search matter? How?
    - Does the topic matter? How?
- Clarifier: What other factors might go into being an expert searcher?
    - Why is that important?
    - If a searcher did not have that, could they still be an expert searcher?
    - If a searcher did not have that, then what would be second best?
- Clarifier: Do you consider yourself to be an expert searcher?
    - Why or why not?
    - Are expert searchers always expert searchers?

Section 2: Defining Search Expertise

Main Question: So considering this expert searcher, let's move on to the actual ability of search expertise that they have. Can you tell me what search expertise means to you?

- Clarifier: By meaning, talk about how you would describe search expertise.
    - Is it one thing or multiple things?
    - Is it consistent or does it change?
- Clarifier: Is Search Expertise important? Why or why not?
    - What specific aspects of search expertise do you think are important?
    - Why is that aspect important?
    - Are any more or less important than others? Which?
    - Are any of the aspects you mentioned optional?
    - Are there any aspects that are external to the searcher?
- Clarifier: Imagine that researchers had announced that they had figured out search expertise. What would the newspaper headline about search expertise say?
- Clarifier: have your thoughts on search expertise changed?
    - What changed?
    - Why did that change?

Section 3: Measuring Search Expertise

Main Question: Considering your thoughts on what search expertise means and what an expert searcher means, can you tell me some specific ways you would measure search expertise?

- Clarifier: Let's go back to the aspects of search expertise you mentioned. How would you measure those aspects?
    - Would you measure them individually or as a group?
    - What units would you use?
    - What kind of scale would you use?
- Clarifier: Are there aspects that you don't feel could or should be measured?
- Clarifier: Does measuring these aspects change your feeling on relative importance?
- Clarifier: Have you seen any of these aspects measured before?
    - Were the measurements reasonable?
    - Were there places where the measurements seemed inappropriate?

Section 4: Specific Measures of Search Expertise

Main Question: I am now going to ask you about some specific concepts that might be related to search expertise. For each one, please tell me if and how you think it might be related, as well as how important it is. Finally, how would you measure it?

- Do you think that familiarity with a search system is a part of search expertise?
- What about the type of computer system you are using?
- What about practicing a profession?
- What about what you already know about something?
- What about any specific kinds of searching you may have done already?
- What about how long you have been online?

General Clarifiers to be used in all Sections

- General Clarifier: Can you expand on that a little?
- General Clarifier: Can you tell me anything else?
- General Clarifier: Can you give me some examples?
- General Clarifier: Specifically what do you mean by _______ ?

After the Interview

Thank you for your participation in this interview. Please accept this token of my gratitude for your assistance (give gift card). As a reminder, I will be sending out an email to schedule the second part of this study – the focus group. Thank you again.

APPENDIX B: INDIVIDUAL ITEMS FROM EXPERTS

Items from Experts in Focus Group 1

Accuracy/relevance
Adaptivity
Being able to connect to unknown controlled vocabularies
Being able to evaluate results
Being able to handle difficult searches
Being dissatisfied with one search
Bibliographic experience
Choosing an appropriate source
Competence in resources
Confidently ignoring information that is not helpful
Creativity
Curiosity
Evaluating accuracy of information
Experience online
Experience searching for news
Experience with a profession
Experience with academic sources
Experience with bibliographic tool
Experience with databases
Experience with hardware/software platforms
Experience with non-digitized sources
Experience with searching many different tasks
Experience with worldcat
Experience working on a reference desk
Extensive experience with a search system
Familiarity with corpus
Familiarity with information formats
Familiarity with search tools
Finding right answer within correct context
Finding the answer
Finding things for others
Finding what you want
Flexibility
Getting more relevant results
Good at analyzing information needs
Good at fine tuning results
Good at learning and understanding new systems
Inspiration
Interacting with search system (non-casual)
Iterative searches
Knowing about non-google search systems
Knowing Boolean
Knowing google's advanced features
Knowing quotes
Knowing reliable websites
Knowing sources
Knowing that universe of information changes
Knowing that you must update skills
Knowing the limitations of search tools
Knowing the limits of your searching abilities/skills
Knowing truncation
Knowing what can't be found
Knowing what information is available
Knowing when the answer you found isn't good enough
Knowing when to stop (walk away)
Knowing when to use specific tools
Knowing which fields are searchable
Knowing why information is available (motives)
Knowing/evaluating results
Knowledge of what is being searched
Motivation
Persistence
Prepares for searching
Specific search experience
Subject knowledge
Tenacity
Thoughtfully trying more than one approach
Time spent online
Understand thesaurus/controlled vocabulary
Understanding connection between search terms and results
Understanding how system will respond to request
Understanding metadata
Understanding search technology
Understanding the information culture
Use basic search tools often
Use of clarification
Uses google frequently
Uses search strategies
Working with faculty/grad students

Items from Experts in Focus Group 2

Ability to focus
Ability to predict search results
Ability to transfer skills to another system
Able to communicate search results
Able to manipulate search using features
Able to market skills
Able to transfer skills to another specialty
Able to troubleshoot
Able to use a tool
Analytical
Can analyze reliability of information
Can analyze results
Can develop the logic of a search
Can judge information quality
Can judge information reliability
Curiosity
Deliberate combination of tools
Effective
Efficient
Experience (amount of time spent using database)
Experience (Bibliographic Database)
Experience (daily searching)
Experience (member of a team)
Experience (reference desk)
Experience (tools)
Experience (working with others)
Experience (years)
Experience in a discipline
Familiar with PubMed
Formal training in how to search
Good Language Skills
Good negotiation skills
Good reviews from clients
Good Vocabulary
Has a degree in Information Science
Has done extensive research using search
Has done inventory
Has worked with archives
Has made presentations on search
Has published papers on search
Has realistic expectations
Has searched for information about a hobby
Has searched for information about a medical condition
Has searched for information about a medication
Has searched for legal information
Has searched for recent information
Has searched regarding a legal matter
Has studied a tool
Has taught courses on search
Has trained others in searching
Has worked with other expert searchers
Humility
Immersion in a topic area
Intuition
Keeps up to date with sources
Keeps up to date with technologies
Keeps up to date with tools
Knowing MESH
Knowing the limitations of a tool
Knowledge of common database fields
Knowledge of database coverage
Knowledge of database dates
Knowledge of metadata
Knows difference between OR / AND
Knows language of the field
Knows medical terminology
Knows the best sources for a search need
Knows the good sources
Knows the standards
Knows the subject
Knows when to ask for help
Masters in Library and Information Science
Open Mind
Organized
Passion for searching
Patience
People skills
Persistence
Persistent analysis
Results oriented
Satisfied with their search results
Self-awareness of search skills
Self-trained in how to search
Specialist in searching
Spends time improving search skills
Spends time learning discipline
Technological expertise
Thinking about end result
Thoughtful selection of database
Understanding full text search
Understanding Google's personalization
Understanding how Google works
Understanding implications of search results
Understanding relevance
Understanding Sensitivity

Items from Experts in Focus Group 2 (cont.)

Understanding Specificity
Understanding the Body of Literature
Understands an index
Understands Boolean
Understands databases
Understands how data is searched by the tool
Understands how information is structured
Understands how language is used in searching
Understands how language is used in storage
Understands key concepts
Understands limiting search sets by source
Understands limiting search sets by time
Understands limiting search sets by type of information
Understands publication cycle
Understands structure of database
Understands the literature of a field
Understands the logic of search
Use of adjacency in search
Use of citations
Use of quotes in search
Uses advanced search features
Uses context of search need
Uses Google's advanced tools
Uses iterative searching
Uses search skills frequently (weekly)
Uses search strategies
Uses Table of Content Searching
Utilize the specific strengths of a tool

Items from Experts in Focus Group 3

Able to analyze results set
Able to break things apart
Able to conduct systematic searches
Able to define or state what they are searching for or what information they need
Able to get consistent results
Able to move expertise to new systems
Able to select best tool
Able to translate a question into a search
Adaptability
Broad understanding of databases
Chooses vocabulary/terms
Confidence
Consistency using terms
Continually updates search skills
Curiosity
Enjoys Search Process
Experience doing searches for others
Experience in a particular system/database
Experience researching for a personal interest
Experience searching cross-discipline
Experience searching for current information
Experience searching multiple databases
Experience searching related to a hobby
Experience using multiple databases
Experience with multiple (3 or more) tools/databases
Experience with different information formats
Experience with finding aids
Experience with Google
Experience with library catalogue
Experience with MESH
Experience with non-digital searching
Experience with using fields to search
Familiar with many resources
Fearlessness
Flexibility
Formal training in Library Science
Good Analytical skills
Good communication skills
Good problem solver
Has taken a course in searching
Has taught others how to search
Knowing how to combine terms
Knowing how to exclude terms
Knowing the discipline
Knowing the terminology of the discipline
Knowing when information need is fulfilled or unable to be fulfilled
Knowing when/how to broaden previous search
Knowing when/how to limit previous search
Knowing where to go to find what you need
Knowing best tools to use
Knowing limitations of a tool
Makes an effort
Patience
Persistence
Planning
Plans the search based upon the database
Preparation

Items from Experts in Focus Group 3 (cont.)

Professional experience
Searches instinctually
Strong Organizational skills
Subject Expertise
Training in searching
Understanding Boolean searching
Understanding why you get certain results
Understands controlled vocabulary
Understands how indexing works
Understands limitations of corpus
Understands metadata tree
Understands ranking
Understands relevance
Uses Advanced Search Options
Uses expertise of others
Uses Limit by Date
Uses Quotation Marks
Uses Synonyms
Uses Truncation
Work experience in a field
Work experience that includes searching

APPENDIX C: FOCUS GROUP GUIDE

Members of the focus group had already received a copy of the item list under discussion. A short message was read aloud and then the researcher only listened or responded to direct questions.

Message read aloud

Thank you for participating in this research. As you know, I am Earl Bailey, the principal researcher. My role today will be to listen and take notes. I am taping this session so that we can study your reactions, but no information on your identities will be given to anyone outside this group. The tape of this session will be destroyed once this research is completed.

I have brought you together to discuss the list of items related to search expertise that you received in email. I want this to be an honest discussion of these items, including both good and not-so-good reactions. I ask that you use an identifier before your first few comments so that when I am listening to the tape I will be able to code the remark properly. Your identifier can be any name you like.

Please limit your discussion to the list of items as much as possible, although discussion of possible items to include is also on topic for this group. I will be giving you some exercises to perform with the cards that have been prepared from your interviews. Topics of interest to me are the item's usefulness for representing some aspect of search expertise, as well as thoughts on its measurement and importance.

Thank you, let's start with the first exercise.

Exercise 1 (25-30 minutes)

For the first exercise, I would like for you to work together, taking the note cards and sorting them into stacks that you consider to be closely related ideas or even redundant ideas. While you are sorting, if you happen to have a specific remark about the phrase written on the card, you may comment on it aloud or write your remark on the back of the card. If you wish, you may create a card representing a missing concept. You may also fasten the existing cards together using a clip if you believe the concepts to be the same. When you have finished grouping the cards, please create a new card for each group describing that group.

Break (5 minutes)

Exercise 2 (20-25 minutes)

For this exercise, please take the sorted cards and discuss how important they are, related to search expertise. Write on each card one of the following codes, based upon that importance.

Keep the cards grouped as you had them from exercise 1.

1 - Essential to Search Expertise
2 - Somewhat Important to Search Expertise
3 - Related or Less Important to Search Expertise
4 - Not at all Important to Search Expertise

Break (5 minutes)

Exercise 3 (40-45 minutes)

For each concept you designated as essential (1) and somewhat important (2) write on the back of the card how you might measure it as well as what scale you might use. If you are not sure how to measure this concept, simply write your reaction or concerns on the back of the card. Some examples that you might consider are on the cards I have laid out on the table, but these should be considered to be possibilities, not limitations.

At the end of the focus group, I thanked the participants again and reminded them that this discussion was to be considered private.

APPENDIX D: FOCUS GROUP RESULTS

Focus Group 1 Results

SORTED AS PERSONAL CHARACTERISTICS

- Curiosity
- Being dissatisfied with one search
- Good at learning and understanding new systems
- Flexibility
- Adaptivity
- Motivation
- Creativity
- Inspiration
- Persistence (combined with – Tenacity)

SORTED AS KNOWLEDGE OF SOURCES

- Choosing an appropriate source (combined with – Knowing when to use specific tools)
- Knowing sources
- Experience with non-digitized sources
- Knowing reliable websites
- Knowing about non-google search systems
- Familiarity with corpus
- Competence in resources
- Familiarity with information formats
- **ADDED**: Broad Knowledge of Information Universe
- Knowing that universe of information changes
- Knowing that you must update skills
- Knowing what information is available
- Knowing why information is available (motives)
- Understanding the information culture

SORTED AS GENERAL SEARCH EXPERIENCE

- Time spent online (combined with – Experience online)
- Experience with searching many different tasks (combined with – Specific search experience)
- Use basic search tools often
- Uses google frequently
- Familiarity with search tools
- Experience with databases

SORTED AS SEARCH TECHNOLOGY/DATABASE STRUCTURE

- Understanding search technology
- Good at analyzing information needs

SORTED AS EVALUATING RESULTS

- Confidently ignoring information that is not helpful
- Knowing/evaluating results (combined with – Being able to evaluate results, Evaluating accuracy of information)
- Accuracy/relevance

SORTED AS KNOWING LIMITATIONS

- Knowing the limits of your searching abilities/skills
- Knowing when to stop (walk away)
- Knowing what can't be found
- Knowing when the answer you found isn't good enough

SORTED AS FINDING RIGHT ANSWER IN CONTEXT

- Finding the answer
- Finding right answer within correct context
- Finding what you want

SORTED AS SUBJECT KNOWLEDGE

- Subject knowledge (combined with – Knowledge of what is being searched)

SORTED AS USE OF SEARCH STRATEGIES

- Uses search strategies
- Prepares for searching
- Thoughtfully trying more than one approach
- Getting more relevant results
- Good at fine tuning results
- Iterative searches
- Use of clarification
- Understanding connection between search terms and results
- Understanding how system will respond to request
- Knowing which fields are searchable (combined with – Understanding metadata)

SORTED BUT NOT NAMED

- Interacting with search system (non-casual) (combined with – Extensive experience with a search system)
- Understand thesaurus/controlled vocabulary (combined with – Being able to connect to unknown controlled vocabularies)
- Knowing the limitations of search tools
- **ADDED**: Phrase Searching, Advanced Features (combined with – Knowing truncation, Knowing quotes, Knowing Boolean)
- Knowing Google's advanced features

DELETED/UNUSED ITEMS

- Being able to handle difficult searches
- Bibliographic experience
- Experience searching for news
- Experience with a profession
- Experience with academic sources
- Experience with bibliographic tool
- Experience with hardware/software platforms
- Experience with worldcat
- Experience working on a reference desk
- Finding things for others
- Working with faculty/grad students

Focus Group 2 Results

SORTED AS KNOWLEDGE OF SPECIFIC DATABASES

- Knowledge of database coverage (combined with – Knowledge of database dates)
- Understands structure of database (combined with – Understands how information is structured)
- Knowing the limitations of a tool
- Utilize the specific strengths of a tool
- Able to use a tool
- Understands how data is searched by the tool
- Familiar with PubMed
- Understanding Google's personalization
- Understanding how Google works
- Uses Google's advanced tools

SORTED AS KNOWLEDGE OF VARIETY OF DATABASES

- Deliberate combination of tools
- Keeps up to date with sources (combined with – Keeps up to date with tools)
- Keeps up to date with technologies
- Ability to transfer skills to another system
- Knows the good sources
- Understands databases
- Thoughtful selection of database (combined with – Knows the best sources for a search need)

SORTED AS ACQUIRING SUBJECT KNOWLEDGE

- Spends time learning discipline
- Immersion in a topic area
- Able to transfer skills to another specialty

SORTED AS NON-SEARCH RELATED EXPERIENCE

- Has done inventory
- Has worked with archives
- Able to manipulate search using features
- Uses iterative searching
- Knows difference between OR / AND (combined with – Understands Boolean, Uses search strategies)
- Understands the logic of search (combined with – Can develop the logic of a search)
- Use of quotes in search
- Uses advanced search features (combined with – Use of adjacency in search)
- **ADDED**: Understands use of citations in search tools (combined with – Use of citations)
- Understands limiting search sets by time
- Understands limiting search sets by source (combined with – Understands limiting search sets by type of information)
- Knowledge of metadata
- Understands an index
- **ADDED**: Understands using an index in searching (combined with – Understands an index, Knowing MESH)
- Knowledge of common database fields
- Understanding full text search
- Uses Table of Content Searching

SORTED AS EXPERIENCE IN SEARCHING SPECIFIC SUBJECTS

- Has searched regarding a legal matter (combined with – Has searched for legal information)
- Has searched for information about a medication
- Has searched for information about a medical condition
- Has searched for information about a hobby
- Has done extensive research using search

SORTED AS MAINTAINING/IMPROVING SEARCH SKILL

- Spends time improving search skills
- Has searched for recent information
- Experience (amount of time spent using database)
- Uses search skills frequently (weekly)
- Experience (daily searching)
- Experience (years)
- Experience (reference desk)
- Experience (Bibliographic Database)
- Experience (tools)
- Has studied a tool **COMMENT**: database? Needs to be more specific
- Technological expertise

SORTED AS PERSONAL CHARACTERISTICS

- Passion for searching
- Persistence
- Humility
- Intuition
- Results oriented
- Self-awareness of search skills
- Open Mind
- Thinking about end result
- Ability to focus
- Organized
- Able to troubleshoot
- Has realistic expectations
- Patience
- Curiosity
- Efficient
- Effective

SORTED AS INTERPERSONAL SKILLS

- People skills
- Knows when to ask for help
- Good negotiation skills
- Able to market skills
- Able to communicate search results
- Good reviews from clients
- Experience (member of a team)
- Experience (working with others)
- **ADDED**: Ability to communicate with user to negotiate and understand the question
- **ADDED**: understanding user needs within the context of a reference interview (combined with – Uses context of search need)
- Understands key concepts **COMMENT**: needs more definition. Can analyze concepts within a search request
- Has worked with other expert searchers
- Has taught courses on search
- Has trained others in searching
- Has made presentations on search

SORTED AS FORMAL AND INFORMAL TRAINING

- Formal training in how to search
- Masters in Library and Information Science
- Has a degree in Information Science
- Self-trained in how to search

SORTED AS LANGUAGE SKILLS IN SEARCHING

- Good Language Skills
- Understands how language is used in searching
- Understands how language is used in storage
- Good Vocabulary

SORTED AS ANALYTICAL SKILLS

- Analytical
- Can judge information reliability (combined with – Can analyze reliability of information)
- Can judge information quality
- Understanding implications of search results
- Can analyze results
- Ability to predict search results
- Knows the standards
- Persistent analysis
- **ADDED**: Understanding Sensitivity and Specificity (combined with – Understanding Specificity, Understanding Sensitivity)
- Understanding relevance
- **ADDED** Self-evaluation of their search results (combined with – Satisfied with their search results)

SORTED AS UNDERSTANDING THE BODY OF LITERATURE

- Understanding the Body of Literature
- Understands publication cycle
- Understands the literature of a field
- Knows the subject
- Knows language of the field
- Knows medical terminology
- **ADDED**: Work Experience in a discipline (combined with – Experience in a discipline)

DELETED/UNUSED ITEMS

- Familiar with PubMed
- Has published papers on search
- Specialist in searching

Focus Group 3 Results

SORTED AS PERSONALITY

- Adaptability
- Confidence
- Curiosity
- Enjoys Search Process
- Fearlessness
- Flexibility
- Good Analytical skills
- Good communication skills
- Good problem solver
- Makes an effort
- Patience
- Persistence
- Searches instinctually
- Strong Organizational skills

SORTED AS INDEXING/CONTROLLED VOCABULARY

- Understands how indexing works
- Understanding Boolean searching (combined with – Knowing how to combine terms, Knowing how to exclude terms, Uses Quotation Marks, Uses Synonyms)
- Understands controlled vocabulary (combined with – Experience with MESH, Chooses vocabulary/terms, Understands metadata tree)
- Understands relevance (combined with – Understands ranking)
- Uses Advanced Search Options (combined with – Experience with using fields to search, Uses Limit by Date)
- Uses Truncation

SORTED AS EXPERIENCE

- Knowing the terminology of the discipline (combined with – Subject Expertise, Knowing the discipline)
- Understanding why you get certain results
- Able to move expertise to new systems
- Experience searching for current information
- Experience searching cross-discipline
- Professional experience (combined with – Work experience in a field)
- Experience with non-digital searching
- Work experience that includes searching
- Experience doing searches for others
- Experience searching related to a hobby (combined with – Experience researching for a personal interest)

SORTED AS TRAINING

- Continually updates search skills
- Formal training in Library Science
- Training in searching
- Has taught others how to search
- Has taken a course in searching

SORTED AS UNDERSTANDING RESULTS

- Knowing when/how to limit previous search
- Able to conduct systematic searches
- Knowing when/how to broaden previous search
- Knowing when information need is fulfilled or unable to be fulfilled
- Able to analyze results set
- Able to get consistent results
- Understanding Tools (combined with – Broad understanding of databases, Familiar with many resources, Experience using multiple databases, Experience with multiple (3 or more) tools/databases, Experience searching multiple databases, Experience with different information formats, Experience with Google, Experience with library catalogue, Experience in a particular system/database, Experience with finding aids)
- Planning
- Knowing limitations of a tool (combined with – Understands limitations of corpus)
- Planning
- Preparation
- Plans the search based upon the database
- Able to select best tool (combined with – Knowing where to go to find what you need, Knowing best tools to use)
- Able to translate a question into a search
- Able to define or state what they are searching for or what information they need (combined with – Able to break things apart)
- Uses expertise of others

APPENDIX E: COGNITIVE INTERVIEW GUIDE

A short message was read aloud when the participant's interview began.

> Thank you for participating in this research. As you know, I am Earl Bailey, the principal researcher. My role today will be to listen and take notes, or to ask for clarification on your reactions. I am recording your voice and your computer screen during this session so that I can study your reactions, but no information on your identity will be given to anyone outside this research. The tape of this session will be destroyed once this research is completed.
>
> I have asked you here to give me your thoughts and reactions as you answer a set of questions about online search. As you answer these questions, please speak aloud what you are thinking and feeling regarding the current question or even the set of questions in general. Please also say aloud your reaction if you are unsure or if you do not understand what a question is asking. I want your remarks to be your honest reactions, both good and not-so-good. Your comments will be examined later, but I will respond only when you need assistance or when I need clarification.
>
> I anticipate that this session should last from 45 to 60 minutes.
>
> I have sent you a copy of the information and consent form for this study. You have already indicated your consent electronically, but please indicate verbally now as well.
>
> May I begin? (start recording) Your responses will be used only for this research and will not be identified with your name or any other information about you. No personal information about you will be discussed during this interview.
>
> Thank you, please start the questions now on this laptop screen. The first few questions are to give you a chance to get feedback about thinking aloud. Take a look at the first question and speak aloud your reactions to it.
>
> (Listen to their reactions to the first sample question, then give feedback on their technique. Once that is done, proceed to the second sample question.)
>
> Now take a look at the second sample question and think aloud for it.
>
> (Give feedback again based upon their technique, then verify that they are clear on the process before continuing.)
>
> Alright, it's time to take the survey. Remember to think out loud and give your reactions to the questions as you answer them. I will not be stopping you after each question for feedback, so continue until you finish with the survey.

At the end of the interview, I thanked the participant again and gave them a $10 Amazon Gift Card.

APPENDIX F: COGNITIVE INTERVIEW RECRUITMENT

Recruitment (UNC Staff and Faculty List)

SUBJECT: [Informational] Study of Searching Ability

Hello. My name is Earl Bailey and I am a PhD student in the School of Information and Library Science at the University of North Carolina at Chapel Hill. I am interested in how people search online for information using tools like Google.

As part of my research, I have created a survey to use to measure different aspects of search expertise. I need your help testing it so that I can find any potential problems with the questions. Your reactions to the survey will help me see where it might need changes.

Your participation will consist of a 45 to 60-minute session answering the questions and speaking aloud to give your feedback on those questions.

Participation will give you the chance to help shape and define a measure of search expertise in the modern age. In addition, you will be given a $10.00 Amazon gift card as a thank you for participating in the interview.

Thank you for your attention. I hope that you will choose to participate. There are only 16 spots available, so please sign up today if you are interested!

Regards,
Earl Bailey

APPENDIX G: COGNITIVE INTERVIEWS FOLLOW-UP MESSAGES

This email was sent to potential participants after they responded to the online recruitment message.

Dear *Participant Name,*

Thank you for your interest in this research. Please reply to this email answering the following questions. You may cut and paste the questions and your answers, or simply respond to each question inline. Your answers to these questions will be used only to categorize our participants. There are no wrong answers and we need participants from all categories. Once we have received your answers, we will send you an email with further details.

Question 1. What type of online searcher are you?

Answers:
A. Expert, I search as part of my job
B. Above Average, I search for schoolwork or other information frequently.
C. I am an Average or Casual Online Searcher.
D. I don't really do a lot of searching for information.
E. Not Sure

Your Answer:

Question 2. How long have you been using Internet search tools?

Answers:
A. Less than 6 months
B. 6 to 12 months
C. 1 to 3 years
D. 4 to 6 years
E. 7 years or more

Your Answer:

Question 3. What kind of training have you had in how to search for information online?

Answers: A. Self taught
B. Learned from friend or relative
C. High School course
D. College course
E. Course at library
F. Other course

Your Answers: (Choose any that apply.)

Question 4. Do you have a degree from a Library or Information Science program?

Answers: A. Yes
B. No

Your Answer:

Thank you for your participation.

Regards,
Earl Bailey
Primary Investigator

This email was sent to all those who qualified, based upon the questions above. Qualification was based solely upon obtaining samples from varied skill levels.

Dear *Participant Name,*

Thank you for your interest and your answers to the categorizing questions. The next steps are reviewing the information sheet and scheduling your session. I am attaching an information sheet about this study outlining your rights as a research participant. Please let me know if you have questions about this sheet. If you don't have any concerns and agree to participate, we can then schedule your session. Your reply to this email to schedule your session indicates your consent to participate.

To schedule your session, please respond to this email with your availability over the next week. Remember that this session will be a one-on-one interview that will take approximately 45-60 minutes. This interview can take place in Manning Hall on campus or another location more convenient for you, whichever you prefer.

Thank you again for your participation.

Regards,
Earl Bailey
Primary Investigator

This email was sent to those not selected to participate in this stage.

Dear *Participant Name,*

Thank you for your interest in this research. All available slots for this phase of the research have been filled, but we can notify you of other opportunities to participate in the future. If you wish to be notified of future participation opportunities, please simply reply YES to this email.

Thank you again for your interest.

Regards,
Earl Bailey
Primary Investigator

This message was sent the day before the interview.

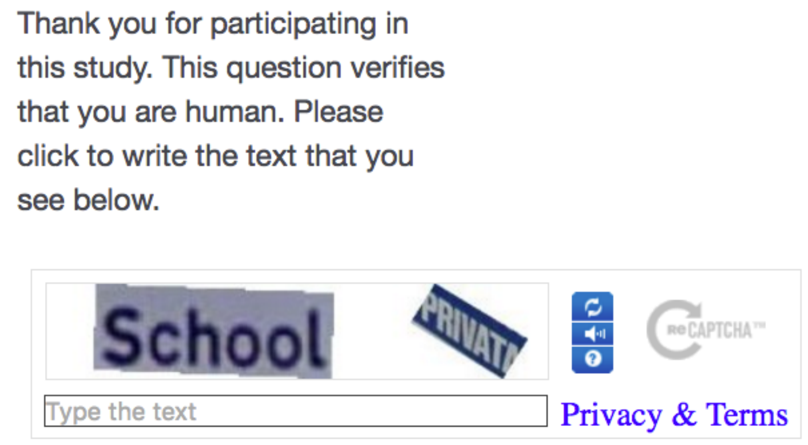
Your interview is scheduled for [date and time] at [location].

As a reminder, you have already been sent a form outlining your rights as a research participant. Please be sure to read over this form before coming to the interview.

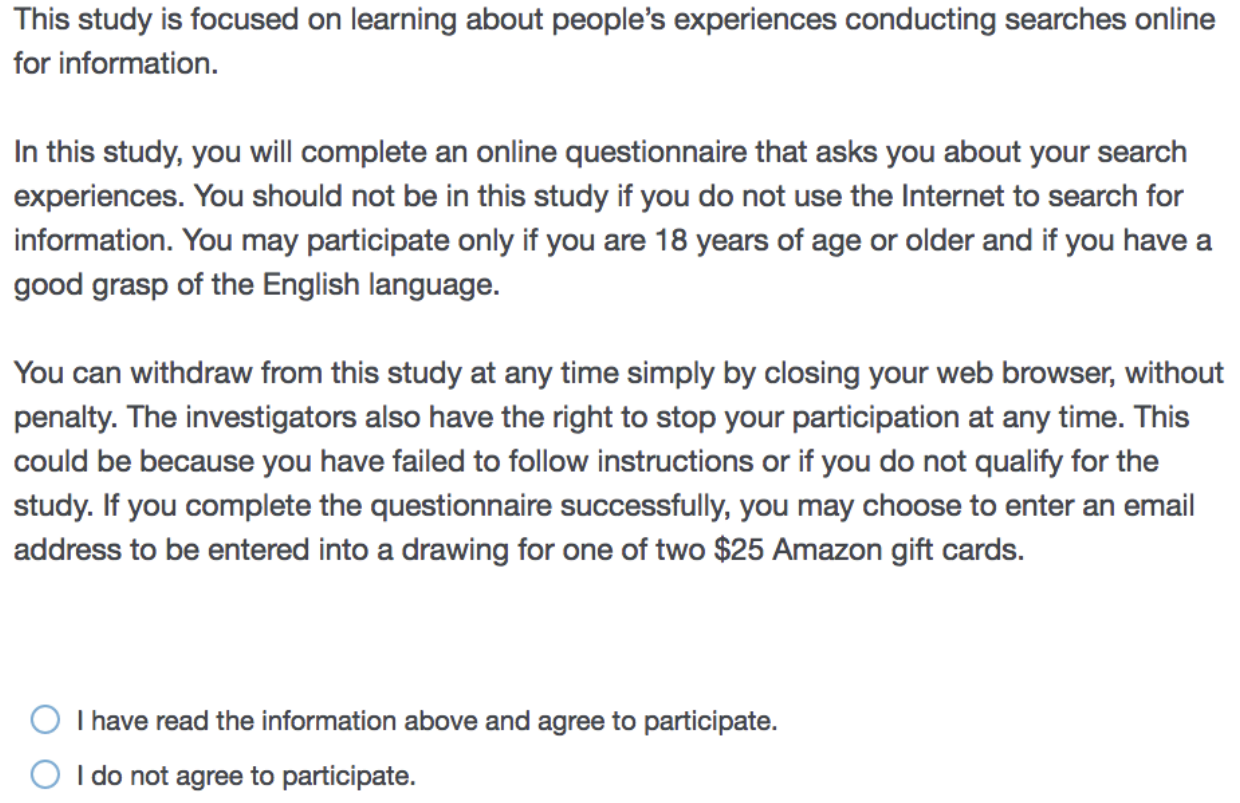
Thank you again and see you [date and time] at [location].

APPENDIX H: UPDATED INSTRUMENT USED FOR TESTING

This instrument was updated from the cognitive interview feedback and then used for online testing. Screenshots from Qualtrics are shown here just as they appeared in the participants' browsers, although not all questions were seen, depending on the participant's answers.



Thank you for participating in this study. This question verifies that you are human. Please click to write the text that you see below.



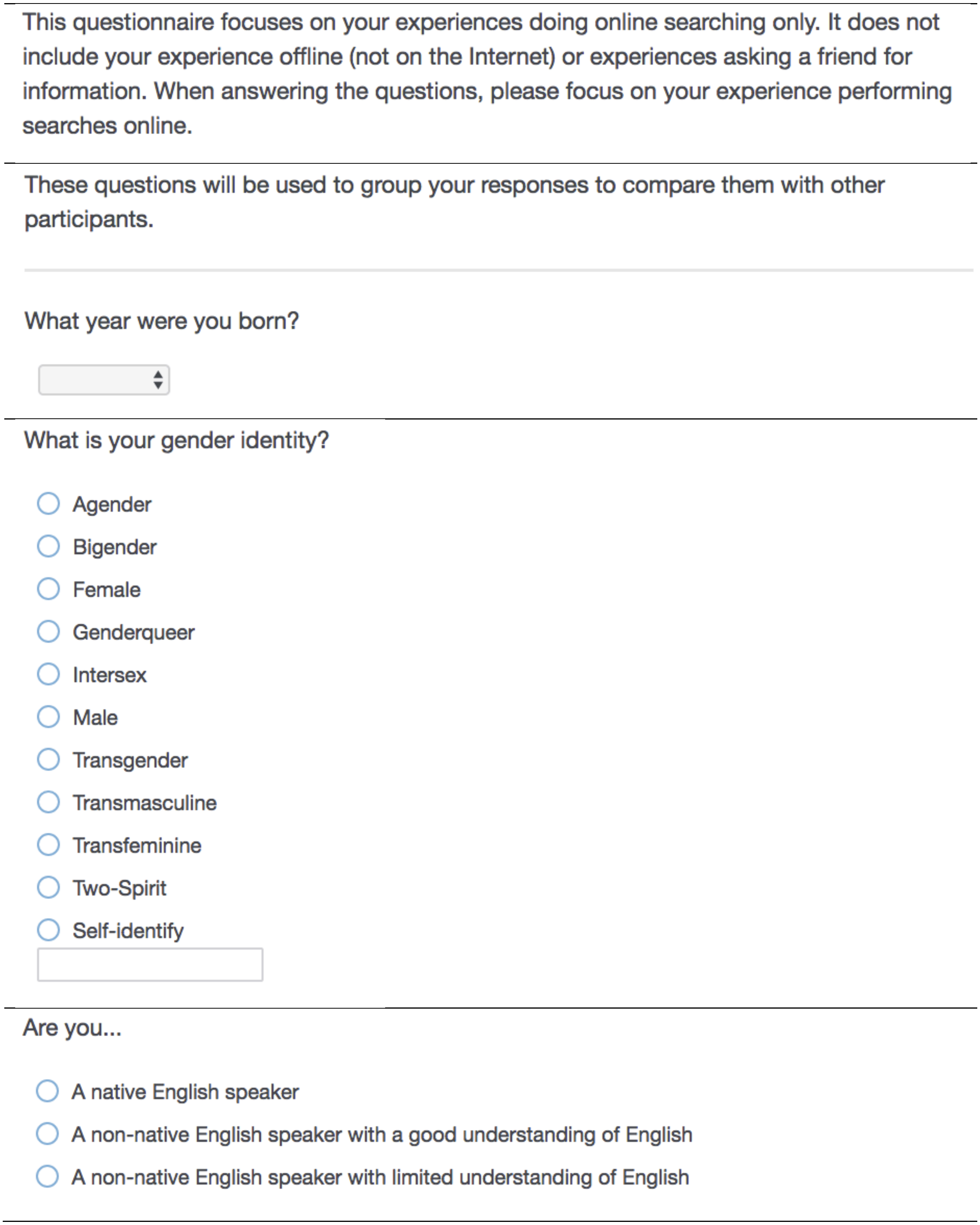
This study is focused on learning about people's experiences conducting searches online for information.

In this study, you will complete an online questionnaire that asks you about your search experiences. You should not be in this study if you do not use the Internet to search for information. You may participate only if you are 18 years of age or older and if you have a good grasp of the English language.

You can withdraw from this study at any time simply by closing your web browser, without penalty. The investigators also have the right to stop your participation at any time. This could be because you have failed to follow instructions or if you do not qualify for the study. If you complete the questionnaire successfully, you may choose to enter an email address to be entered into a drawing for one of two $25 Amazon gift cards.

○ I have read the information above and agree to participate.

○ I do not agree to participate.



This questionnaire focuses on your experiences doing online searching only. It does not include your experience offline (not on the Internet) or experiences asking a friend for information. When answering the questions, please focus on your experience performing searches online.

These questions will be used to group your responses to compare them with other participants.

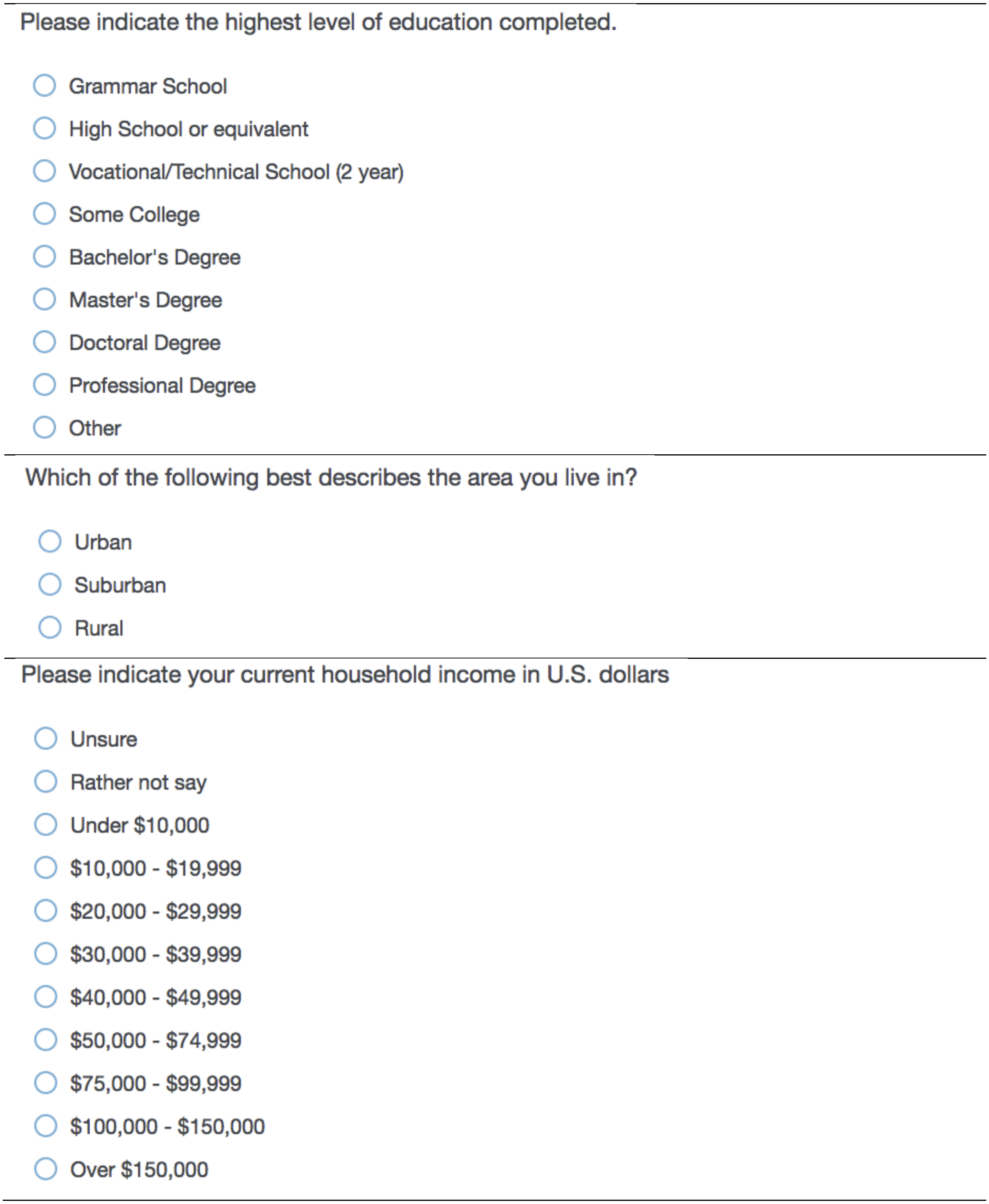
What year were you born?

What is your gender identity?

○ Agender
○ Bigender
○ Female
○ Genderqueer
○ Intersex
○ Male
○ Transgender
○ Transmasculine
○ Transfeminine
○ Two-Spirit
○ Self-identify

Are you...

○ A native English speaker
○ A non-native English speaker with a good understanding of English
○ A non-native English speaker with limited understanding of English



Please indicate the highest level of education completed.

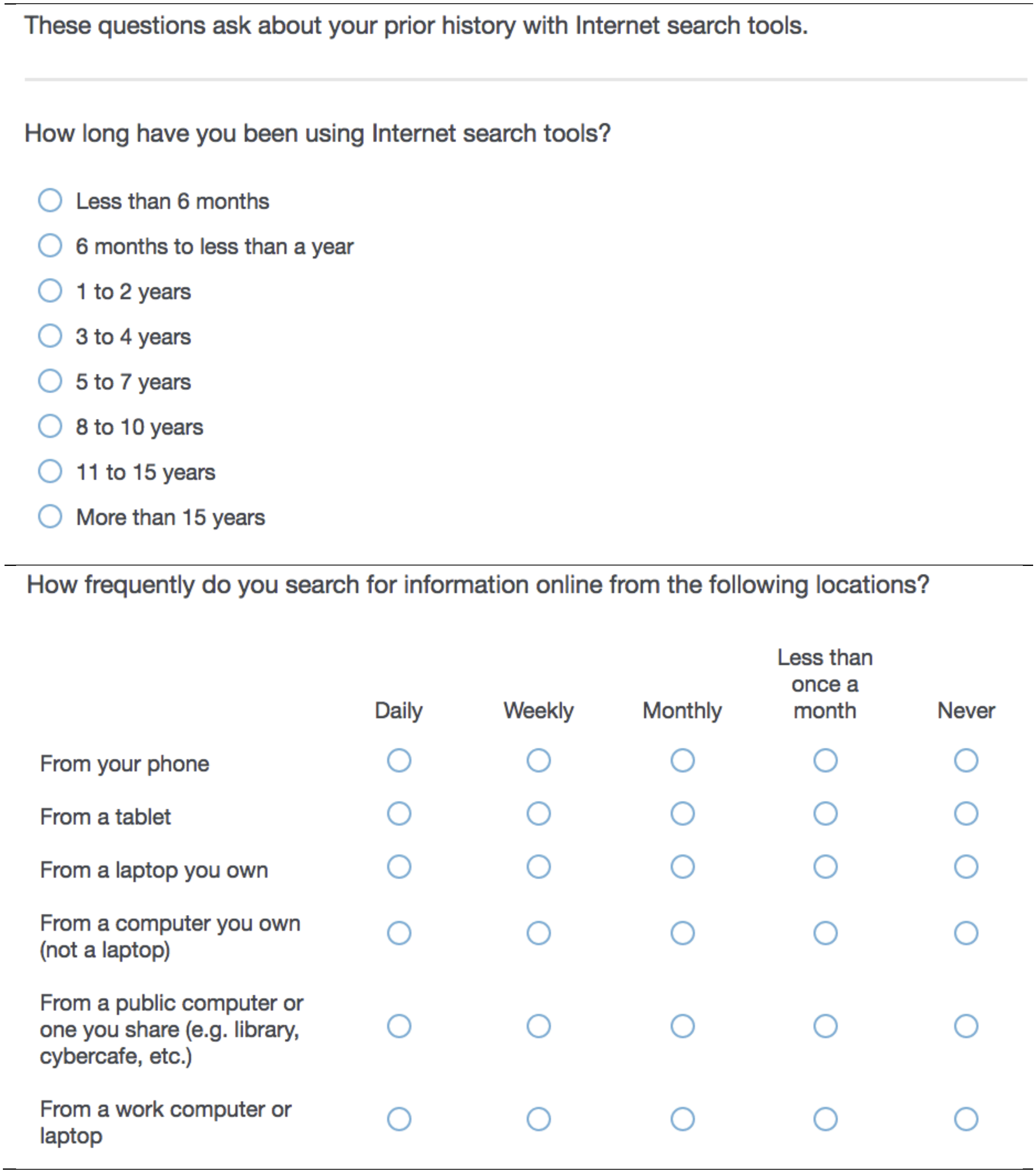
○ Grammar School
○ High School or equivalent
○ Vocational/Technical School (2 year)
○ Some College
○ Bachelor's Degree
○ Master's Degree
○ Doctoral Degree
○ Professional Degree
○ Other

Which of the following best describes the area you live in?

○ Urban
○ Suburban
○ Rural

Please indicate your current household income in U.S. dollars

○ Unsure
○ Rather not say
○ Under $10,000
○ $10,000 - $19,999
○ $20,000 - $29,999
○ $30,000 - $39,999
○ $40,000 - $49,999
○ $50,000 - $74,999
○ $75,000 - $99,999
○ $100,000 - $150,000
○ Over $150,000



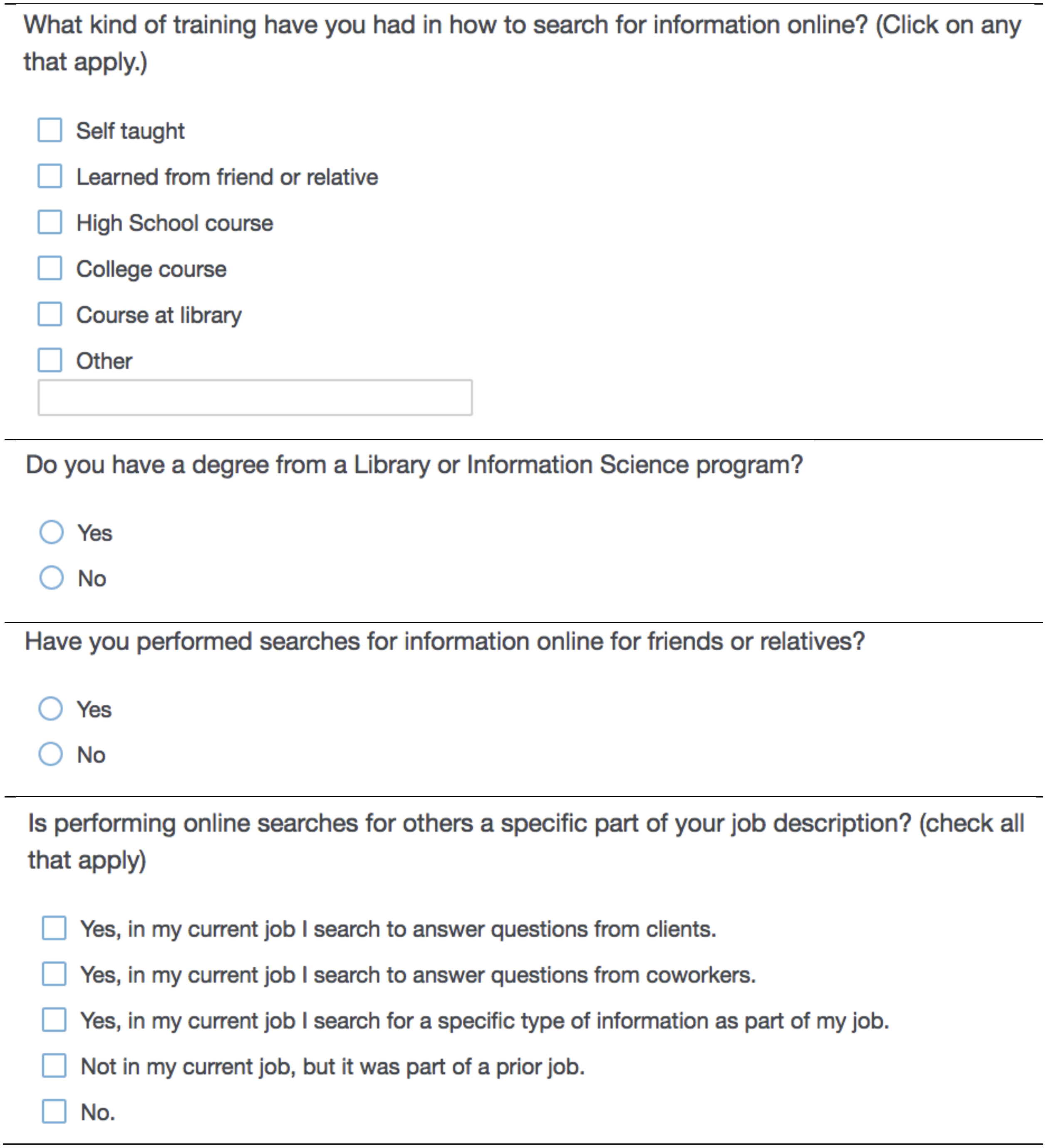
These questions ask about your prior history with Internet search tools.

How long have you been using Internet search tools?

- ○ Less than 6 months
- ○ 6 months to less than a year
- ○ 1 to 2 years
- ○ 3 to 4 years
- ○ 5 to 7 years
- ○ 8 to 10 years
- ○ 11 to 15 years
- ○ More than 15 years

How frequently do you search for information online from the following locations?

	Daily	Weekly	Monthly	Less than once a month	Never
From your phone	○	○	○	○	○
From a tablet	○	○	○	○	○
From a laptop you own	○	○	○	○	○
From a computer you own (not a laptop)	○	○	○	○	○
From a public computer or one you share (e.g. library, cybercafe, etc.)	○	○	○	○	○
From a work computer or laptop	○	○	○	○	○



What kind of training have you had in how to search for information online? (Click on any that apply.)

☐ Self taught
☐ Learned from friend or relative
☐ High School course
☐ College course
☐ Course at library
☐ Other

Do you have a degree from a Library or Information Science program?

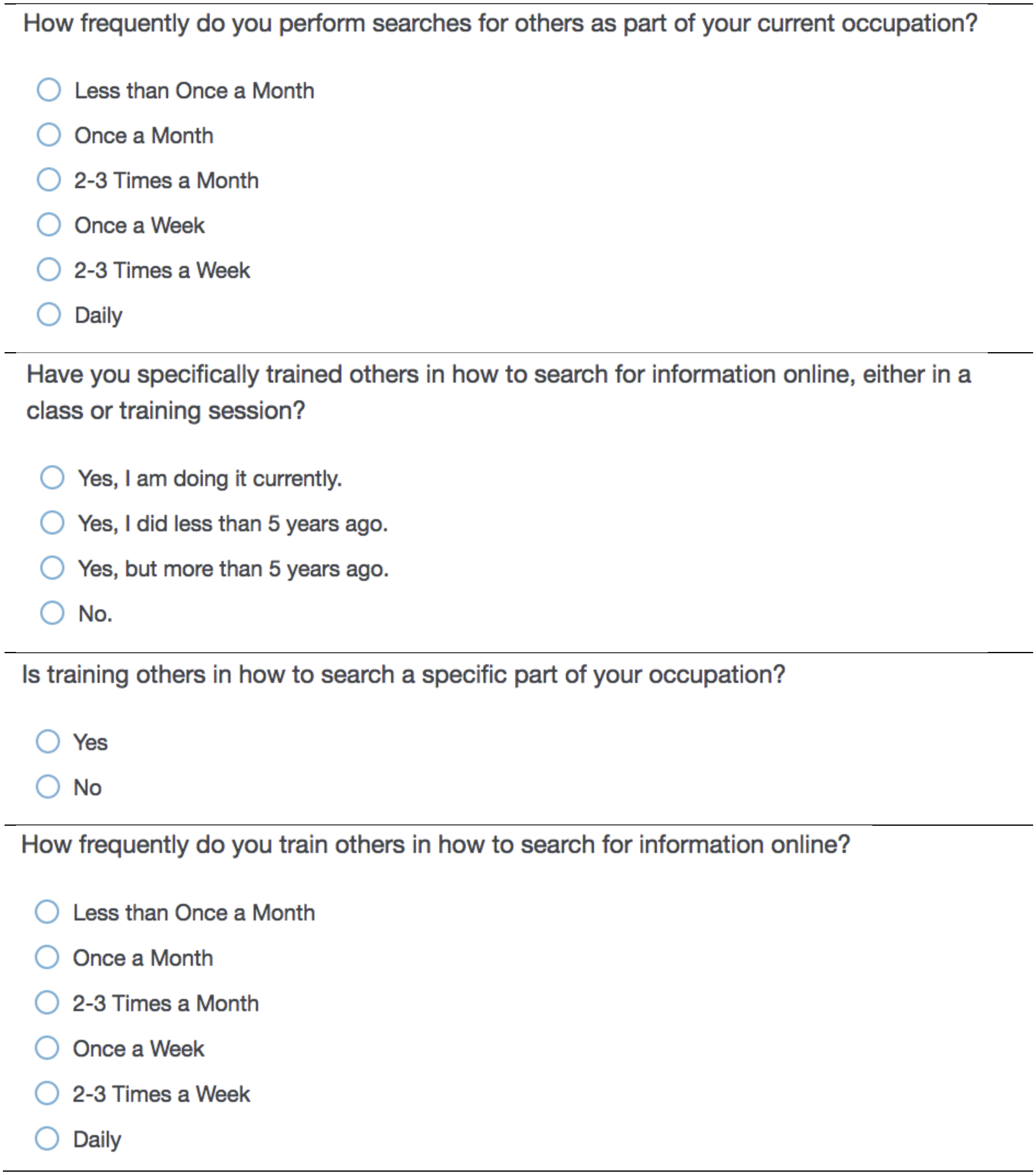
○ Yes
○ No

Have you performed searches for information online for friends or relatives?

○ Yes
○ No

Is performing online searches for others a specific part of your job description? (check all that apply)

☐ Yes, in my current job I search to answer questions from clients.
☐ Yes, in my current job I search to answer questions from coworkers.
☐ Yes, in my current job I search for a specific type of information as part of my job.
☐ Not in my current job, but it was part of a prior job.
☐ No.



How frequently do you perform searches for others as part of your current occupation?

- ○ Less than Once a Month
- ○ Once a Month
- ○ 2-3 Times a Month
- ○ Once a Week
- ○ 2-3 Times a Week
- ○ Daily

Have you specifically trained others in how to search for information online, either in a class or training session?

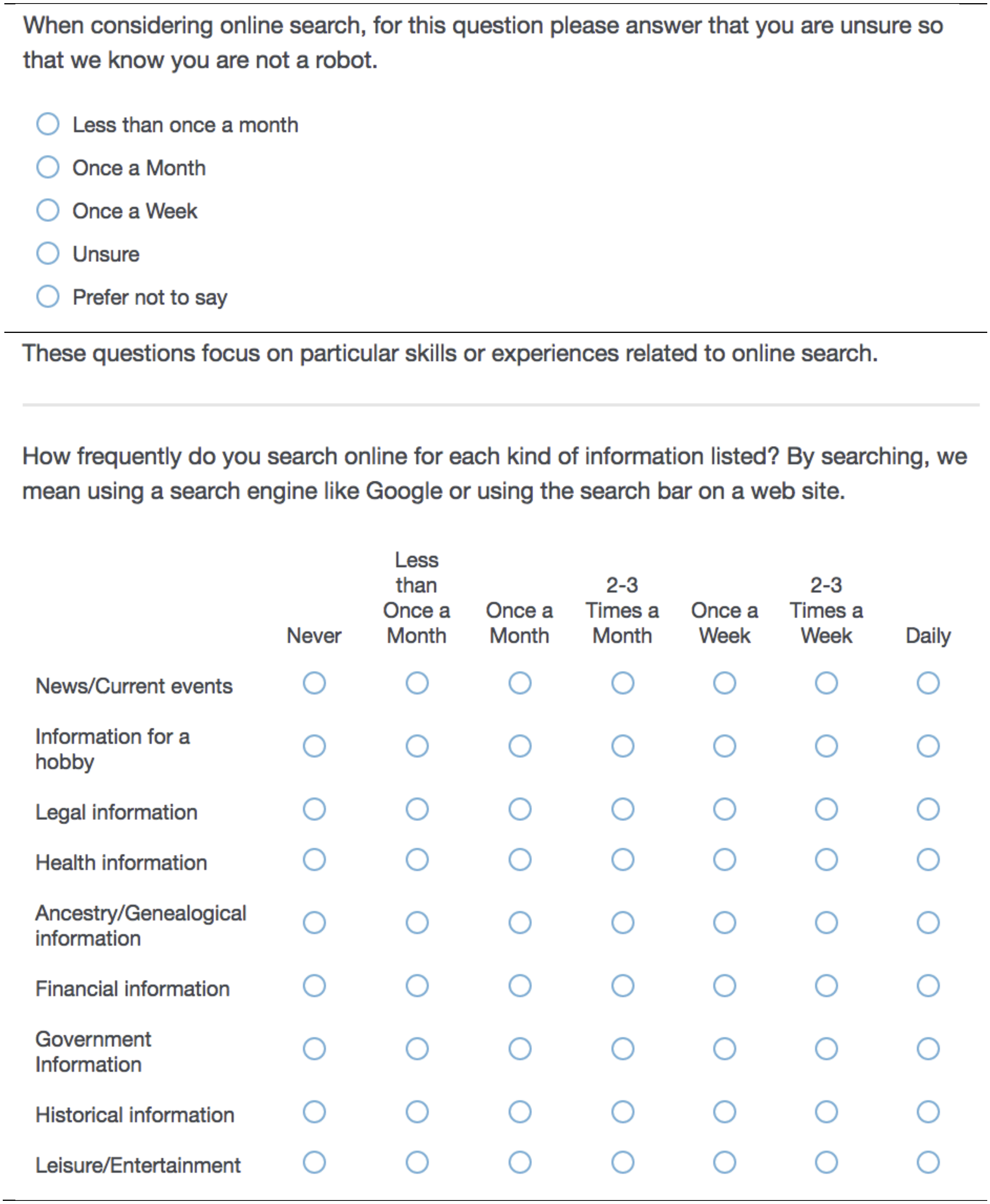
- ○ Yes, I am doing it currently.
- ○ Yes, I did less than 5 years ago.
- ○ Yes, but more than 5 years ago.
- ○ No.

Is training others in how to search a specific part of your occupation?

- ○ Yes
- ○ No

How frequently do you train others in how to search for information online?

- ○ Less than Once a Month
- ○ Once a Month
- ○ 2-3 Times a Month
- ○ Once a Week
- ○ 2-3 Times a Week
- ○ Daily



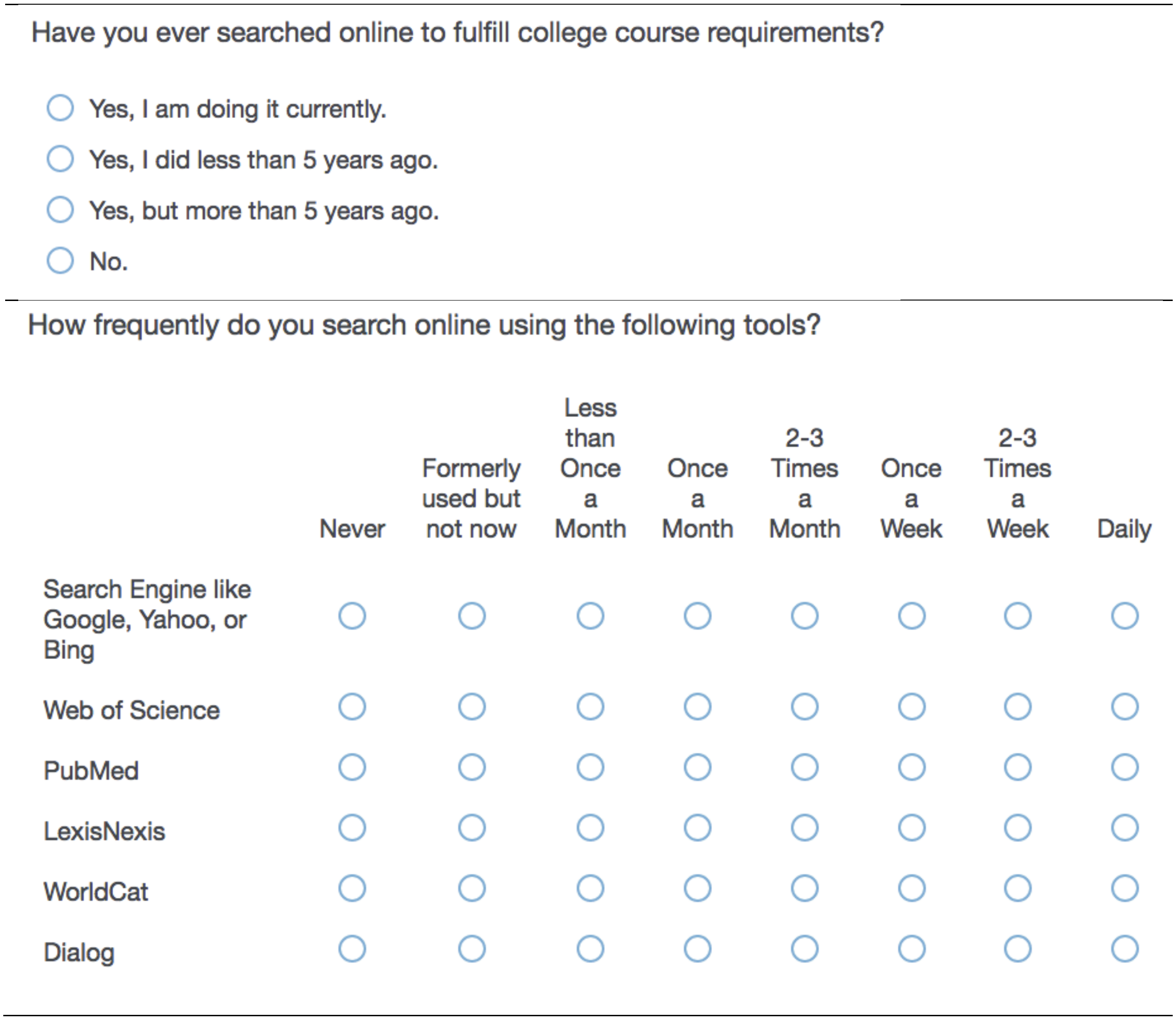
When considering online search, for this question please answer that you are unsure so that we know you are not a robot.

- ○ Less than once a month
- ○ Once a Month
- ○ Once a Week
- ○ Unsure
- ○ Prefer not to say

These questions focus on particular skills or experiences related to online search.

How frequently do you search online for each kind of information listed? By searching, we mean using a search engine like Google or using the search bar on a web site.

	Never	Less than Once a Month	Once a Month	2-3 Times a Month	Once a Week	2-3 Times a Week	Daily
News/Current events	○	○	○	○	○	○	○
Information for a hobby	○	○	○	○	○	○	○
Legal information	○	○	○	○	○	○	○
Health information	○	○	○	○	○	○	○
Ancestry/Genealogical information	○	○	○	○	○	○	○
Financial information	○	○	○	○	○	○	○
Government Information	○	○	○	○	○	○	○
Historical information	○	○	○	○	○	○	○
Leisure/Entertainment	○	○	○	○	○	○	○



Have you ever searched online to fulfill college course requirements?

○ Yes, I am doing it currently.
○ Yes, I did less than 5 years ago.
○ Yes, but more than 5 years ago.
○ No.

How frequently do you search online using the following tools?

	Never	Formerly used but not now	Less than Once a Month	Once a Month	2-3 Times a Month	Once a Week	2-3 Times a Week	Daily
Search Engine like Google, Yahoo, or Bing	○	○	○	○	○	○	○	○
Web of Science	○	○	○	○	○	○	○	○
PubMed	○	○	○	○	○	○	○	○
LexisNexis	○	○	○	○	○	○	○	○
WorldCat	○	○	○	○	○	○	○	○
Dialog	○	○	○	○	○	○	○	○

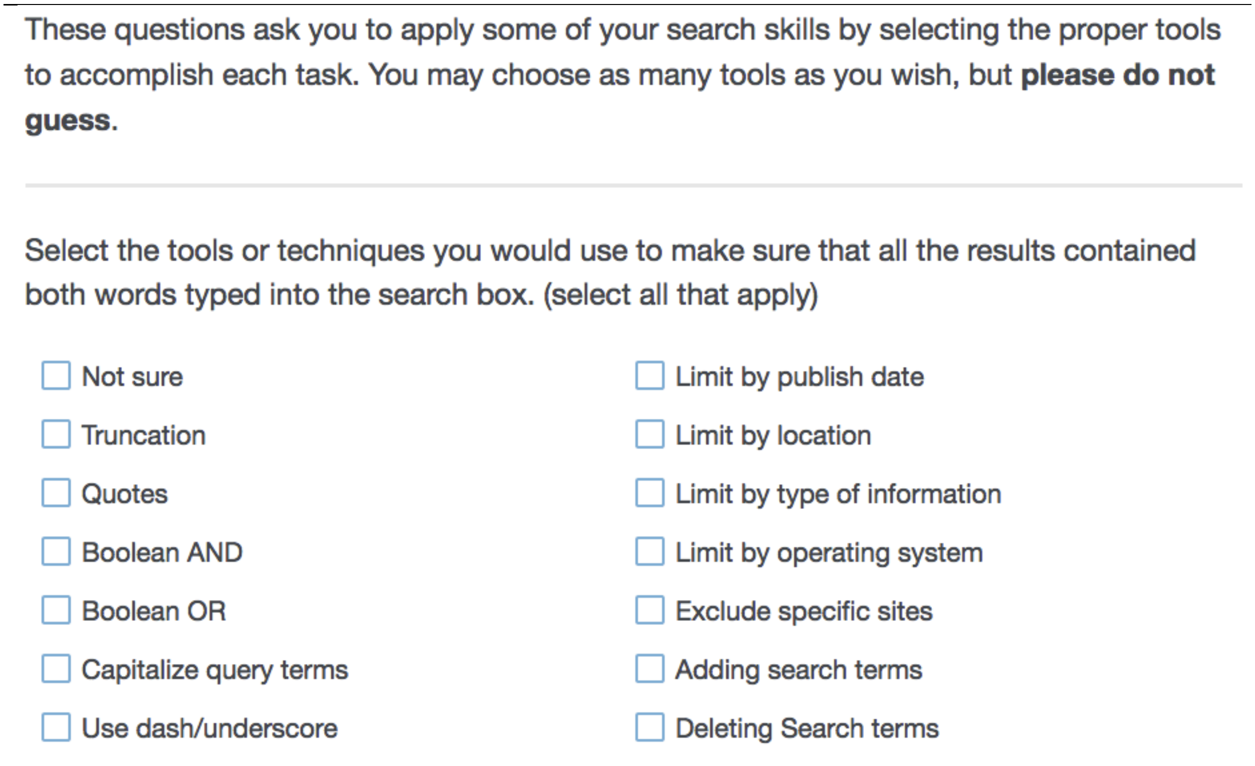
These questions ask for your assessment of your own search skills.

When searching, how familiar are you with each of these techniques?

	Not At All Familiar	Not Very Familiar	Somewhat Familiar	Reasonably Familiar	Extremely Familiar
Truncation	○	○	○	○	○
Quotes	○	○	○	○	○
Boolean logic (AND OR NOT)	○	○	○	○	○
Limit by publish date	○	○	○	○	○
Limit by location	○	○	○	○	○
Limit by type of information	○	○	○	○	○
Limit by price	○	○	○	○	○
Exclude specific sites	○	○	○	○	○

If you needed to perform an online search, how confident are you that you could ...

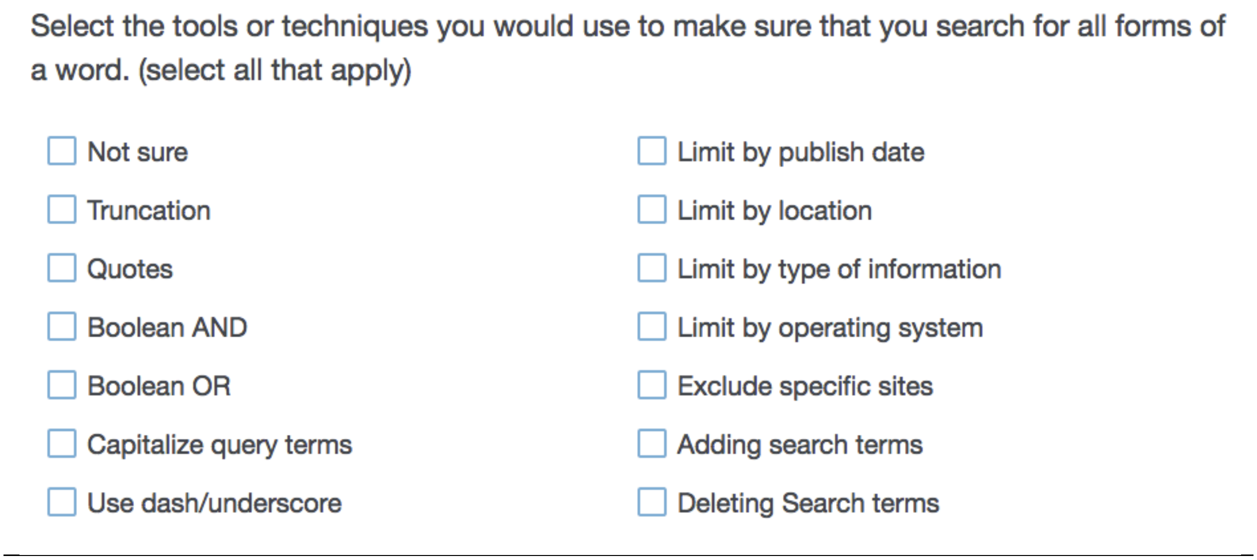
	Not At All Confident	Not very Confident	Somewhat Confident	Reasonably Confident	Extremely Confident
Find articles similar in quality to those obtained by a professional searcher?	○	○	○	○	○
Create a query that would return every useful document?	○	○	○	○	○
Create a query that would return only a few very useful documents?	○	○	○	○	○



These questions ask you to apply some of your search skills by selecting the proper tools to accomplish each task. You may choose as many tools as you wish, but **please do not guess**.

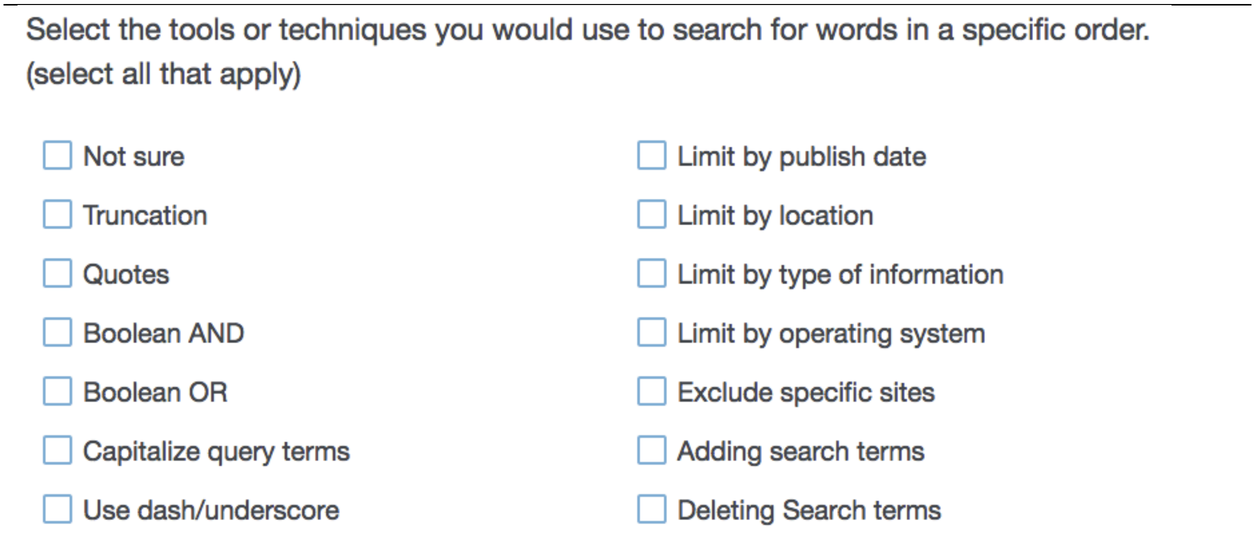
Select the tools or techniques you would use to make sure that all the results contained both words typed into the search box. (select all that apply)

☐ Not sure
☐ Truncation
☐ Quotes
☐ Boolean AND
☐ Boolean OR
☐ Capitalize query terms
☐ Use dash/underscore
☐ Limit by publish date
☐ Limit by location
☐ Limit by type of information
☐ Limit by operating system
☐ Exclude specific sites
☐ Adding search terms
☐ Deleting Search terms



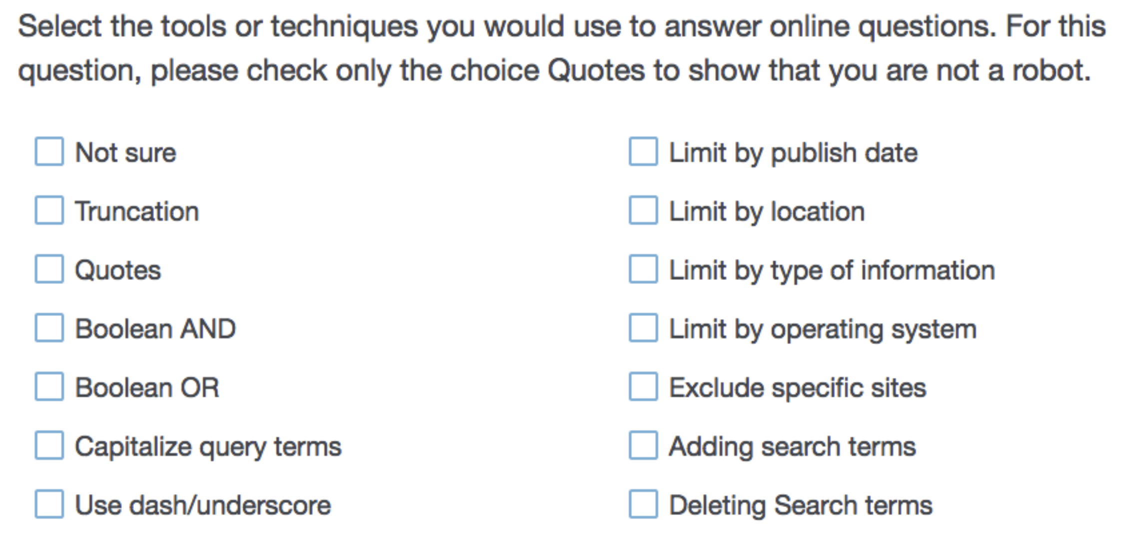
Select the tools or techniques you would use to make sure that you search for all forms of a word. (select all that apply)

☐ Not sure
☐ Truncation
☐ Quotes
☐ Boolean AND
☐ Boolean OR
☐ Capitalize query terms
☐ Use dash/underscore
☐ Limit by publish date
☐ Limit by location
☐ Limit by type of information
☐ Limit by operating system
☐ Exclude specific sites
☐ Adding search terms
☐ Deleting Search terms



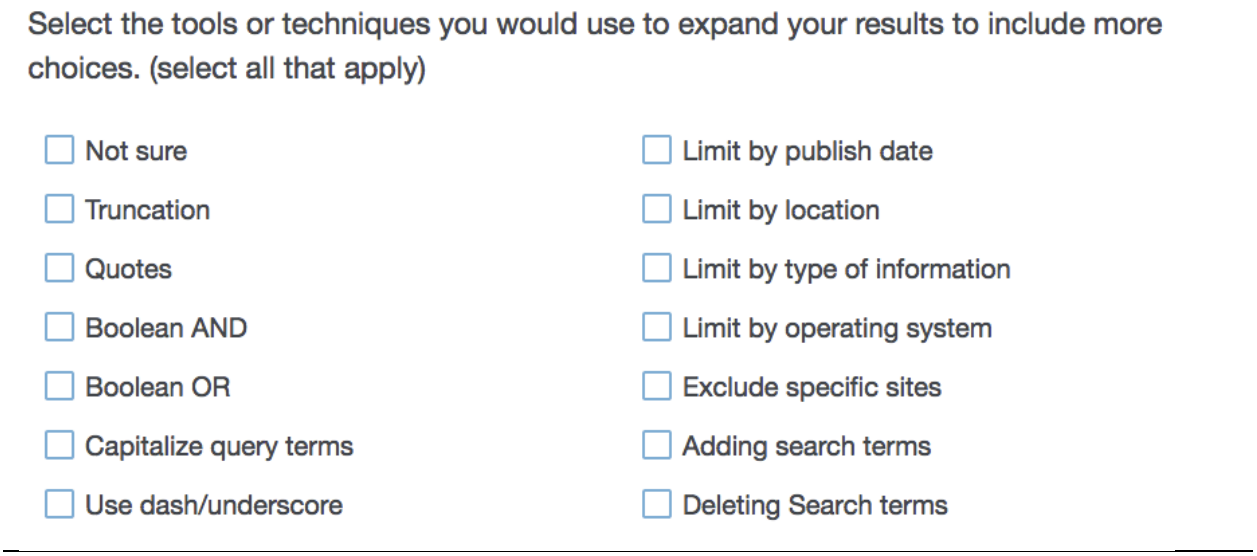
Select the tools or techniques you would use to search for words in a specific order. (select all that apply)

☐ Not sure
☐ Truncation
☐ Quotes
☐ Boolean AND
☐ Boolean OR
☐ Capitalize query terms
☐ Use dash/underscore
☐ Limit by publish date
☐ Limit by location
☐ Limit by type of information
☐ Limit by operating system
☐ Exclude specific sites
☐ Adding search terms
☐ Deleting Search terms



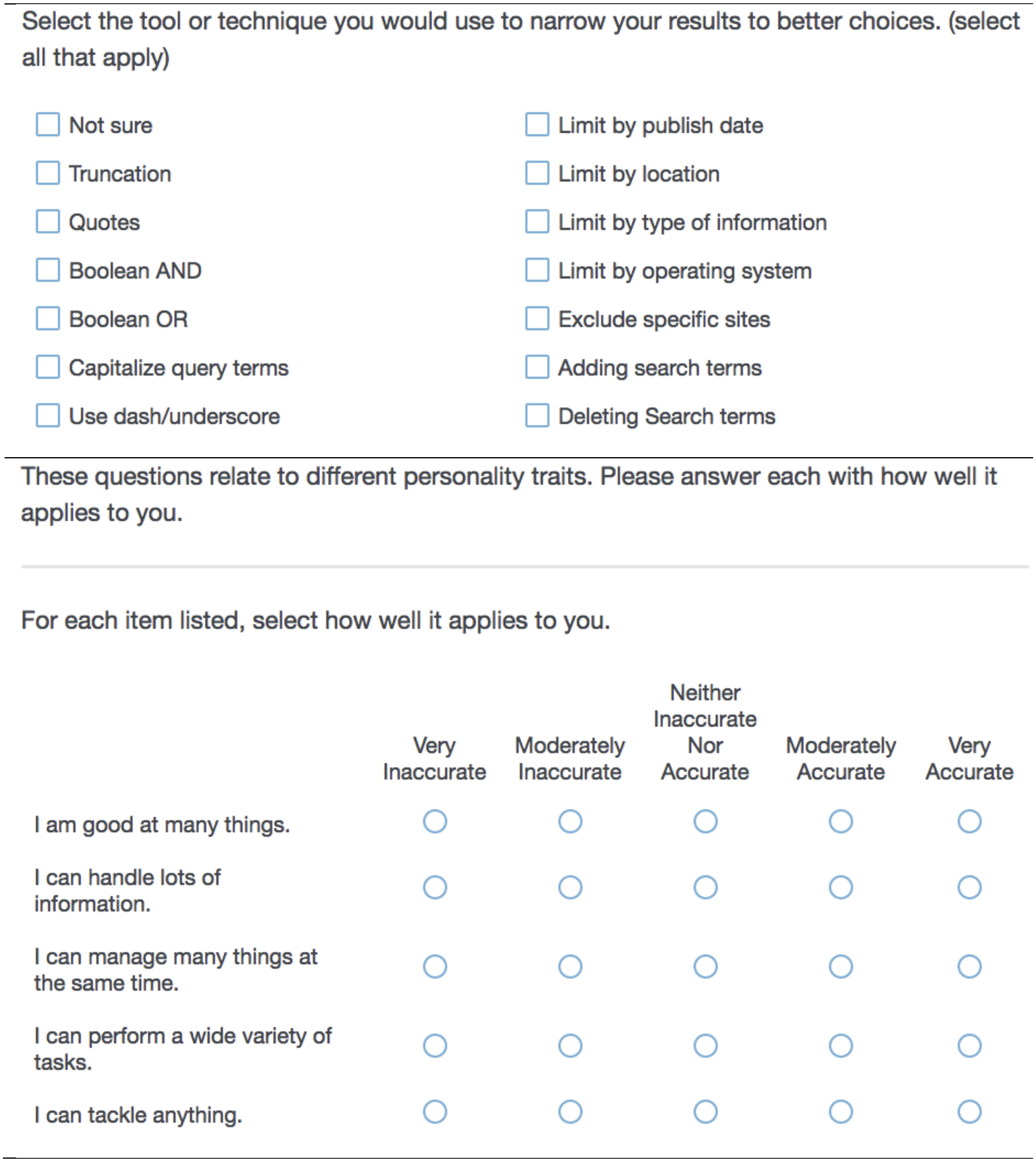
Select the tools or techniques you would use to answer online questions. For this question, please check only the choice Quotes to show that you are not a robot.

☐ Not sure
☐ Truncation
☐ Quotes
☐ Boolean AND
☐ Boolean OR
☐ Capitalize query terms
☐ Use dash/underscore
☐ Limit by publish date
☐ Limit by location
☐ Limit by type of information
☐ Limit by operating system
☐ Exclude specific sites
☐ Adding search terms
☐ Deleting Search terms



Select the tools or techniques you would use to expand your results to include more choices. (select all that apply)

☐ Not sure
☐ Truncation
☐ Quotes
☐ Boolean AND
☐ Boolean OR
☐ Capitalize query terms
☐ Use dash/underscore
☐ Limit by publish date
☐ Limit by location
☐ Limit by type of information
☐ Limit by operating system
☐ Exclude specific sites
☐ Adding search terms
☐ Deleting Search terms



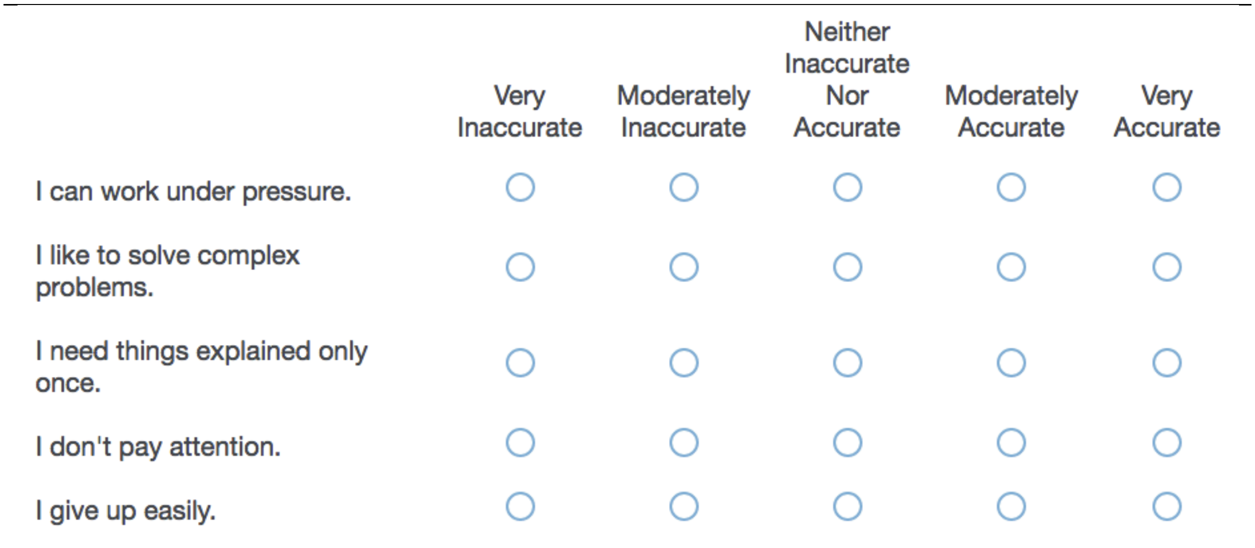
Select the tool or technique you would use to narrow your results to better choices. (select all that apply)

☐ Not sure
☐ Truncation
☐ Quotes
☐ Boolean AND
☐ Boolean OR
☐ Capitalize query terms
☐ Use dash/underscore
☐ Limit by publish date
☐ Limit by location
☐ Limit by type of information
☐ Limit by operating system
☐ Exclude specific sites
☐ Adding search terms
☐ Deleting Search terms

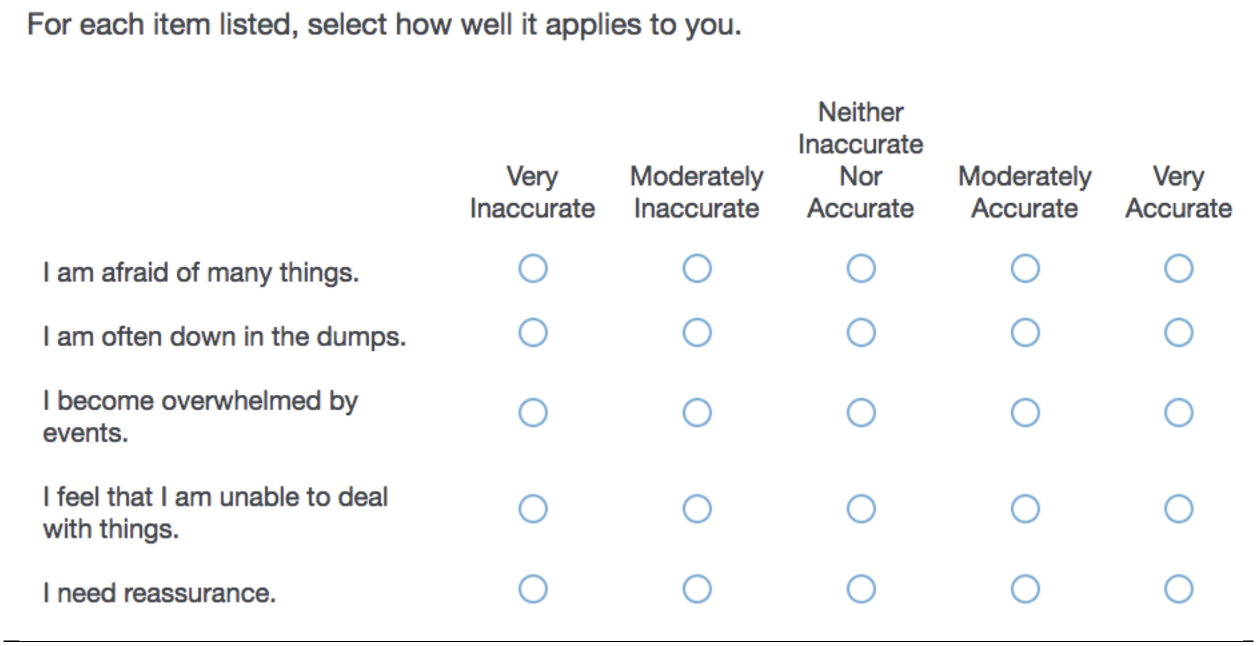
These questions relate to different personality traits. Please answer each with how well it applies to you.

For each item listed, select how well it applies to you.

	Very Inaccurate	Moderately Inaccurate	Neither Inaccurate Nor Accurate	Moderately Accurate	Very Accurate
I am good at many things.	○	○	○	○	○
I can handle lots of information.	○	○	○	○	○
I can manage many things at the same time.	○	○	○	○	○
I can perform a wide variety of tasks.	○	○	○	○	○
I can tackle anything.	○	○	○	○	○



	Very Inaccurate	Moderately Inaccurate	Neither Inaccurate Nor Accurate	Moderately Accurate	Very Accurate
I can work under pressure.	○	○	○	○	○
I like to solve complex problems.	○	○	○	○	○
I need things explained only once.	○	○	○	○	○
I don't pay attention.	○	○	○	○	○
I give up easily.	○	○	○	○	○



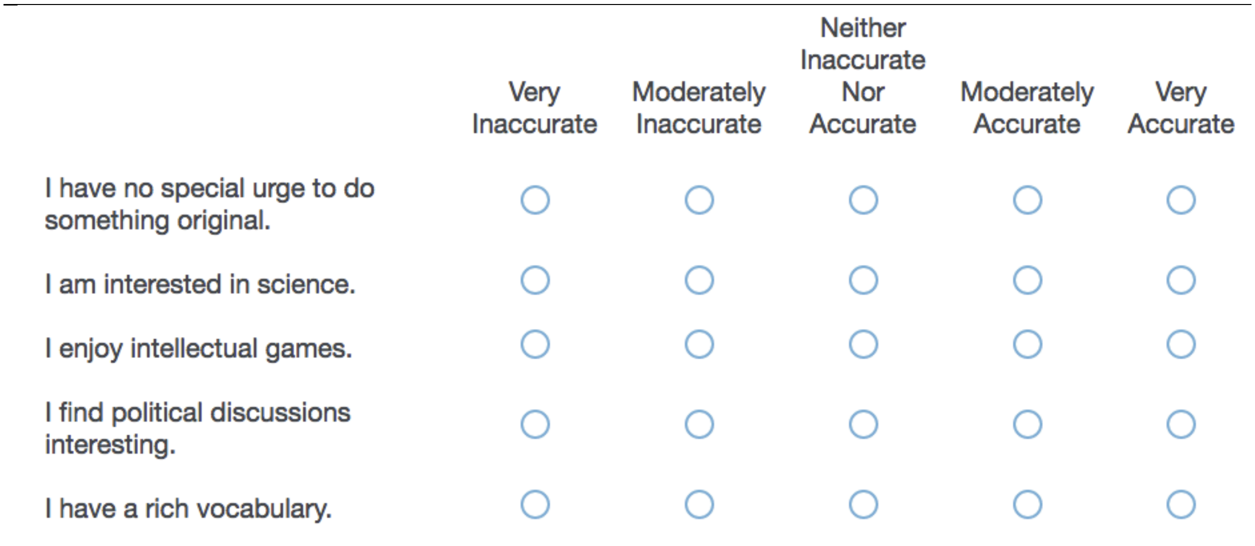
For each item listed, select how well it applies to you.

	Very Inaccurate	Moderately Inaccurate	Neither Inaccurate Nor Accurate	Moderately Accurate	Very Accurate
I am afraid of many things.	○	○	○	○	○
I am often down in the dumps.	○	○	○	○	○
I become overwhelmed by events.	○	○	○	○	○
I feel that I am unable to deal with things.	○	○	○	○	○
I need reassurance.	○	○	○	○	○

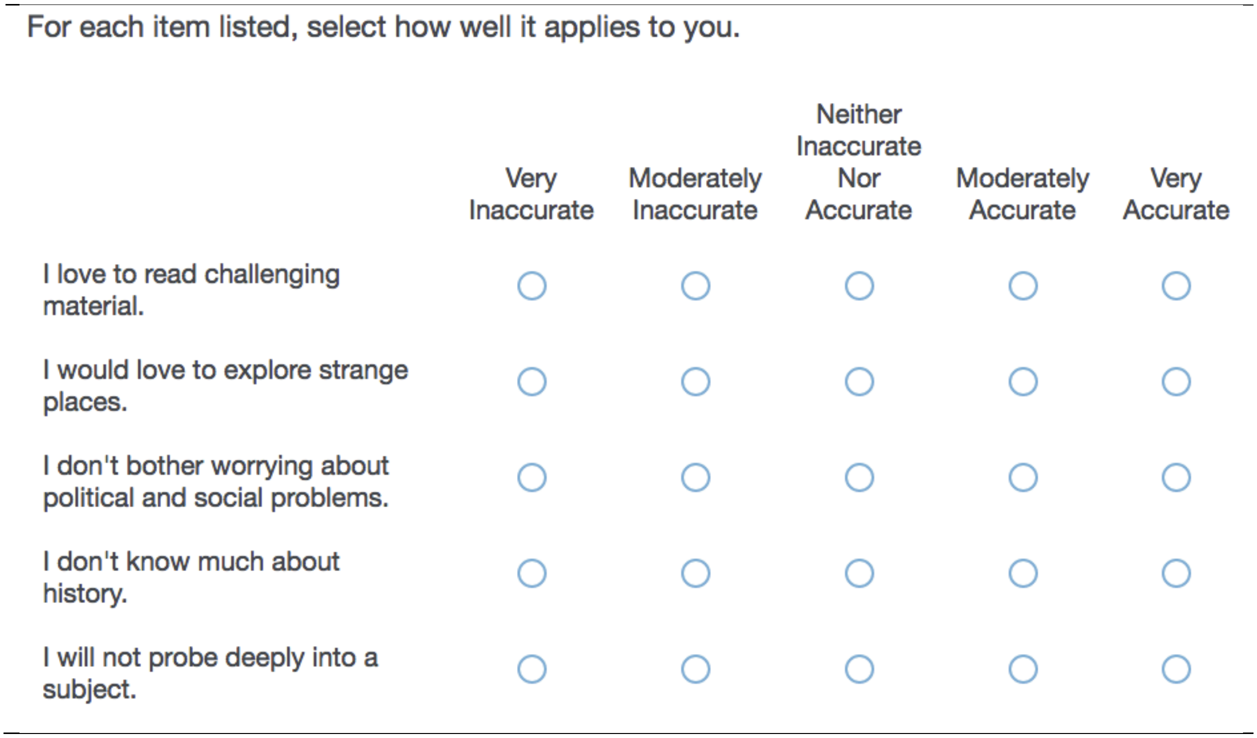
	Very Inaccurate	Moderately Inaccurate	Neither Inaccurate Nor Accurate	Moderately Accurate	Very Accurate
I readily overcome setbacks.	○	○	○	○	○
I think quickly.	○	○	○	○	○
I am reading this question and will answer very inaccurate.	○	○	○	○	○
I am able to come up with new and different ideas.	○	○	○	○	○
I am an original thinker.	○	○	○	○	○

For each item listed, select how well it applies to you.

	Very Inaccurate	Moderately Inaccurate	Neither Inaccurate Nor Accurate	Moderately Accurate	Very Accurate
I come up with new ways to do things.	○	○	○	○	○
I have an imagination that stretches beyond that of my friends.	○	○	○	○	○
I like to think of new ways to do things.	○	○	○	○	○
I am not considered to have new and different ideas.	○	○	○	○	○
I don't pride myself in being original.	○	○	○	○	○

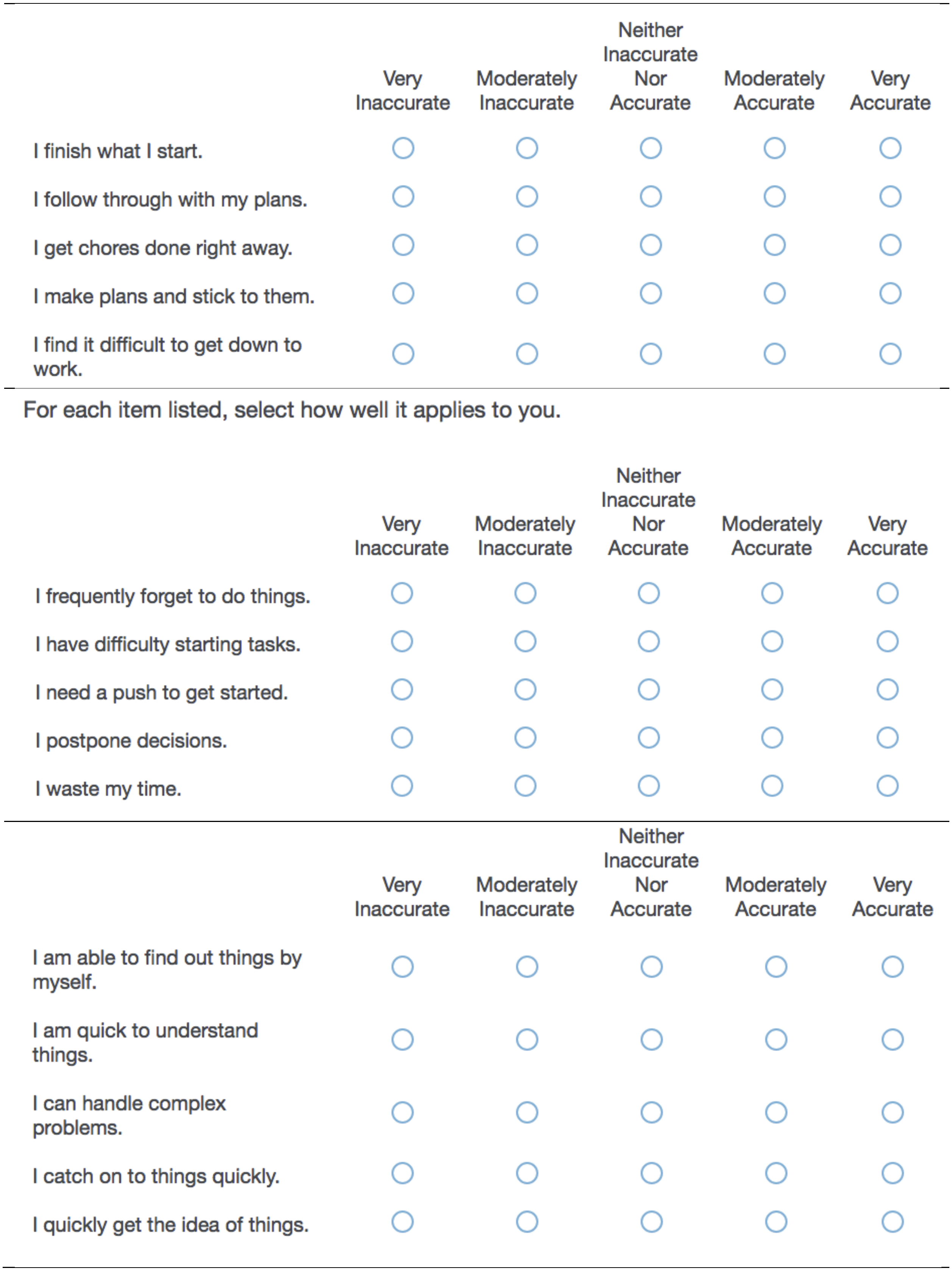


	Very Inaccurate	Moderately Inaccurate	Neither Inaccurate Nor Accurate	Moderately Accurate	Very Accurate
I have no special urge to do something original.	○	○	○	○	○
I am interested in science.	○	○	○	○	○
I enjoy intellectual games.	○	○	○	○	○
I find political discussions interesting.	○	○	○	○	○
I have a rich vocabulary.	○	○	○	○	○



For each item listed, select how well it applies to you.

	Very Inaccurate	Moderately Inaccurate	Neither Inaccurate Nor Accurate	Moderately Accurate	Very Accurate
I love to read challenging material.	○	○	○	○	○
I would love to explore strange places.	○	○	○	○	○
I don't bother worrying about political and social problems.	○	○	○	○	○
I don't know much about history.	○	○	○	○	○
I will not probe deeply into a subject.	○	○	○	○	○



	Very Inaccurate	Moderately Inaccurate	Neither Inaccurate Nor Accurate	Moderately Accurate	Very Accurate
I finish what I start.	○	○	○	○	○
I follow through with my plans.	○	○	○	○	○
I get chores done right away.	○	○	○	○	○
I make plans and stick to them.	○	○	○	○	○
I find it difficult to get down to work.	○	○	○	○	○

For each item listed, select how well it applies to you.

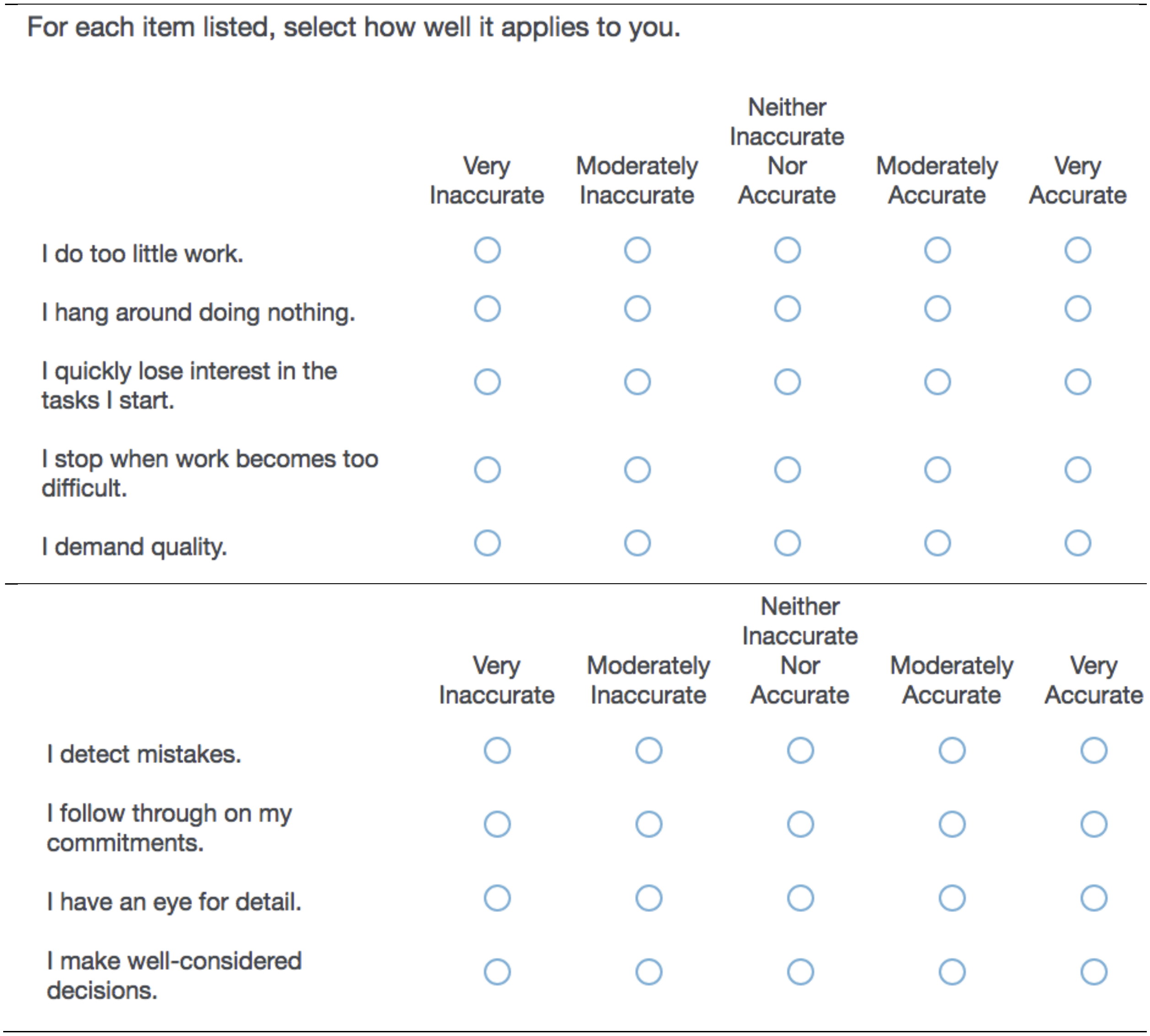
	Very Inaccurate	Moderately Inaccurate	Neither Inaccurate Nor Accurate	Moderately Accurate	Very Accurate
I frequently forget to do things.	○	○	○	○	○
I have difficulty starting tasks.	○	○	○	○	○
I need a push to get started.	○	○	○	○	○
I postpone decisions.	○	○	○	○	○
I waste my time.	○	○	○	○	○

	Very Inaccurate	Moderately Inaccurate	Neither Inaccurate Nor Accurate	Moderately Accurate	Very Accurate
I am able to find out things by myself.	○	○	○	○	○
I am quick to understand things.	○	○	○	○	○
I can handle complex problems.	○	○	○	○	○
I catch on to things quickly.	○	○	○	○	○
I quickly get the idea of things.	○	○	○	○	○

You are almost finished! There are just a couple more pages. Your responses are very important to me. For each item listed, select how well it applies to you.

	Very Inaccurate	Moderately Inaccurate	Neither Inaccurate Nor Accurate	Moderately Accurate	Very Accurate
I avoid difficult reading material.	○	○	○	○	○
I don't understand things.	○	○	○	○	○
I try to avoid complex people.	○	○	○	○	○
I am reading this question and will answer very accurate.	○	○	○	○	○
I am exacting in my work.	○	○	○	○	○

	Very Inaccurate	Moderately Inaccurate	Neither Inaccurate Nor Accurate	Moderately Accurate	Very Accurate
I complete tasks successfully.	○	○	○	○	○
I get started quickly on doing a job.	○	○	○	○	○
I push myself very hard to succeed.	○	○	○	○	○
I work hard.	○	○	○	○	○
I do just enough work to get by.	○	○	○	○	○



For each item listed, select how well it applies to you.

	Very Inaccurate	Moderately Inaccurate	Neither Inaccurate Nor Accurate	Moderately Accurate	Very Accurate
I do too little work.	○	○	○	○	○
I hang around doing nothing.	○	○	○	○	○
I quickly lose interest in the tasks I start.	○	○	○	○	○
I stop when work becomes too difficult.	○	○	○	○	○
I demand quality.	○	○	○	○	○

	Very Inaccurate	Moderately Inaccurate	Neither Inaccurate Nor Accurate	Moderately Accurate	Very Accurate
I detect mistakes.	○	○	○	○	○
I follow through on my commitments.	○	○	○	○	○
I have an eye for detail.	○	○	○	○	○
I make well-considered decisions.	○	○	○	○	○

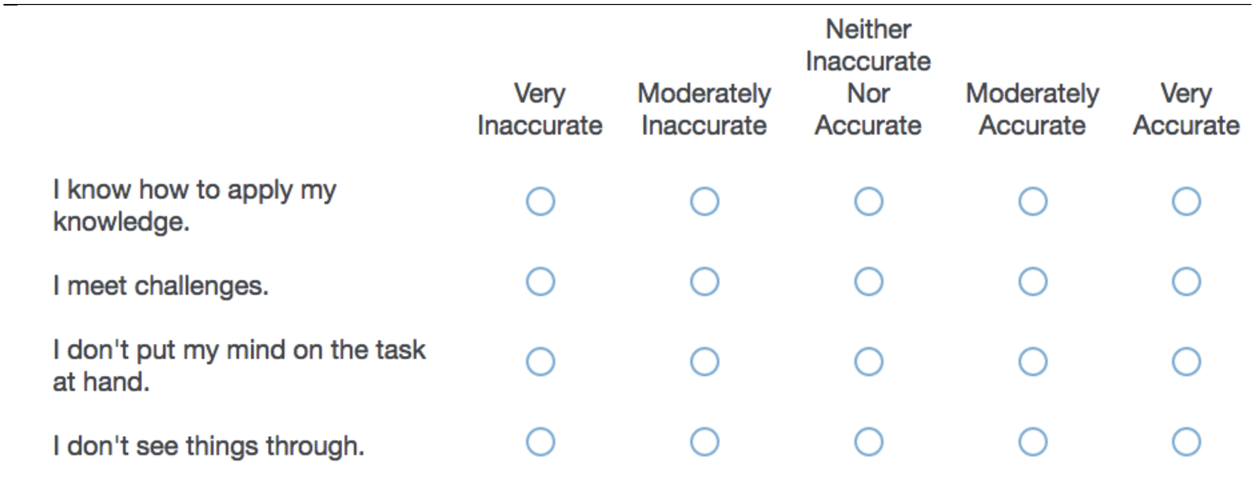
For each item listed, select how well it applies to you.

	Very Inaccurate	Moderately Inaccurate	Neither Inaccurate Nor Accurate	Moderately Accurate	Very Accurate
I pay attention to details.	○	○	○	○	○
I set high standards for myself and others.	○	○	○	○	○
I think ahead.	○	○	○	○	○
I put little time and effort into my work.	○	○	○	○	○
I seldom notice details.	○	○	○	○	○

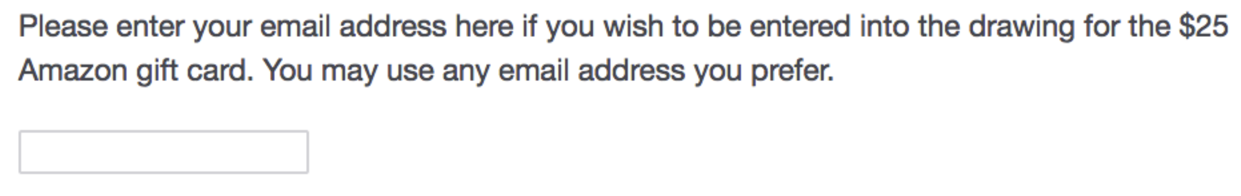
	Very Inaccurate	Moderately Inaccurate	Neither Inaccurate Nor Accurate	Moderately Accurate	Very Accurate
I am a goal-oriented person.	○	○	○	○	○
I am a hard worker.	○	○	○	○	○
I don't get sidetracked when I work.	○	○	○	○	○
I don't quit a task before it is finished.	○	○	○	○	○

Last Page! For each item listed, select how well it applies to you.

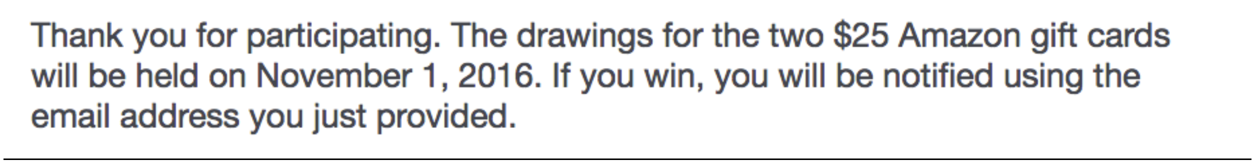
	Very Inaccurate	Moderately Inaccurate	Neither Inaccurate Nor Accurate	Moderately Accurate	Very Accurate
I finish things despite obstacles in the way.	○	○	○	○	○
I don't finish what I start.	○	○	○	○	○
I accept challenging tasks.	○	○	○	○	○
I feel up to any task.	○	○	○	○	○



	Very Inaccurate	Moderately Inaccurate	Neither Inaccurate Nor Accurate	Moderately Accurate	Very Accurate
I know how to apply my knowledge.	○	○	○	○	○
I meet challenges.	○	○	○	○	○
I don't put my mind on the task at hand.	○	○	○	○	○
I don't see things through.	○	○	○	○	○

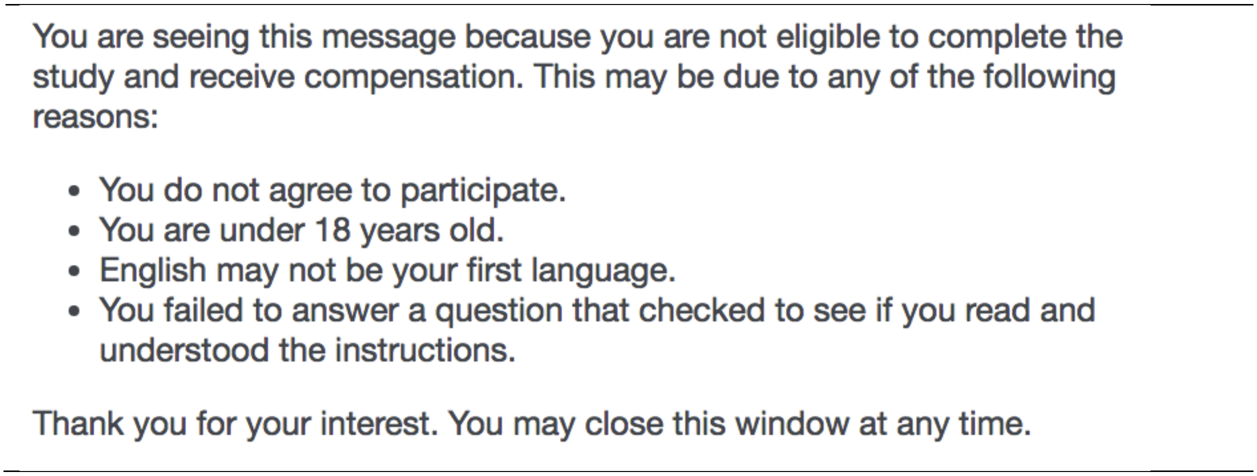


Please enter your email address here if you wish to be entered into the drawing for the $25 Amazon gift card. You may use any email address you prefer.



Thank you for participating. The drawings for the two $25 Amazon gift cards will be held on November 1, 2016. If you win, you will be notified using the email address you just provided.

(The following is the error message received if a participant failed one of the validation checks.)



You are seeing this message because you are not eligible to complete the study and receive compensation. This may be due to any of the following reasons:

- You do not agree to participate.
- You are under 18 years old.
- English may not be your first language.
- You failed to answer a question that checked to see if you read and understood the instructions.

Thank you for your interest. You may close this window at any time.

APPENDIX I: RECRUITMENT FOR ONLINE TESTING

Recruitment (Research Librarian Lists (RUSA and ASIS&T)

Title: What does it mean to be good at searching online? Be a part of finding the answer!

Are you an expert online searcher? What makes you an expert? We want to find out! We are seeking online search experts to fill out a short (5-7) minute survey to help determine which qualities or experience might set you apart from other searchers. Your participation is vital in order to compare your responses to the responses of the average searcher.

Please consider participating now – the survey will be available online for a limited time. Your participation will consist of answering a set of questions related to online searching, including some questions about your experience searching. Your answers to these questions will be anonymous and will be used to further refine the survey and to help determine what it takes to be an expert online searcher.

This is a research study. To join the study is voluntary. You may refuse to join, or you may withdraw your consent to be in the study, for any reason, without penalty. Research studies are designed to obtain new knowledge.

Participants who complete the survey will be entered into a drawing for one of two $25 Amazon gift cards as a thank you for participating.

Thank you for your attention. I hope that you will choose to participate. Please click on the link below to participate.

https://UNC.az1.qualtrics.com/SE/?SID=SV_e3a5di717PNtPHT

Regards,
Earl Bailey
School of Information and Library Science
University of North Carolina

Recruitment (UNC Staff List)

Title: Complete a short survey about how you search online

We are looking for all types and levels of online searchers to complete a short 5-7 minute survey online. Completing the survey will enter you in a raffle to win one of two $25 Amazon gift certificates as our thank you.

Please consider participating now – the survey will be available online for a limited time. Your participation will consist of answering a set of questions related to online searching, including some questions about your experience searching. Your answers to these questions will be completely anonymous.

This is a research study. To join the study is voluntary. You may refuse to join, or you may withdraw your consent to be in the study, for any reason, without penalty. Research studies are designed to obtain new knowledge.

Thank you for your attention. I hope that you will choose to participate. Please click on the link below to participate.

https://UNC.az1.qualtrics.com/SE/?SID=SV_6DRbBAKXvLMNyFD

Regards,
Earl Bailey
School of Information and Library Science
University of North Carolina

Recruitment notice for Amazon Mechanical Turk

Title: Study of Searching Ability

We are recruiting participants for a short (5-7 minute) survey related to searching online. Your participation will consist of answering a set of questions related to online searching, including some questions about your experience searching. Your answers to these questions will be completely anonymous.

This is a research study. To join the study is voluntary. You may refuse to join, or you may withdraw your consent to be in the study, for any reason, without penalty. Research studies are designed to obtain new knowledge.

Participants who complete the survey will receive $1.00 as a thank you for participating.

APPENDIX J: FAILURE MESSAGE

You are seeing this message because you are not eligible to complete the study and receive compensation. This may be due to any of the following reasons:

- You do not agree to participate.
- You are under 18 years old.
- English may not be your first language.
- You failed to answer a question that checked to see if you read and understood the instructions.

Thank you for your interest. You may close this window at any time.

APPENDIX K: FACTOR ANALYSIS TABLES

Table 125: Factor Analysis of Personality Items

Extraction Method: Maximum Likelihood. Eigenvalue=1.

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Factor	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	24.786	29.508	29.508	24.252	28.872	28.872
2	6.830	8.131	37.638	6.184	7.362	36.233
3	3.707	4.413	42.051	3.146	3.745	39.978
4	2.991	3.561	45.612	2.572	3.062	43.040
5	2.331	2.775	48.388	1.736	2.067	45.107
6	2.245	2.673	51.060	1.910	2.273	47.380
7	2.113	2.516	53.576	1.709	2.035	49.415
8	1.721	2.049	55.624	1.426	1.697	51.112
9	1.518	1.807	57.432	1.272	1.514	52.626
10	1.486	1.770	59.201	1.257	1.496	54.122
11	1.258	1.497	60.699	.747	.889	55.011
12	1.174	1.397	62.096	.837	.997	56.008
13	1.114	1.326	63.422	.745	.887	56.895
14	1.065	1.268	64.690	.565	.672	57.568
15	.996	1.186	65.876			
16	.970	1.155	67.031			
17	.937	1.115	68.146			
18	.878	1.045	69.191			
19	.859	1.022	70.213			
20	.848	1.009	71.222			
21	.844	1.004	72.226			
22	.787	.937	73.163			
23	.755	.898	74.062			
24	.752	.895	74.957			
25	.724	.862	75.819			
26	.698	.831	76.650			
27	.673	.802	77.451			
28	.656	.781	78.232			
29	.634	.755	78.987			
30	.625	.744	79.731			
31	.597	.711	80.442			
32	.592	.705	81.146			
33	.578	.688	81.835			
34	.570	.678	82.513			
35	.540	.643	83.155			
36	.537	.639	83.794			
37	.522	.621	84.416			
38	.500	.595	85.011			
39	.490	.583	85.594			

Table 125 (cont.): Factor Analysis of Personality Items

40	.473	.564	86.158			
41	.463	.551	86.709			
42	.442	.527	87.235			
43	.436	.519	87.755			
44	.424	.505	88.259			
45	.419	.499	88.758			
46	.407	.485	89.244			
47	.399	.475	89.719			
48	.389	.463	90.182			
49	.383	.457	90.639			
50	.375	.446	91.085			
51	.359	.427	91.512			
52	.348	.415	91.927			
53	.341	.406	92.333			
54	.338	.402	92.735			
55	.319	.380	93.115			
56	.315	.375	93.490			
57	.312	.372	93.862			
58	.300	.358	94.220			
59	.295	.352	94.571			
60	.282	.336	94.907			
61	.273	.325	95.232			
62	.266	.317	95.549			
63	.252	.300	95.849			
64	.235	.280	96.129			
65	.232	.276	96.405			
66	.224	.267	96.673			
67	.224	.266	96.939			
68	.211	.251	97.190			
69	.208	.247	97.437			
70	.199	.237	97.674			
71	.190	.226	97.900			
72	.185	.220	98.120			
73	.175	.209	98.328			
74	.167	.199	98.528			
75	.163	.194	98.722			
76	.153	.182	98.904			
77	.138	.164	99.068			
78	.135	.160	99.228			
79	.126	.150	99.378			
80	.120	.143	99.521			
81	.118	.140	99.662			
82	.111	.132	99.793			
83	.096	.114	99.907			
84	.078	.093	100.000			

Table 126: Factor Analysis of Personality Items, Eigenvalue 1.4

Extraction Method: Maximum Likelihood. Eigenvalue=1.4. Varimax Rotation.

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Factor	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	24.786	29.508	29.508	24.158	28.760	28.760	8.360	9.952	9.952
2	6.830	8.131	37.638	6.180	7.358	36.117	5.144	6.124	16.076
3	3.707	4.413	42.051	3.032	3.610	39.727	5.048	6.010	22.086
4	2.991	3.561	45.612	2.622	3.122	42.849	4.832	5.752	27.837
5	2.331	2.775	48.388	1.792	2.134	44.983	4.540	5.404	33.242
6	2.245	2.673	51.060	1.907	2.270	47.253	3.940	4.690	37.932
7	2.113	2.516	53.576	1.737	2.068	49.321	3.912	4.657	42.589
8	1.721	2.049	55.624	1.437	1.711	51.032	3.818	4.546	47.134
9	1.518	1.807	57.432	1.106	1.316	52.348	3.585	4.268	51.402
10	1.486	1.770	59.201	1.251	1.489	53.838	2.046	2.435	53.838
11	1.258	1.497	60.699						
12	1.174	1.397	62.096						
13	1.114	1.326	63.422						
14	1.065	1.268	64.690						
15	.996	1.186	65.876						
16	.970	1.155	67.031						
17	.937	1.115	68.146						
18	.878	1.045	69.191						
19	.859	1.022	70.213						
20	.848	1.009	71.222						
21	.844	1.004	72.226						
22	.787	.937	73.163						
23	.755	.898	74.062						
24	.752	.895	74.957						
25	.724	.862	75.819						
26	.698	.831	76.650						
27	.673	.802	77.451						
28	.656	.781	78.232						
29	.634	.755	78.987						
30	.625	.744	79.731						
31	.597	.711	80.442						
32	.592	.705	81.146						
33	.578	.688	81.835						
34	.570	.678	82.513						
35	.540	.643	83.155						
36	.537	.639	83.794						
37	.522	.621	84.416						
38	.500	.595	85.011						
39	.490	.583	85.594						

Table 126 (cont.): Factor Analysis of Personality Items, Eigenvalue 1.4

40	.473	.564	86.158						
41	.463	.551	86.709						
42	.442	.527	87.235						
43	.436	.519	87.755						
44	.424	.505	88.259						
45	.419	.499	88.758						
46	.407	.485	89.244						
47	.399	.475	89.719						
48	.389	.463	90.182						
49	.383	.457	90.639						
50	.375	.446	91.085						
51	.359	.427	91.512						
52	.348	.415	91.927						
53	.341	.406	92.333						
54	.338	.402	92.735						
55	.319	.380	93.115						
56	.315	.375	93.490						
57	.312	.372	93.862						
58	.300	.358	94.220						
59	.295	.352	94.571						
60	.282	.336	94.907						
61	.273	.325	95.232						
62	.266	.317	95.549						
63	.252	.300	95.849						
64	.235	.280	96.129						
65	.232	.276	96.405						
66	.224	.267	96.673						
67	.224	.266	96.939						
68	.211	.251	97.190						
69	.208	.247	97.437						
70	.199	.237	97.674						
71	.190	.226	97.900						
72	.185	.220	98.120						
73	.175	.209	98.328						
74	.167	.199	98.528						
75	.163	.194	98.722						
76	.153	.182	98.904						
77	.138	.164	99.068						
78	.135	.160	99.228						
79	.126	.150	99.378						
80	.120	.143	99.521						
81	.118	.140	99.662						
82	.111	.132	99.793						
83	.096	.114	99.907						
84	.078	.093	100.000						

Table 127: Factor Analysis of Personality & Self-Rated Search Ability Items, Eigenvalue=1

Extraction Method: Maximum Likelihood. Not rotated. Eigenvalue at default = 1.

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Factor	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	24.801	26.106	26.106	24.269	25.546	25.546
2	6.851	7.212	33.318	5.848	6.155	31.701
3	6.210	6.537	39.855	6.189	6.515	38.216
4	3.712	3.908	43.763	3.185	3.352	41.568
5	3.019	3.178	46.940	2.554	2.689	44.257
6	2.328	2.450	49.391	1.751	1.843	46.100
7	2.257	2.376	51.766	1.908	2.008	48.108
8	2.122	2.234	54.000	1.665	1.752	49.861
9	1.724	1.815	55.815	1.468	1.546	51.406
10	1.554	1.636	57.451	1.324	1.393	52.800
11	1.495	1.574	59.025	1.289	1.357	54.156
12	1.291	1.359	60.383	.928	.976	55.133
13	1.265	1.332	61.715	.733	.772	55.904
14	1.221	1.285	63.000	.795	.837	56.741
15	1.119	1.178	64.178	.852	.897	57.638
16	1.080	1.136	65.314	.757	.797	58.435
17	1.035	1.089	66.404	.567	.597	59.032
18	.981	1.032	67.436			
19	.951	1.002	68.437			
20	.908	.956	69.394			
21	.887	.934	70.328			
22	.880	.927	71.254			
23	.849	.894	72.148			
24	.810	.853	73.001			
25	.787	.829	73.830			
26	.764	.804	74.634			
27	.751	.791	75.425			
28	.724	.763	76.187			
29	.700	.737	76.924			
30	.675	.711	77.635			
31	.664	.699	78.334			
32	.648	.683	79.016			
33	.641	.675	79.691			
34	.623	.656	80.347			
35	.603	.634	80.982			
36	.584	.615	81.597			
37	.572	.602	82.199			
38	.550	.579	82.778			
39	.544	.573	83.351			
40	.528	.556	83.907			
41	.525	.553	84.460			

Table 127 (cont.): Factor Analysis of Personality & Self-Rated Search Ability Items, Eigenvalue=1

42	.496	.522	84.983			
43	.489	.515	85.498			
44	.483	.509	86.006			
45	.475	.500	86.506			
46	.457	.481	86.987			
47	.442	.466	87.453			
48	.432	.454	87.907			
49	.424	.447	88.354			
50	.418	.440	88.794			
51	.413	.435	89.228			
52	.404	.426	89.654			
53	.404	.425	90.079			
54	.386	.406	90.486			
55	.380	.400	90.885			
56	.373	.392	91.278			
57	.360	.379	91.656			
58	.349	.367	92.024			
59	.346	.364	92.388			
60	.330	.347	92.735			
61	.327	.344	93.079			
62	.317	.334	93.413			
63	.306	.322	93.735			
64	.301	.317	94.052			
65	.300	.315	94.368			
66	.286	.302	94.669			
67	.278	.292	94.961			
68	.263	.277	95.238			
69	.260	.274	95.512			
70	.245	.258	95.770			
71	.232	.244	96.014			
72	.225	.236	96.250			
73	.224	.235	96.485			
74	.214	.226	96.711			
75	.211	.222	96.933			
76	.209	.220	97.153			
77	.201	.212	97.365			
78	.194	.204	97.569			
79	.187	.197	97.765			
80	.184	.193	97.959			
81	.177	.187	98.145			
82	.175	.184	98.329			
83	.163	.172	98.501			
84	.160	.168	98.669			

Table 127 (cont.): Factor Analysis of Personality & Self-Rated Search Ability Items, Eigenvalue=1

85	.149	.157	98.826			
86	.138	.146	98.972			
87	.131	.137	99.110			
88	.127	.133	99.243			
89	.121	.127	99.370			
90	.115	.121	99.492			
91	.111	.117	99.609			
92	.104	.109	99.718			
93	.101	.106	99.824			
94	.094	.099	99.922			
95	.074	.078	100.000			

Table 128: Factor Analysis of Personality and Self-Efficacy Items, Eigenvalue=1.3

Extraction Method: Maximum Likelihood. Eigenvalue = 1.3

	Initial Eigenvalues			Rotation Sums of Squared Loadings		
Factor	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	24.801	26.106	26.106	9.068	9.545	9.545
2	6.851	7.212	33.318	5.681	5.980	15.525
3	6.210	6.537	39.855	5.208	5.483	21.008
4	3.712	3.908	43.763	5.142	5.413	26.421
5	3.019	3.178	46.940	4.758	5.009	31.430
6	2.328	2.450	49.391	4.574	4.815	36.244
7	2.257	2.376	51.766	3.814	4.014	40.259
8	2.122	2.234	54.000	3.787	3.986	44.245
9	1.724	1.815	55.815	3.727	3.923	48.168
10	1.554	1.636	57.451	3.468	3.651	51.819
11	1.495	1.574	59.025	1.797	1.892	53.711
12	1.291	1.359	60.383			
13	1.265	1.332	61.715			
14	1.221	1.285	63.000			
15	1.119	1.178	64.178			
16	1.080	1.136	65.314			
17	1.035	1.089	66.404			
18	.981	1.032	67.436			
19	.951	1.002	68.437			
20	.908	.956	69.394			
21	.887	.934	70.328			
22	.880	.927	71.254			
23	.849	.894	72.148			
24	.810	.853	73.001			
25	.787	.829	73.830			
26	.764	.804	74.634			
27	.751	.791	75.425			
28	.724	.763	76.187			
29	.700	.737	76.924			
30	.675	.711	77.635			
31	.664	.699	78.334			
32	.648	.683	79.016			
33	.641	.675	79.691			
34	.623	.656	80.347			
35	.603	.634	80.982			
36	.584	.615	81.597			
37	.572	.602	82.199			
38	.550	.579	82.778			
39	.544	.573	83.351			
40	.528	.556	83.907			
41	.525	.553	84.460			
42	.496	.522	84.983			

Table 128 (cont.): Factor Analysis of Personality and Self-Efficacy Items, Eigenvalue=1.3

43	.489	.515	85.498			
44	.483	.509	86.006			
45	.475	.500	86.506			
46	.457	.481	86.987			
47	.442	.466	87.453			
48	.432	.454	87.907			
49	.424	.447	88.354			
50	.418	.440	88.794			
51	.413	.435	89.228			
52	.404	.426	89.654			
53	.404	.425	90.079			
54	.386	.406	90.486			
55	.380	.400	90.885			
56	.373	.392	91.278			
57	.360	.379	91.656			
58	.349	.367	92.024			
59	.346	.364	92.388			
60	.330	.347	92.735			
61	.327	.344	93.079			
62	.317	.334	93.413			
63	.306	.322	93.735			
64	.301	.317	94.052			
65	.300	.315	94.368			
66	.286	.302	94.669			
67	.278	.292	94.961			
68	.263	.277	95.238			
69	.260	.274	95.512			
70	.245	.258	95.770			
71	.232	.244	96.014			
72	.225	.236	96.250			
73	.224	.235	96.485			
74	.214	.226	96.711			
75	.211	.222	96.933			
76	.209	.220	97.153			
77	.201	.212	97.365			
78	.194	.204	97.569			
79	.187	.197	97.765			
80	.184	.193	97.959			
81	.177	.187	98.145			
82	.175	.184	98.329			
83	.163	.172	98.501			
84	.160	.168	98.669			
85	.149	.157	98.826			
86	.138	.146	98.972			
87	.131	.137	99.110			

Table 128 (cont.): Factor Analysis of Personality and Self-Efficacy Items, Eigenvalue=1.3

88	.127	.133	99.243			
89	.121	.127	99.370			
90	.115	.121	99.492			
91	.111	.117	99.609			
92	.104	.109	99.718			
93	.101	.106	99.824			
94	.094	.099	99.922			
95	.074	.078	100.000			

Extraction Method: Maximum Likelihood. Eigenvalue = 1.3

Table 129: Rotated Factor Matrix for Personality and Self-Reported Ability – Highest Value for Each Item Shaded

Items	Factors										
	1	2	3	4	5	6	7	8	9	10	11
Self-Reported Search Ability: When searching, how familiar are you with Truncation?	.019	.614	-.028	-.046	-.034	-.016	-.013	-.011	.012	-.004	-.003
Self-Reported Search Ability: When searching, how familiar are you with Quotes?	.024	.595	-.063	-.003	-.036	.034	-.027	-.003	-.031	-.016	.026
Self-Reported Search Ability: When searching, how familiar are you with Boolean logic?	-.003	.611	.010	-.076	-.042	.050	-.023	.055	-.015	-.027	-.011
Self-Reported Search Ability: When searching, how familiar are you with Limit by publish date?	-.026	.873	-.006	.013	.030	-.062	.023	.031	-.026	.027	-.012
Self-Reported Search Ability: When searching, how familiar are you with Limit by location?	-.002	.893	.014	.017	-.019	-.091	.009	-.031	.029	.027	.000
Self-Reported Search Ability: When searching, how familiar are you with Limit by type of information?	.010	.892	.008	.005	.034	-.105	.012	-.027	-.018	.023	-.017
Self-Reported Search Ability: When searching, how familiar are you with Limit by price?	-.012	.697	.006	.066	.076	-.097	.053	-.061	.028	.015	-.004
Self-Reported Search Ability: When searching, how familiar are you with Exclude specific sites?	-.052	.709	-.039	-.021	.023	-.098	.015	-.040	.013	-.002	.027
Self-Reported Search Ability: How confident - create query return only a few good results?	-.030	.527	.083	-.067	.023	.041	-.006	.053	.018	-.023	-.027
Self-Reported Search Ability: How confident - create query that would return every useful result?	-.033	.614	.012	-.037	-.008	.078	.003	.003	.046	.030	.016
Self-Reported Search Ability: How confident - find articles in quality same as expert searcher?	.022	.700	-.005	-.031	-.063	.091	.010	.056	-.053	.031	-.028
Analytical: I am good at many things.	.127	.008	.127	.306	-.026	.598	.143	.072	.083	.123	.006
Analytical/Flexibility: I can handle lots of information.	.153	-.024	.216	.178	.000	.675	.064	.127	.010	.264	-.022
Analytical/Confidence: I can manage many things at the same time.	.238	-.049	.061	.111	.085	.613	.065	.108	.066	.186	.027
Analytical/Problem Solver: I can perform a wide variety of tasks.	.073	-.037	.113	.201	.131	.764	.059	.146	.042	.141	.044
Analytical/Confidence: I can tackle anything.	.211	-.049	.097	.257	.013	.531	.170	.029	.114	.111	.071
Analytical: I can work under pressure.	.144	-.014	.167	.150	.211	.513	.232	.033	.240	.163	.122

Table 129 (cont.): Rotated Factor Matrix for Personality and Self-Reported Ability – Highest Value for Each Item Shaded

Items	Factors										
	1	2	3	4	5	6	7	8	9	10	11
Analytical/Problem Solver: I like to solve complex problems.	.016	.016	.427	.284	.046	.382	.226	.032	.214	.209	-.010
Analytical: I need things explained only once.	.209	.059	.212	.153	-.014	.298	.136	.072	.008	.326	.032
Analytical/Organized: I don't pay attention. (Reverse)	.442	.002	.101	-.009	.213	.033	.015	.204	-.142	.059	.065
Analytical/Problem Solver/Persistence: I give up easily. (Reverse)	.281	.013	.255	.125	.339	.210	.244	.172	.086	.038	.178
Confidence: I am afraid of many things. (Reverse)	.163	.014	.133	.064	.146	.096	.621	.046	-.038	.033	-.009
Confidence: I am often down in the dumps. (Reverse)	.310	.039	.017	.120	.146	.118	.689	.031	.092	.062	.068
Confidence: I become overwhelmed by events. (Reverse)	.281	.004	.079	.109	.100	.124	.738	.004	-.024	.002	.027
Confidence: I feel that I am unable to deal with things. (Reverse)	.329	-.009	.074	.114	.196	.168	.717	.068	.028	.074	.066
Confidence: I need reassurance. (Negative)	.322	-.006	-.009	.070	.035	.039	.479	-.006	.018	.153	-.026
Confidence: I readily overcome setbacks.	.220	.068	.121	.268	.078	.173	.356	.036	.220	.164	.153
Confidence: I think quickly.	.167	.004	.222	.253	-.083	.293	.174	.058	.144	.451	-.024
Creativity: I am able to come up with new and different ideas.	.090	-.073	.256	.708	.025	.237	.120	.089	.200	.161	.056
Creativity: I am an original thinker.	.131	-.070	.267	.774	-.003	.129	.078	.113	.140	.184	.047
Creativity: I come up with new ways to do things.	.054	-.051	.234	.722	.087	.250	.124	.095	.154	.132	.041
Creativity: I have an imagination that stretches beyond that of my friends.	.057	-.019	.168	.618	-.055	.175	-.021	.041	-.029	.106	.011
Creativity: I like to think of new ways to do things.	.076	-.049	.247	.700	.032	.207	.145	.094	.142	.121	.053
Creativity: I am not considered to have new and different ideas. (Reverse)	.071	-.051	.202	.502	.218	.108	.164	.102	-.024	.127	.023
Creativity: I don't pride myself on being original. (Reverse)	.062	-.052	.178	.576	.153	.066	.082	.105	.012	.059	-.022
Creativity: I have no special urge to do something original. (Reverse)	.044	-.011	.261	.553	.177	.058	.006	.062	.118	.042	-.005
Curiosity: I am interested in Science.	.003	-.006	.424	.076	-.058	.050	.137	-.019	.077	.012	.011
Curiosity: I enjoy intellectual games.	.046	-.002	.477	.117	.028	.163	.083	.110	.146	.137	.139

Table 129 (cont.): Rotated Factor Matrix for Personality and Self-Reported Ability – Highest Value for Each Item Shaded

Items	Factors										
	1	2	3	4	5	6	7	8	9	10	11
Curiosity: I find political discussions interesting.	.051	-.004	.495	.160	.003	.011	-.155	-.022	.119	.004	-.046
Curiosity: I have a rich vocabulary.	.032	.036	.476	.226	.028	.139	-.031	.189	.023	.220	.035
Curiosity/Flexibility: I love to read challenging material.	.110	-.015	.716	.174	-.031	.082	-.002	.059	.157	.112	.093
Curiosity: I would love to explore strange places.	-.053	-.004	.354	.305	.013	.207	.111	-.035	.077	-.072	.120
Curiosity/Flexibility: I avoid difficult reading material. (Reverse)	.139	-.021	.699	.073	.084	.054	.074	.151	.013	.139	.071
Curiosity: I don't bother worrying about political and social problems. (Reverse)	-.079	.049	.424	.126	.289	-.042	-.116	.023	.046	.048	-.056
Curiosity: I don't know much about history. (Reverse)	.100	-.018	.468	.154	.131	.060	.045	.043	-.033	-.008	-.043
Curiosity: I will not probe deeply into a subject. (Reverse)	-.038	-.007	.501	.264	.154	.045	.030	.140	-.005	.070	-.018
Efficiency: I finish what I start.	.516	-.027	.129	.080	.348	.133	.072	.099	.182	.043	.491
Efficiency: I follow through with my plans.	.550	-.020	.101	.115	.204	.142	.057	.089	.192	.111	.576
Efficiency: I get chores done right away.	.674	-.064	.006	.026	-.007	.000	.117	.023	.124	.002	.184
Efficiency: I make plans and stick to them.	.573	-.072	.110	.060	-.001	.068	.060	.124	.081	.124	.448
Efficiency: I find it difficult to get down to work. (Reverse)	.662	.037	-.015	.051	.221	.104	.123	.040	.046	.048	.041
Efficiency: I frequently forget to do things. (Reverse)	.605	-.023	.121	-.022	.065	.054	.044	.219	-.008	.085	.026
Efficiency: I have difficulty starting tasks. (Reverse)	.829	-.042	.021	.052	.107	.143	.206	.055	.072	.057	-.125
Efficiency: I need a push to get started. (Reverse)	.722	.018	.126	.042	.222	.155	.193	.091	.079	.021	-.112
Efficiency: I postpone decisions. (Reverse)	.699	-.016	.064	.107	.129	.095	.276	.029	.058	.001	-.009
Efficiency: I waste my time. (Reverse)	.739	.024	.001	.090	.179	.058	.208	.012	.113	.044	-.046
Efficiency/Motivation: I am exacting in my work.	.205	.028	.123	.086	.160	.038	-.102	.417	.242	.052	.112
Flexibility: I am able to find out things by myself.	-.045	.014	.207	.189	.199	.290	.032	.178	.088	.422	.062
Flexibility: I am quick to understand things.	.147	.020	.191	.193	.114	.367	.090	.179	.053	.669	.030
Flexibility: I can handle complex problems.	.105	.018	.355	.223	.119	.418	.161	.120	.268	.372	.046

Table 129 (cont.): Rotated Factor Matrix for Personality and Self-Reported Ability – Highest Value for Each Item Shaded

Items	Factors										
	1	2	3	4	5	6	7	8	9	10	11
Flexibility: I catch on to things quickly.	.162	.025	.176	.204	.066	.241	.082	.155	.106	.810	.061
Flexibility: I quickly get the idea of things.	.132	.029	.175	.251	.092	.269	.091	.169	.127	.797	.083
Flexibility: I don't understand things. (Reverse)	.134	-.025	.401	.183	.213	.218	.172	.122	-.100	.237	.061
Flexibility: I try to avoid complex people. (Reverse)	.035	.026	.605	.110	.174	.100	.139	.003	.004	.059	.031
Motivation/Organized: I complete tasks successfully.	.298	.019	.131	.159	.164	.283	.099	.204	.254	.289	.262
Motivation: I get started quickly on doing a job.	.707	-.027	-.024	.114	.071	.150	.117	.132	.192	.085	.053
Motivation: I push myself very hard to succeed.	.347	-.021	.143	.167	.300	.106	.007	.150	.538	.073	.044
Motivation: I work hard.	.338	-.013	.142	.120	.392	.076	-.010	.118	.635	.102	.016
Motivation: I do just enough work to get by. (Reverse)	.202	-.005	.080	.098	.604	-.008	.066	.059	.316	.002	-.029
Motivation: I do too little work. (Reverse)	.374	-.010	.006	.112	.580	.062	.121	.091	.161	.068	.047
Motivation: I hang around doing nothing. (Reverse)	.382	-.010	.053	.097	.510	-.011	.122	.043	.207	.011	-.048
Motivation: I quickly lose interest in the tasks I start. (Reverse)	.493	-.030	.105	.069	.474	.114	.120	.102	.091	.038	.097
Motivation: I stop when work becomes too difficult. (Reverse)	.336	-.019	.126	.123	.583	.177	.231	.070	.104	.030	.184
Organized: I demand quality.	.123	.039	.168	.096	.178	.085	-.075	.399	.439	.072	.073
Organized: I detect mistakes.	.062	.007	.129	.126	.042	.127	.023	.559	.118	.111	.068
Organized: I follow through on my commitments.	.366	.008	.060	.104	.222	.074	.124	.257	.228	.190	.313
Organized: I have an eye for detail.	.206	.021	.073	.116	.041	.105	.065	.857	.044	.079	.028
Organized: I make well-considered decisions.	.316	.000	.175	.058	.181	.139	.101	.309	.199	.114	.186
Organized: I pay attention to details.	.199	.011	.030	.060	.126	.068	.033	.811	.131	.094	.019
Organized: I set high standards for myself and others.	.158	.033	.132	.202	.161	.220	.033	.375	.486	.093	.115
Organized: I think ahead.	.237	-.065	.122	.175	.099	.152	.112	.318	.260	.143	.070
Organized: I put little time and effort into my work. (Reverse)	.131	-.015	.133	.032	.562	.004	.046	.111	.090	.034	-.068
Organized: I seldom notice details. (Reverse)	.079	.024	.070	.126	.433	.053	.131	.617	-.046	.143	-.114

Table 129 (cont.): Rotated Factor Matrix for Personality and Self-Reported Ability – Highest Value for Each Item Shaded

Items	Factors										
	1	2	3	4	5	6	7	8	9	10	11
Persistence: I am a goal-oriented person.	.407	.041	.122	.132	.167	.140	.066	.069	.539	.063	.083
Persistence: I am a hard worker.	.323	-.009	.100	.119	.433	.086	-.002	.180	.594	.067	.042
Persistence: I don't get sidetracked when I work.	.565	.011	-.001	.011	.123	.082	.091	.027	.194	.049	.019
Persistence: I don't quit a task before it is finished.	.467	.019	.006	.036	.189	.005	.058	.122	.246	.089	.267
Persistence: I finish things despite obstacles in the way.	.315	-.007	.205	.103	.331	.179	.198	.193	.359	.118	.292
Persistence: I don't finish what i start. (Reverse)	.339	.050	.119	.031	.528	.039	.160	.141	.127	.118	.305
Problem Solver: I accept challenging tasks.	.220	-.014	.392	.284	.156	.223	.290	.122	.375	.232	.106
Problem Solver: I feel up to any task.	.318	-.009	.209	.221	.060	.284	.368	.046	.255	.162	.093
Problem Solver: I know how to apply my knowledge.	.202	-.066	.313	.127	.141	.274	.232	.234	.310	.224	.062
Problem Solver: I meet challenges.	.259	-.006	.293	.186	.158	.302	.347	.151	.409	.190	.175
Problem Solver: I don't put my mind on the task at hand. (Reverse)	.284	-.033	.117	.044	.431	.142	.155	.163	.060	.044	.201
Problem Solver: I don't see things through. (Reverse)	.368	-.036	.106	-.001	.508	.094	.195	.172	.103	.067	.320

APPENDIX L: DATA FROM COGNITIVE INTERVIEWS

This data focuses on the information transcribed from the cognitive interviews but also refer to the answers given by the participants. Participants are identified by their number first, followed by a dash to indicate their group [1: Experts/Trained Searchers (4), 2: Casual Searchers (4), Group 3: Students and Academics (3), Group 4: Frequent Searchers (3)].

Table 130: Cognitive Interviews Demographic Items

Item	Answer Choices	Indicators and Actions
What year were you born?	Drop down box, years 1900 to 2000	Selections ranged from 1940 to 1998, with a mode of 3 choosing 1981. Participants gave no feedback on this question.
What is your gender?	Multiple Choice: Female, Male	P11-3 wanted more gender options, split into sex and gender identity P13-1 noted others might have trouble There were 11 female and 3 male participants. One of the participants suggested splitting the question into questions about sex and gender identity and additionally suggested using the choices from the UNC-Chapel Hill LGBTQ Center.
How well do you understand English?	Multiple Choice: Native Speaker, Non-Native speaker with good understanding, Non-Native speaker with limited understanding	P7-2 "Native but not sure if it means I understand it." All participants marked that they were Native Speakers. This question is primarily used to weed out participants that may not have a good enough understanding of English to complete the instrument successfully. For the Phase 4 the question was changed to simply ask participants to classify themselves as one of the three choices.

Table 130 (cont.): Cognitive Interviews Demographic Items

Item	Answer Choices	Indicators and Actions
Please indicate the highest level of education completed.	Multiple Choice: Grammar School, High School or equivalent, Vocational/Technical School, Some College, College graduate (4 year), Masters Degree (MS), Doctoral Degree (PhD), Professional Degree (MD, JD, etc.), Other	P2-4 Masters degree, not MS P7-2 "I have the equivalent of 2" Participants were spread over all choices except Grammar School, with 6 having Masters degrees. For Phase 4 the parenthetical comments were removed so that they did not limit the choices.
Which of the following best describes the area you live in?	Multiple Choice: Urban, Suburban, Rural	P2-4 Unsure P4-3 Unsure Eight participants selected Suburban. This question is believed to have limited value for this research, but was retained for Phase 4.
Please indicate your current household income in US dollars.	Multiple Choice: Rather not say, Under $10000, $10000-$19000, $20000-$29000, $30000-$39000, $40000-$49000, $50000-$74999, $75000-$99999, $100000-$150000, Over $150000	P4-3 wanted Unsure to be an option P10-3 guessed how much their family makes Incomes ranged among the participants. Three selected 'Rather not say.' 'Unsure' was added as an option in Phase 4.

Table 131: Cognitive Interviews Prior History Items

Item	Answer Choices	Indicators and Actions
How long have you been using Internet search tools?	Multiple Choice: Less than 6 months, 6 to 12 months, 1 to 3 years, 4 to 6 years, 7 years or more	All but one of the participants selected 7 years or more, prompting this question to be examined for ability to discriminate. In Phase 4 additional categories were accordingly added at the higher end.
How frequently do you search for information online from the following locations? From your phone From a tablet From a laptop From a computer you own (not a laptop) From a public computer or one you share (e.g. library, cybercafe, etc.)	Matrix Table: Daily, Weekly, Monthly, Less than once a month, Never	P5-2 "not completely sure if it means internet searches or includes social media" P7-2 didn't know how to answer ones never used P14-1 "unsure between daily and weekly, that's why I paused." P9-2 work computer doesn't fit any category P13-1 "I guess this is talking about currently" The phone and laptop answers were Daily for almost all participants, making them potentially less useful for discrimination despite their common usage in current research. The categories were reexamined and changed for Phase 4 to make them clearer.
What kind of training have you had in how to search for information online? (Click any that apply.)	Multiple Choice, Multiple Answer: Self taught, Learned from friend or relative, Course at library, High School course, College course, Other (specified)	P1-2 "None" P2-4 had an informal class so selected course at library P4-3 "I guess a college course" P9-2 "self taught mostly, not sure what other option" P11-3 "part of college course" P11-3 "session at library" P13-1 workshops, online tutorials Nearly all participants selected 'Self taught" and many selected "Learned from a friend or relative."
(If they answered College Course) Do you have a degree from a Library or Information Science program?	Y/N	P13-1 "Do they mean a master's degree?" Of the five participants who got this question, two answered "Yes."

Table 131 (cont.): Cognitive Interviews Prior History Items

Item	Answer Choices	Indicators and Actions
Have you performed searches for information online for friends or relatives?	Y/N	P7-2 “That’s so vague.” P9-2 “Well, parents” All 14 participants answered yes to this question, flagging this question for phase 4 to examine its discriminatory ability.
Have you performed searches for others as part of your occupation?	Y/N	P9-2 “Not really for others but part of my occupation” came back to change answer to yes for teaching ESL P13-1 “At least in the past” This question prompted comments from participants that indicated that they answered a different but similar question instead of the question asked. This question was reworded into several related questions for Phase 4.
(Follow up if they answer Yes to searching for others.) Is performing searches for others a specific part of your occupation?	Y/N	P1-2 “sometimes” P2-4 “not quite sure how to answer” P6-1 long pause, initially thought of help requests from users P8-1 “answer for prior occupation - what if currently unemployed?” P12-4 “people don’t specifically ask me to search, but they expect me to know the answers” P13-1 “It’s not right now but it was in the past” This question was also reworked for Phase 4 since it is based upon the previous question.
(Follow up if they answer Yes to searching for others.) How frequently do you perform searches for others as part of your occupation?	Multiple Choice: Less than once a month, Once a month, 2-3 times a month, Once a week, 2-3 times a week, Daily	This question was also reworked for Phase 4 since it is based upon the previous question.

Table 131 (cont.): Cognitive Interviews Prior History Items

Item	Answer Choices	Indicators and Actions
Have you trained others in how to search for information online?	Multiple Choice: Yes, I am doing it currently; Yes, I did less than 5 years ago; Yes, but more than 5 years ago; No	P1-2 "I've showed people but not trained" P3-4 "What do you mean by training, do you mean some kind of class showing someone how to find something online?" P4-3 "how extensive you mean by training? I show my mom, not sure if it counts." P12-4 "it's not on my job description but I am going to say yes." Confusion for this question came from all four targeted groups. This question was reworked for phase 4 to be more specific.
(Follow up if they answer Yes, I am doing it currently.) Is training others in how to search a specific part of your occupation?	Y/N	No remarks from participants. The question was not altered for phase 4 although the question leading to it was altered as noted above.
(Follow up if they answer Yes, I am doing it currently.) How frequently do you train others in how to search for information online?	Multiple Choice: Less than once a month, Once a month, 2-3 times a month, Once a week, 2-3 times a week, Daily	P9-2 "Is this different from the one a few questions back? I guess frequently wasn't used in that one." "Is search here even directing <someone> to a URL?" The question was not altered for phase 4 although the question leading to it was altered as noted above.

Table 132: Cognitive Interviews Specific Search History Items

Item	Answer Choices	Indicators and Actions
How frequently do you search online for each kind of information listed? News/current events Information for a hobby Legal information Health information Genealogical information Financial information Government Information Historical information Leisure/Entertainment	Matrix Table: Never, Less than once a month, Once a month, 2-3 times a month, Once a week, 2-3 times a week, Daily	P1-2 wanted an ‘Almost Never’ category P2-4 “There should be another category here. Seems like a jump. Rarely” P9-2 wanted ‘Seldom’ or ‘As needed’ as a choice P13-1 <News> “I don’t regularly do a lot of searching but I regularly browse, so I’m monitoring information.” P13-1 <Health> “assuming I’m talking about for myself” P3-4 <Genealogy> “Is that heritage?” P4-3 <Genealogy> “Not sure what that means” P5-2 <Genealogy> not sure, put never P9-2 <Genealogy> had done it but not recently, wanted another answer choice P5-2 <Financial> not sure P7-2 <Financial> “just checking bank account” P11-3 <Financial> “if checking bank account counts” P2-4 <Government> not sure, taxes? Policy? Law? “Maybe need ‘Not Applicable’” P5-2 <Government> not sure, “Any web site created by the government?” P11-3 <Government> “pausing because this is election season” P7-2 <Leisure> “Does that mean like playing Solitaire?” Participants had many comments about the choices available for this question. There was also confusion on what the question was asking. ‘Geneological’ was changed to ‘Ancestry/Geneological’ for phase 4.
Is there information that you consistently search for online that is important or meaningful to you?	Y/N	P4-3 “What does that mean? I’m not sure that it’s meaningful, just fun.” P6-1 “meaningful in terms of my position” P10-3 “No, I just have a short memory.” This question was eliminated for phase 4.

Table 132 (cont.): Cognitive Interviews Specific Search History Items

Item	Answer Choices	Indicators and Actions
(Follow up if they answer yes to searching for important or meaningful information.) Please describe the information that you consistently search for that is important or meaningful to you.	Entry box	P3-4 "Separate the job from personal stuff" P5-2 "Is that just anything that you enjoy searching for?" P9-2 "Getting confused. General internet use vs searching." This question is a follow up to the previous question and was also eliminated for phase 4. Answers here were varied and examined for additional categories for other questions.
Have you ever searched online to fulfill college course requirements?	Multiple Choice: Yes, I am doing it currently Yes, I did less than 5 years ago Yes, but more than 5 years ago No	P2-4 "guessing this means as part of a class" P3-4 "you mean look up stuff for class you're taking" P4-3 "Is that meaning for a class, or does it mean do I take classes online?" P5-2 "Not sure, some kind of assignment…to look something up." P7-2 "obviously for young people" P8-1 "This counts as college, right?" This question was not changed for phase 4.
How frequently do you search in each specific site listed? Google Web of Science PubMed LexisNexis WorldCat Dialog	Matrix Table: Never, Less than once a month, Once a month, 2-3 times a month, Once a week, 2-3 times a week, Daily	P1-2 "alludes to earlier question" P13-1 add ProQuest and PyschInfo P12-4 "we mostly use Chrome" P7-2 <Web of Science> "should be category N/A or don't understand" P2-4 <Lexis/Nexis> "used in the past, do not use now, unsure what to choose" P6-1 <Dialog> "Say never to mean not familiar with" P8-1 <Dialog> "I have, but not since grad school. I would never use it now." P13-1 <Dialog> "haven't used in years, used extensively but not right now" This question was changed to specifically ask about tools and an option was added in phase 4 of 'Formerly used but not now.' 'Google' was changed to 'Search Engine, like Google or Bing.'

Table 132 (cont.): Cognitive Interviews Specific Search History Items

Item	Answer Choices	Indicators and Actions
Now, in addition to the specific systems mentioned above, how often do you search other systems in these categories? Library databases Professional databases Scholarly databases	Matrix Table: Never, Less than once a month, Once a month, 2-3 times a month, Once a week, 2-3 times a week, Daily	P1-2 "Not sure what scholarly databases are" P3-4 "You mean the library over there?" <professional> "work related, financial systems" P7-2 "That's vague" P11-3 "Search on library website, not sure if that counts" Not sure of difference between professional and scholarly P2-4 "Can you give me an example?" P4-3 not sure about professional P8-1 "What do you mean? Library databases are professional databases" P13-1 <professional> "not sure what that means" P14-1 <professional> "I assume that would be WebMD for a doctor?" P3-4 <scholarly> "something I would access if I was in school" P8-1 "These are all basically synonyms to me." This question was deleted in phase 4.

Table 133: Cognitive Interviews Self-Rated Search Ability Items

Item	Answer Choices	Indicators and Actions
When searching, how familiar are you with each of these techniques? Truncation Quotes Boolean logic Limit by publish date Limit by location Limit by type of information Limit by operating system Exclude specific sites	Matrix Table: Not at all familiar, Not very familiar, Somewhat familiar, Reasonably familiar, Extremely familiar	P7-2 “Not designed for old people” P8-1 “These are all things that I have taught in a prior job.” P5-2 “never heard of most of these” P1-2 <truncation> “shorten up a list” P1-2 <Boolean> “Boolean algebra” P3-4 <truncation> “don’t know” P5-2 <truncation> “not sure what it means” P9-2 <truncation> “not familiar with it in this context” P12-4 <truncation> “don’t know” P9-2 <Quotes> “I have searched for quotes before if that is what it means.” P3-4 <Boolean> don’t know P4-3 <Boolean> not sure P12-4 <Boolean> don’t know P7-2 <Limit By…> “Makes sense” P4-3 “Not sure what it means by limit” P11-3 <Limit by …> “depending on search system I am using” P13-1 <OS> “Not very” P11-3 <sites> “in some search systems” P9-2 “My searching is not that sophisticated.” P6-1 “Putting reasonable because I am not always using each one” This question was changed in phase 4 to specify Boolean AND and OR and adding ‘Limit by price.’ ‘Limit by OS’ was deleted.

Table 133 (cont.): Cognitive Interviews Self-Rated Search Ability Items

Item	Answer Choices	Indicators and Actions
When searching, how familiar are you with each of these types of searches? Dictionary search Recipe search Patent search Find social tags	Matrix Table: Not at all familiar, Not very familiar, Somewhat familiar, Reasonably familiar, Extremely familiar	P2-4 "I feel like these are common words…never heard in context of searching." P8-1 "so this means all online?" P4-3 <dictionary> "like using an online dictionary?" P5-2 <dictionary> "sounds familiar but not totally sure what it is" P10-3 <dictionary> "Is this a paper dictionary or online?" P13-1 <dictionary> "I usually just use Google" P3-4 <Patent> never done P1-2 <social> "facebook or something" P4-3 <social> "if it's a hashtag" P8-1 <social> "not sure of meaning" P9-2 <social> "guessing that means social network" P11-3 <social> "if that means on social media" P13-1 <social> "I kinda know what that is" This question was deleted for phase 4.
If you needed to perform a search, how confident are you that you could… Develop a focused search query that will retrieve a small number of appropriate articles? Efficiently structure your time to complete the task? Find articles similar in quality to those obtained by a professional searcher?	Matrix Table: Not at all Confident, Not very Confident, Somewhat confident, Reasonably Confident, Extremely Confident	P2-4 "Before this I thought I was pretty competent." P8-1 "I might answer differently depending on if I was talking about Google or library databases. I assume means Google." P2-4 <time> "I never even thought about time it takes to search." P3-4 <time> "I don't really understand." P9-2 <time> "I assume I could do it quickly" P10-3 <time> "I get distracted easily." P11-3 <time> "I have never thought about that." The question was changed to read 'When you perform searches online, how confident are you that you could…' and the individual questions were changed for phase 4. 'Create a query that would return every useful document' and 'Create a query that would return only a few very useful documents' were added for Phase 4. 'Develop a focused search query that will retrieve a small number of appropriate articles' and 'Efficiently structure your time to complete the task' were discarded.

Table 134: Cognitive Interviews Using Search Skills Items

Item	Answer Choices	Indicators and Actions
Select the tool or technique you would use to make sure that all the results contained both words typed into the search box.	Drop down box (same for all) Not sure Truncation Quotes Boolean AND Boolean OR Capitalize query terms Use dash/underscore	P1-2 hesitated between AND and OR P2-4 "only thing I know is quotes" P3-4 "I'll just type both words in" P4-3 "I have to keep rereading to make sure I answer correctly for myself." P7-2 read over multiple times, seemed unsure P9-2 "not 100% clear to me" P10-3 "Oh that's what Boolean is!" P13-1 wanted to choose 2 things
Select the tool or technique you would use to make sure that you search for all forms of a word.	Limit by publish date Limit by location Limit by type of information Limit by operating system Exclude specific sites Adding search terms Deleting Search terms	P2-4 "not sure maybe AND" P5-2 "don't understand" P6-1 "Not sure, all forms, all definitions? Partial to actual word." P7-2 "may go home and look these up" P9-2 "never done that before, just search then browse what comes up." P11-3 "This is an asterisk."
Select the tool or technique you would use to search for words in a specific order.		P3-4 "After this, I'll look them up." P7-2 "Truncation – does that have to do with 1 2 in an order?" P8-1 "make sure that I remembered everything that was on the list." P9-2 "confused, general questions, expect more of an example."
Select the tool or technique you would use to search for recent items only.		P2-4 "just a guess" P3-4 no hesitation P4-3 "I guess that's what it means by limit." P7-2 "guess" P9-2 "guess, deduce" P10-3 "easy" P11-3 "easy" P12-4 "easy" This question was deleted due to lack of discriminatory power.

Table 134 (cont.): Cognitive Interviews Using Search Skills Items

Item	Answer Choices	Indicators and Actions
Select the tool or technique you would use to search for information from England.	Drop down box (same for all) Not sure Truncation Quotes Boolean AND Boolean OR Capitalize query terms Use dash/underscore Limit by publish date Limit by location Limit by type of information Limit by operating system Exclude specific sites Adding search terms Deleting Search terms	P2-4 "probably limit by location" P3-4 no hesitation P5-2 "I didn't know that you could search for information from a certain place. I guess that would be limit by location." P7-2 "easy" P8-1 "to me location means where the resource is actually located, which library" P9-2 "guess" This question was deleted due to lack of discriminatory power.
Select the tool or technique you would use to expand your results.		P2-4 "guess" P7-2 "guess" P8-1 "assumes already have results, no assume doing new search so use OR." P9-2 "guess" P11-3 "could be more than one" (this does not seem to be a good question) P12-4 "I probably would just type it."
Select the tool or technique you would use to narrow your results.		P2-4 "this is a guess. Truncation means to cut short" P7-2 "limit by…" P8-1 "a lot of these could be used to narrow" P9-2 "guess, hesitant to keep saying unsure" P10-3 scrolled over page while considering answer P11-3 "could be more than one. I feel like a bunch of these could do that." P12-4 "most of the time I will either use quotes or I'll make it say AND or OR. Now that I'm looking at it this on…I just don't know the formal name." P13-1 "You could narrow it by many of these." P14-1 "There's lots of ways you could narrow."

Table 135: Cognitive Interviews Personality Items Page 1

Item	Source	Subscale	Key
I am good at many things.	6FPQ	Resourcefulness (Analytical)	Positive
I can handle lots of information.	6FPQ	Resourcefulness (Analytical)	Positive
	AB5C	Quickness (Flexibility)	
I can manage many things at the same time.	6FPQ	Resourcefulness (Analytical)	Positive
	TCI	Low Self-Efficacy (Confidence)	Negative
I can perform a wide variety of tasks.	6FPQ	Resourcefulness (Analytical)	Positive
	TCI	Competence (Problem Solver)	
I can tackle anything.	6FPQ	Resourcefulness (Analytical)	Positive
	TCI	Low Self-Efficacy (Confidence)	Negative
I can work under pressure.	6FPQ	Resourcefulness (Analytical)	Positive
I like to solve complex problems.	6FPQ	Resourcefulness (Analytical)	Positive
	TCI	Competence (Problem Solver)	
I need things explained only once.	6FPQ	Resourcefulness (Analytical)	Positive
I don’t pay attention.	6FPQ	Resourcefulness (Analytical)	Negative
	AB5C	Organization (Organized)	Negative
I give up easily.	6FPQ	Resourcefulness (Analytical)	Negative
	TCI	Competence (Problem Solver)	Negative
	VIA	Industry/Perseverance/Persistence (Persistence)	Negative

Comments from Participants for page 1:

- P9-2 “So broad, not sure how to answer, what is function of middle column? Use does not apply.”
- P1-2 <handle> “depends”
- P5-2 <manage> “I think this means I can process a lot of information at once.”
- P13-1 <task> “what kind of task?” chose middle
- P10-3 <pressure> “thank you college”
- P13-1 <complex> “sometimes” chose middle
- P2-4 <explained> “depends on what it is. I will say middle.”
- P11-3 <explained> “That depends on what it is so I will put in the middle.”
- P4-3 “Does middle section count as sometimes accurate? If I am between I choose the middle section.”

Table 136: Cognitive Interviews Personality Items Page 2

Item	Source	Subscale	Key
P2_1 I am afraid of many things.	TCI	Low Self-Efficacy (Confidence) Note change in key.	Positive
P2_11 I am often down in the dumps.	TCI	Low Self-Efficacy (Confidence) Note change in key.	Positive
P2_12 I become overwhelmed by events.	TCI	Low Self-Efficacy (Confidence) Note change in key.	Positive
P2_13 I feel that I am unable to deal with things.	TCI	Low Self-Efficacy (Confidence) Note change in key.	Positive
P2_2 I need reassurance.	TCI	Low Self-Efficacy (Confidence) Note change in key.	Positive
P2_3 I readily overcome setbacks.	TCI	Low Self-Efficacy (Confidence) Note change in key.	Negative
P2_14 I think quickly.	TCI	Low Self-Efficacy (Confidence) Note change in key.	Negative
P2_5 I am able to come up with new and different ideas.	VIA	Creativity/Originality (Creativity)	Positive
P2_6 I am an original thinker.	VIA	Creativity/Originality (Creativity)	Positive
P3_1 I come up with new ways to do things.	VIA	Creativity/Originality (Creativity)	Positive

Comments from Participants for page 2:

- P13-1 "I'm having to pay attention to the negative/positive things."
- P11-3 "sometimes" answered middle for dumps and events
- P2-4 "sometimes" answered middle for reassurance
- P14-1 "sometimes" answered middle for reassurance
- P9-2 "wasn't expecting these kinds of questions."
- P8-1 "these are interesting because I like to organize but…wish I was a big idea person."
- P9-2 <new ways> "tough to answer"
- P14-1 "These questions are all very similar." (last 3)

Table 137: Cognitive Interviews Personality Items Page 3

Item	Source	Subscale	Key
P3_2 I have an imagination that stretches beyond that of my friends.	VIA	Creativity/Originality (Creativity)	Positive
P3_3 I like to think of new ways to do things.	VIA	Creativity/Originality (Creativity)	Positive
P3_4 I am not considered to have new and different ideas.	VIA	Creativity/Originality (Creativity)	Negative
P3_5 I don't pride myself on being original.	VIA	Creativity/Originality (Creativity)	Negative
P3_6 I have no special urge to do something original.	VIA	Creativity/Originality (Creativity)	Negative
P3_7 I am interested in science.	HEXACO	Inquisitiveness (Curiosity)	Positive
P3_8 I enjoy intellectual games.	HEXACO	Inquisitiveness (Curiosity)	Positive
P3_9 I find political discussions interesting.	HEXACO	Inquisitiveness (Curiosity)	Positive
P3_10 I have a rich vocabulary.	HEXACO	Inquisitiveness (Curiosity)	Positive
P4_1 I love to read challenging material.	HEXACO	Inquisitiveness (Curiosity)	Positive
	AB5C	Quickness (Flexibility)	Positive

Comments from Participants for page 3:

- P5-2 "They make sense. Now I want to go back and change some answers. Not sure how they relate to searching for information."
- P2-2 <imagination> "Never thought about friends' imagination"
- P11-3 <imagination> "My friends are pretty imaginative, but that doesn't mean I'm not."
- P13-1 <imagination> "I do but I don't know if it's beyond my friends." Answered middle
- P8-1 <considered> "I don't really know how I am considered to be."
- P9-2 <considered> "trouble with the wording"
- P12-4 <pride> chose middle
- P13-1 <pride> "having trouble with that one" chose middle
- P14-1 <pride> "the negative here is really…"
- P7-2 "I can see how one could get all twisted…answer the opposite."
- P3-4 <science> skipped then went back to it
- P9-2 <games> "not sure what this is"
- P11-3 <politics> "this depends so I will put it in the middle"
- P11-3 <read> "it depends on what purpose" chose middle
- P4-3 using middle choice and saying sometimes

Table 138: Cognitive Interviews Personality Items Page 4

Item	Source	Subscale	Key
P4_2 I would love to explore strange places	HEXACO	Inquisitiveness (Curiosity)	Positive
P4_3 I don't bother worrying about political and social problems.	HEXACO	Inquisitiveness (Curiosity)	Negative
P4_4 I don’t know much about history.	HEXACO	Inquisitiveness (Curiosity)	Negative
P4_5 I will not probe deeply into a subject.	HEXACO	Inquisitiveness (Curiosity)	Negative
P4_6 I finish what I start.	AB5C	Efficiency (Efficient)	Positive
P4_7 I follow through on my plans.	AB5C	Efficiency (Efficient)	Positive
P4_8 I get chores done right away.	AB5C	Efficiency (Efficient)	Positive
P4_9 I make plans and stick to them.	AB5C	Efficiency (Efficient)	Positive
P4_10 I find it difficult to get down to work.	AB5C	Efficiency (Efficient)	Negative
P5_1 I frequently forget to do things.	AB5C	Efficiency (Efficient)	Negative

Comments from Participants for page 4:

- P9-2 “Questions go back and forth and you really have to think because they switch back and forth affirmative and negative statements.
- P14-1 <political> “Who would ever admit to that?”
- P3-4 <history> “Some of these questions are so vague.”
- P2-4 <probe> “Depends on the subject”
- P3-4 <probe> “Some subjects I do and some subjects I don’t, so I picked the middle one.”
- P13-1 <finish> “most things” chose middle
- P9-2 <second set> “these were easier because all affirmative”
- P13-1 sometimes middle choice for <follow through> and <make plans>
- P12-4 neither middle choice <frequently forget>

Table 139: Cognitive Interviews Personality Items Page 5

Item	Source	Subscale	Key
P5_2 I have difficulty starting tasks.	AB5C	Efficiency (Efficient)	Negative
P5_3 I need a push to get started.	AB5C	Efficiency (Efficient)	Negative
P5_4 I postpone decisions.	AB5C	Efficiency (Efficient)	Negative
P5_5 I waste my time.	AB5C	Efficiency (Efficient)	Negative
P5_6 I am able to find out things for myself.	AB5C	Quickness (Flexibility)	Positive
P5_7 I am quick to understand things.	AB5C	Quickness (Flexibility)	Positive
P5_8 I can handle complex problems.	AB5C	Quickness (Flexibility)	Positive
P5_9 I catch on to things quickly.	AB5C	Quickness (Flexibility)	Positive
P5_10 I quickly get the idea of things.	AB5C	Quickness (Flexibility)	Positive

Comments from Participants for page 5:

- P4-3 showing signs of fatigue, choosing middle option and saying sometimes
- P3-4 “Not sometimes kinds of questions, so went through quickly”
- P1-2 <tasks> “sometimes”
- P8-1 <postpone> “use middle to mean neutral”
- P5-2 <by myself> “not sure”
- P11-3 <by myself> “true for a lot of things, but I am not one to ask people.”
- P2-4 <quick> and <catch on to> “seem like same question”
- P6-1 <complex> hesitates then uses middle choice
- P9-2 <complex> “Example, I guess it’s relative, don’t know what to put, feels like center column doesn’t suit what I need.”
- P13-1 <catch on to> and <quickly get> middle choice
- P1-2 <quickly get> “Just depends on what the ideas are”
- P4-3 marked last four as sometimes
- P13-1 “These are interesting questions. I’m curious how they relate to search.”

Table 140: Cognitive Interviews Personality Items Page 6

Item	Source	Subscale	Key
P6_1 I avoid difficult reading material.	AB5C HEXACO	Quickness (Flexibility) Inquisitiveness (Curiosity)	Negative Negative
P6_2 I don’t understand things.	AB5C	Quickness (Flexibility)	Negative
P6_3 I try to avoid complex people.	AB5C	Quickness (Flexibility)	Negative
P6_5 I am exacting in my work.	HEXACO	Diligence (Motivation) Efficiency (Efficient)	Positive
P6_6 I complete tasks successfully.	HEXACO AB5C	Diligence (Motivation) Organization (Organized)	Positive Positive
P6_7 I get started quickly on doing a job.	HEXACO	Diligence (Motivation)	Positive
P6_8 I push myself very hard to succeed.	HEXACO	Diligence (Motivation)	Positive
P6_9 I work hard.	HEXACO	Diligence (Motivation)	Positive
P6_10 I do just enough work to get by.	HEXACO	Diligence (Motivation)	Negative
P7_1 I do too little work.	HEXACO	Diligence (Motivation)	Negative

Comments from Participants for page 6:

- P10-3 “Am I doing this properly?”
- P7-2 “This is reassurance, I love that!”
- P6-1 <avoid> “don’t avoid but don’t read too much”
- P11-3 <avoid> “it depends” middle choice
- P2-4 <don’t understand> “strange question”
- P5-2 <don’t understand> “seems vague”
- P7-2 <don’t understand> “depends”
- P8-1 <don’t understand> “pretty general”
- P2-4 <exacting> “I don’t know what that means.”
- P4-3 <exacting> “not sure what exacting means”
- P14-1 “I was actually just wondering how many more I have”
- P13-1 <don’t understand> “seen some of these in different format”
- P11-3 <complex> “Not sure what you mean by complex people”
- P6-1 <exacting> “for the most part” middle choice
- P11-3 <exacting> “I’m thinking too philosophically about this.”
- P6-1 <started quickly> “depends” middle choice
- P13-1 <started quickly> <push myself> <work hard> <too little> “depends” middle choice
- P2-4 hesitated at end of page before continuing

Table 141: Cognitive Interviews Personality Items Page 7

Item	Source	Subscale	Key
P7_2 I hang around doing nothing.	HEXACO	Diligence (Motivation)	Negative
P7_3 I quickly lose interest in the tasks I start.	HEXACO	Diligence (Motivation)	Negative
P7_4 I stop when work becomes too difficult.	HEXACO	Diligence (Motivation)	Negative
P7_5 I demand quality.	AB5C	Organization (Organized)	Positive
P7_7 I detect mistakes.	AB5C	Organization (Organized)	Positive
P7_8 I follow through on my commitments.	AB5C	Organization (Organized)	Positive
P7_9 I have an eye for detail.	AB5C	Organization (Organized)	Positive
P7_10 I make well-considered decisions.	AB5C	Organization (Organized)	Positive
P8_1 I pay attention to details.	AB5C	Organization (Organized)	Positive
P8_2 I set high standards for myself and others.	AB5C	Organization (Organized)	Positive

Comments from Participants for page 7:

- P7-2 "I think I need reassurance again."
- P7-2 <hang> "that needs some kind of time, like frequently"
- P10-3 <hang> "sometimes" middle choice
- P7-2 <quality> "of who?"
- P2-4 <mistakes> "confused"
- P1-2 "hard to be specific"
- P11-3 <eye> "depends"
- P2-4 <well-considered> "sounds strange, guess well thought out?"
- P11-3 <attention> "sometimes" middle choice
- P9-2 <eye> <attention> "I guess these are different"
- P1-2 <standards> "sort of accurate"
- P13-1 <standards> "different for myself and others"

Table 142: Cognitive Interviews Personality Items Page 8

Item	Source	Subscale	Key
P8_3 I think ahead.	AB5C	Organization (Organized)	Positive
P8_4 I put little time and effort into my work.	AB5C	Organization (Organized)	Negative
P8_5 I seldom notice details.	AB5C	Organization (Organized)	Negative
P8_6 I am a goal-oriented person.	VIA	Industry/Perseverance/Persistence (Persistence)	Positive
P8_7 I am a hard worker.	VIA	Industry/Perseverance/Persistence (Persistence)	Positive
P8_9 I don't get sidetracked when I work.	VIA	Industry/Perseverance/Persistence (Persistence)	Positive
P8_10 I don't quit a task before it is finished.	VIA	Industry/Perseverance/Persistence (Persistence)	Positive
P9_1 I finish things despite obstacles in the way.	VIA	Industry/Perseverance/Persistence (Persistence)	Positive
P9_2 I don't finish what I start.	VIA	Industry/Perseverance/Persistence (Persistence)	Negative
P9_3 I accept challenging tasks.	TCI	Competence (Problem Solver)	Positive

Comments from Participants for page 8:

- P6-1 Got an error message at this point
- P3-4 "If I do slow down it's because the question is similar to a previous question."
- P3-4 <seldom> hesitated
- P9-2 <seldom> "that's kind of strong"
- P7-2 <hard worker> "some repetition here"
- P11-3 <sidetracked> "depends"
- P6-1 <quit a task> "depending" middle choice
- P8-1 <quit a task> "not sure what this means, have to eat and sleep"

Table 143: Cognitive Interviews Personality Items Page 9

Item	Source	Subscale	Key
P9_4 I feel up to any task.	TCI	Competence (Problem Solver)	Positive
P9_5 I know how to apply my knowledge.	TCI	Competence (Problem Solver)	Positive
P9_6 I meet challenges.	TCI	Competence (Problem Solver)	Positive
P9_8 I don’t put my mind on the task at hand.	TCI	Competence (Problem Solver)	Negative
P9_9 I don’t see things through.	TCI	Competence (Problem Solver)	Negative

Comments from Participants for page 9:

- P7-2 <up to> “not sure, have to know what task is”
- P8-1 <up to> “too broad” middle choice
- P5-2 <apply> “trying to figure out this one”
- P13-1 <apply> “that’s a challenging question”
- P9-2 <mind> paused
- P11-3 <mind> “not sure about that question” middle choice

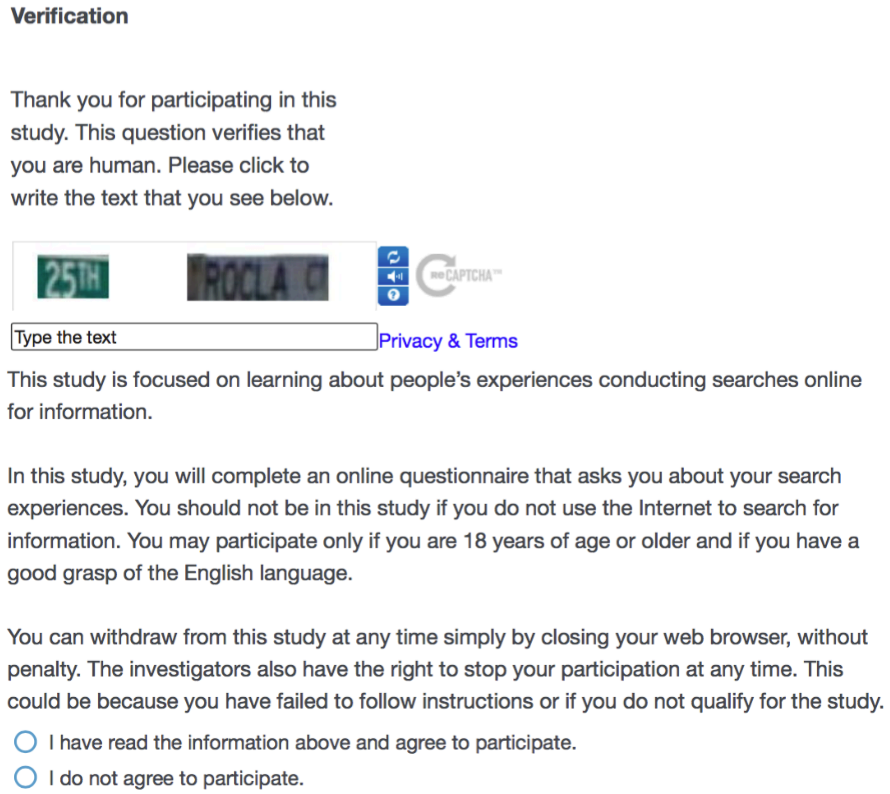
End comments from Participants:

- P2-4 “trouble going back and forth in positive and negative questions”
- P3-4 “if there is a don’t or a no I make sure I’m reading right. Some questions I didn’t know which way to answer so I stuck to the middle. Search terms I didn’t know and I guess I should know if I am supposed to be good at searches.
- P4-3 “On last questions, maybe break it up with different formats. Seemed like a lot of the same. Ack, another page!”
- P5-2 “Made me curious about what information you are trying to collect. Some were sort of vague and I wasn’t sure how to answer them.”
- P6-1 “Middle of the road kind of guy, everything is conditional.”
- P7-2 “I feel absurdly inadequate.”
- P8-1 “It wasn’t what I expected. Felt like personality tests.”
- P9-2 “Not expecting some questions. Stayed away from extremes at either end because no example. Thought Google was the only search engine. All those terms made me think, ‘Wow I am very amateur at this.’”
- P10-3 “made me realize that I need to do better.”
- P11-3 ”When I didn’t know I just clicked one in the middle.”
- P12-4 selected lots of extremes
- P13-1 “wondered if I am being consistent”
- P14-1 “I have difficulty with negative questions”

APPENDIX M: ONLINE SEARCH EXPERTISE INSTRUMENT

This work is licensed under the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License. To view a copy of this license, visit http://creativecommons.org/licenses/by-nc-sa/4.0/ or send a letter to Creative Commons, PO Box 1866, Mountain View, CA 94042, USA. Please share data and request the latest version of this instrument from the email earl.bailey@gmail.com.

Figure 38: Online Search Expertise Instrument v1.0



Verification

Thank you for participating in this study. This question verifies that you are human. Please click to write the text that you see below.

This study is focused on learning about people's experiences conducting searches online for information.

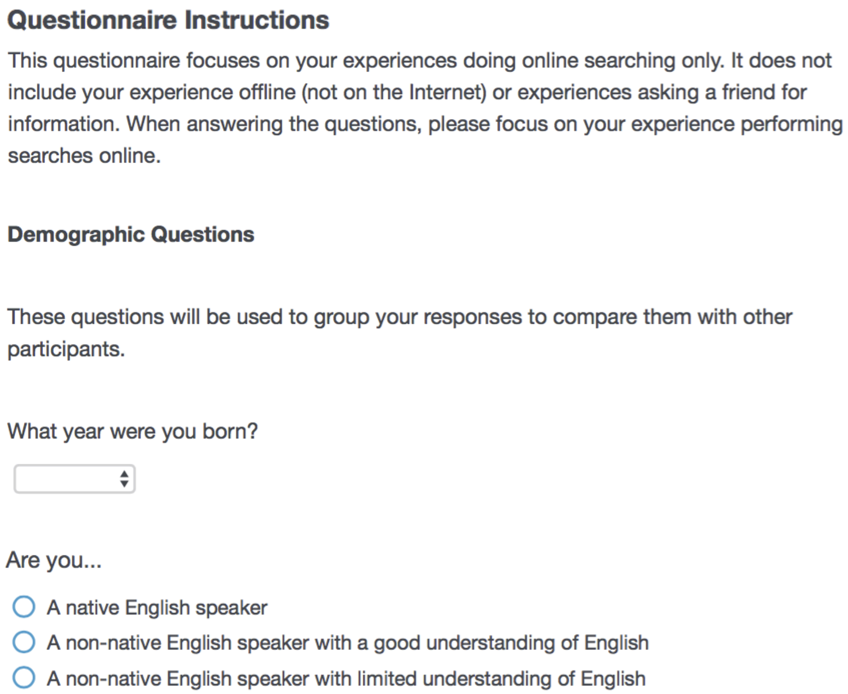
In this study, you will complete an online questionnaire that asks you about your search experiences. You should not be in this study if you do not use the Internet to search for information. You may participate only if you are 18 years of age or older and if you have a good grasp of the English language.

You can withdraw from this study at any time simply by closing your web browser, without penalty. The investigators also have the right to stop your participation at any time. This could be because you have failed to follow instructions or if you do not qualify for the study.

○ I have read the information above and agree to participate.

○ I do not agree to participate.

(Those that do not agree are taken to the end message.)



Questionnaire Instructions

This questionnaire focuses on your experiences doing online searching only. It does not include your experience offline (not on the Internet) or experiences asking a friend for information. When answering the questions, please focus on your experience performing searches online.

Demographic Questions

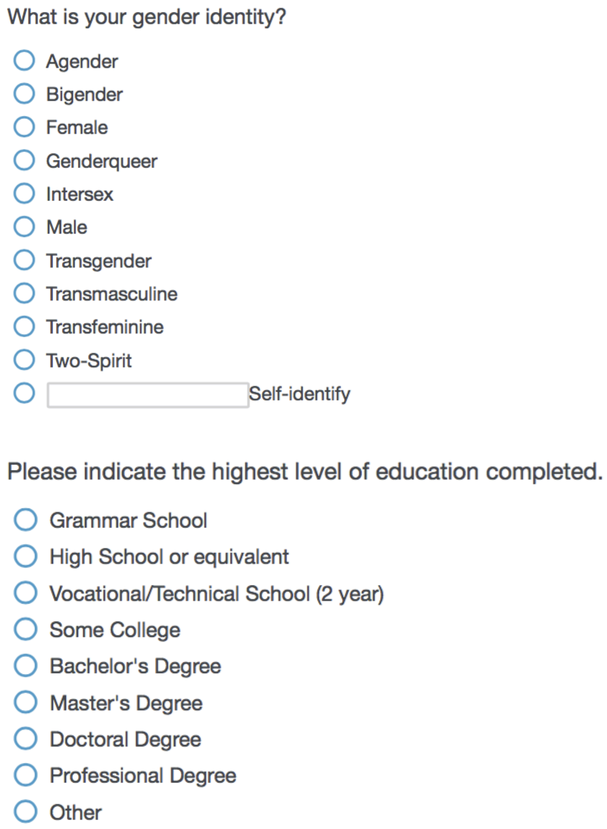
These questions will be used to group your responses to compare them with other participants.

What year were you born?

Are you...

- ○ A native English speaker
- ○ A non-native English speaker with a good understanding of English
- ○ A non-native English speaker with limited understanding of English

(Answering as less than 18 or a non-native speaker sends to end message)

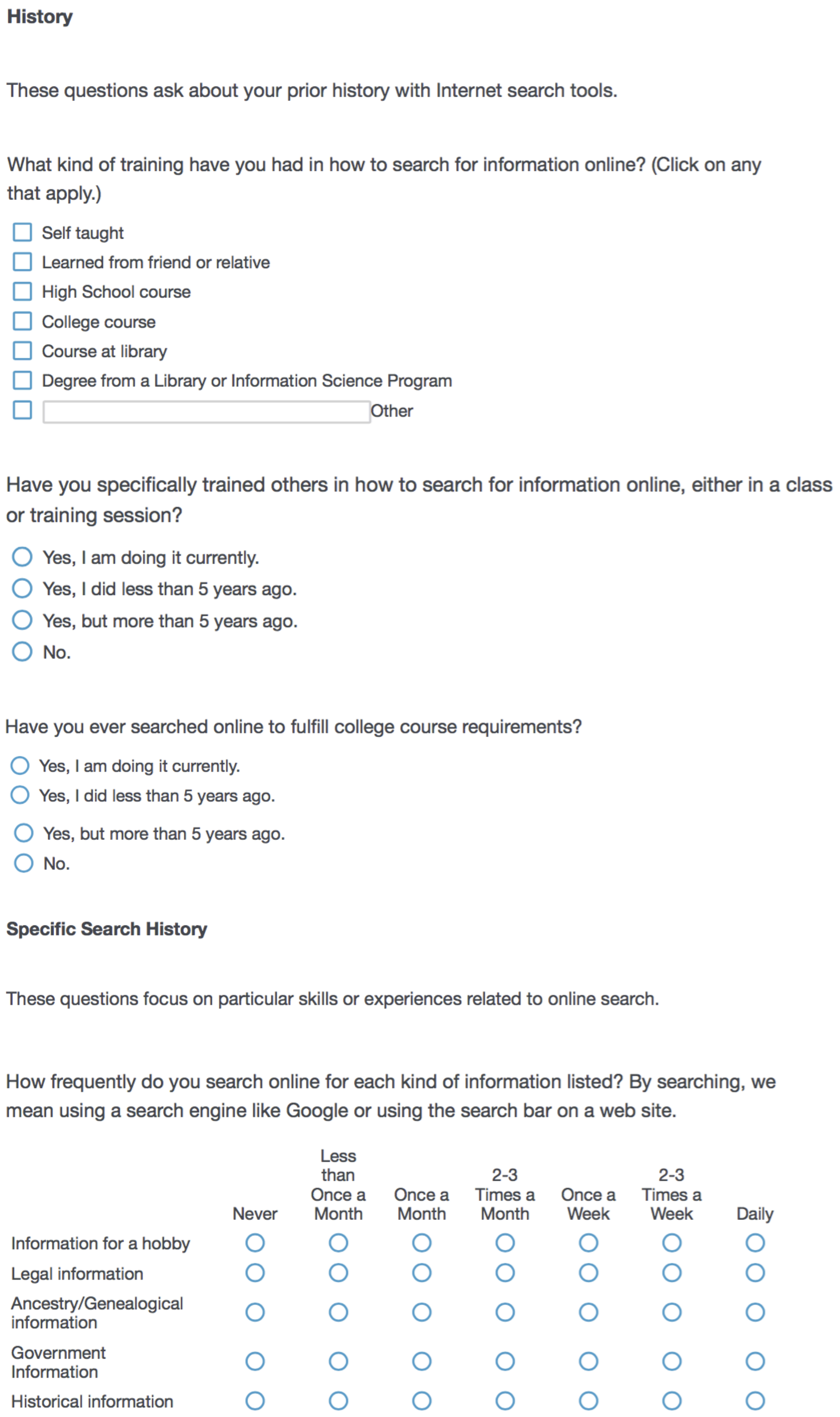


What is your gender identity?

- ○ Agender
- ○ Bigender
- ○ Female
- ○ Genderqueer
- ○ Intersex
- ○ Male
- ○ Transgender
- ○ Transmasculine
- ○ Transfeminine
- ○ Two-Spirit
- ○ Self-identify

Please indicate the highest level of education completed.

- ○ Grammar School
- ○ High School or equivalent
- ○ Vocational/Technical School (2 year)
- ○ Some College
- ○ Bachelor's Degree
- ○ Master's Degree
- ○ Doctoral Degree
- ○ Professional Degree
- ○ Other



History

These questions ask about your prior history with Internet search tools.

What kind of training have you had in how to search for information online? (Click on any that apply.)

☐ Self taught
☐ Learned from friend or relative
☐ High School course
☐ College course
☐ Course at library
☐ Degree from a Library or Information Science Program
☐ ________ Other

Have you specifically trained others in how to search for information online, either in a class or training session?

○ Yes, I am doing it currently.
○ Yes, I did less than 5 years ago.
○ Yes, but more than 5 years ago.
○ No.

Have you ever searched online to fulfill college course requirements?

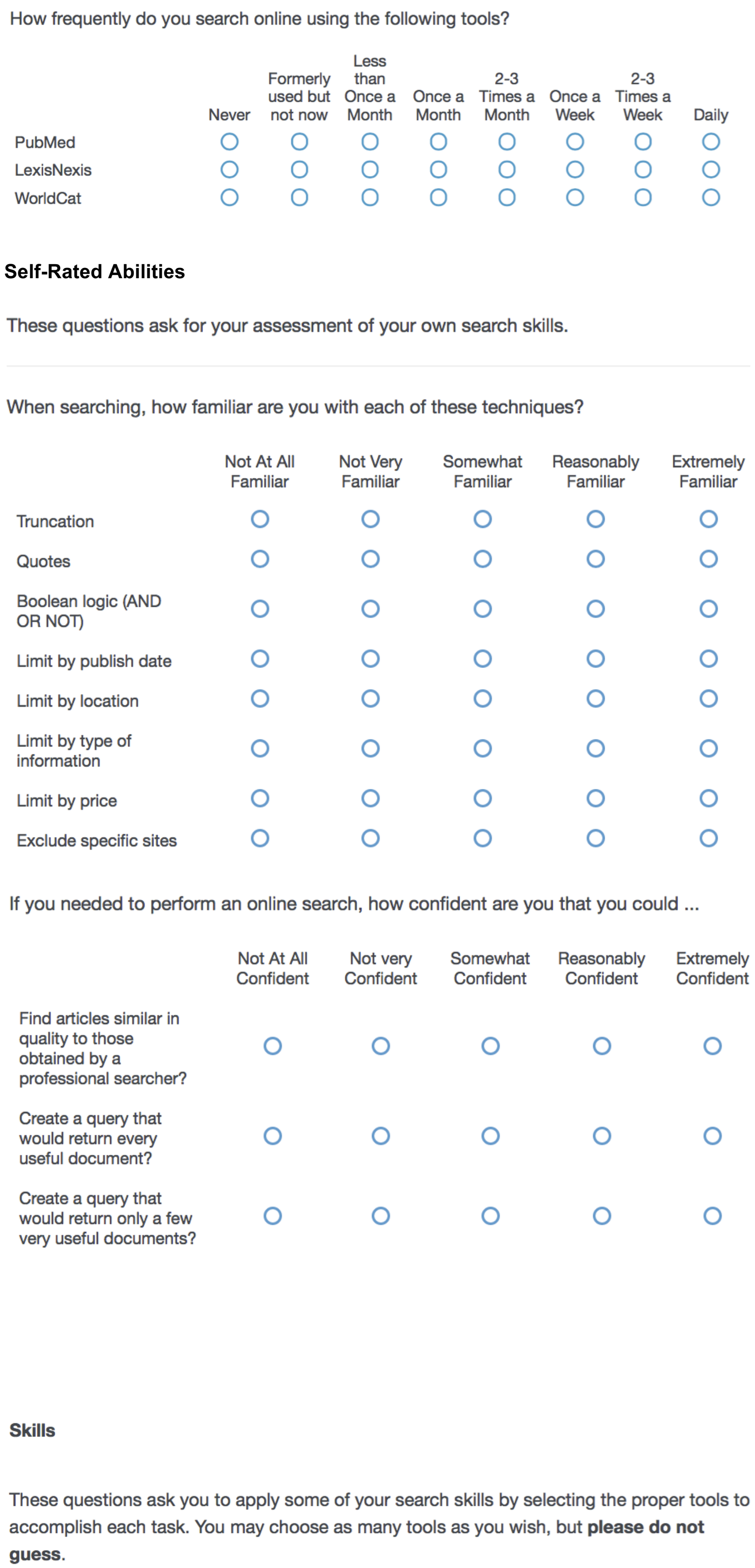
○ Yes, I am doing it currently.
○ Yes, I did less than 5 years ago.
○ Yes, but more than 5 years ago.
○ No.

Specific Search History

These questions focus on particular skills or experiences related to online search.

How frequently do you search online for each kind of information listed? By searching, we mean using a search engine like Google or using the search bar on a web site.

	Never	Less than Once a Month	Once a Month	2-3 Times a Month	Once a Week	2-3 Times a Week	Daily
Information for a hobby	○	○	○	○	○	○	○
Legal information	○	○	○	○	○	○	○
Ancestry/Genealogical information	○	○	○	○	○	○	○
Government Information	○	○	○	○	○	○	○
Historical information	○	○	○	○	○	○	○



How frequently do you search online using the following tools?

	Never	Formerly used but not now	Less than Once a Month	Once a Month	2-3 Times a Month	Once a Week	2-3 Times a Week	Daily
PubMed	○	○	○	○	○	○	○	○
LexisNexis	○	○	○	○	○	○	○	○
WorldCat	○	○	○	○	○	○	○	○

Self-Rated Abilities

These questions ask for your assessment of your own search skills.

When searching, how familiar are you with each of these techniques?

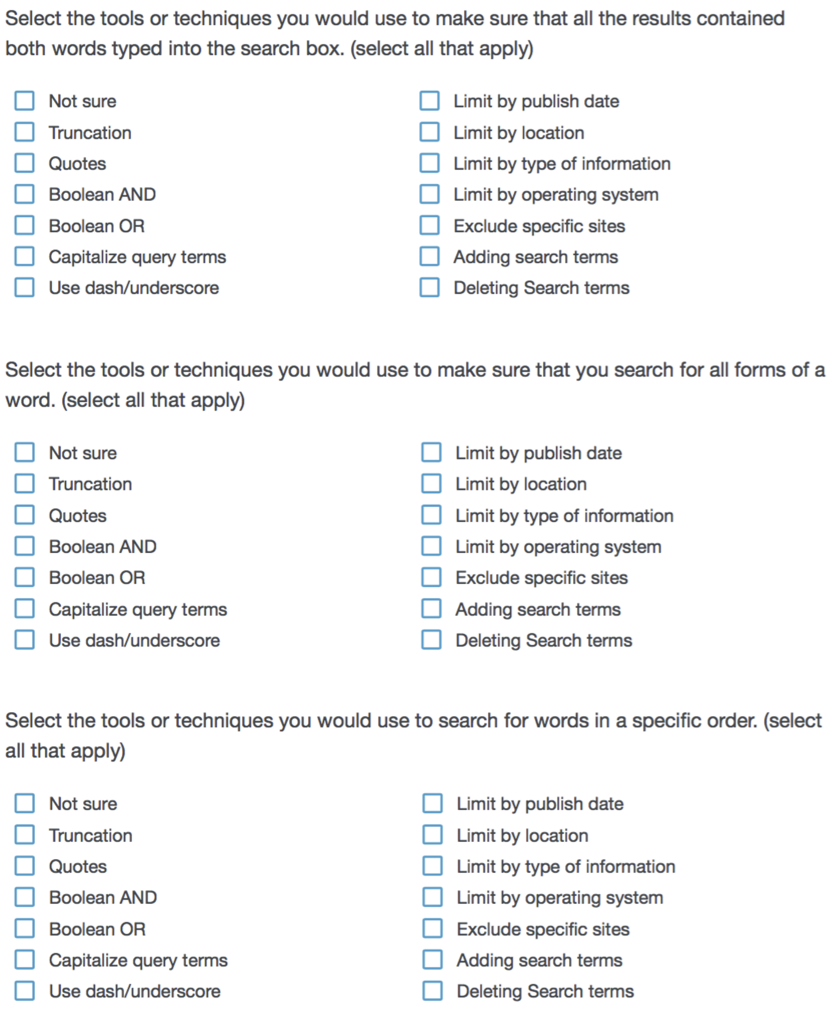
	Not At All Familiar	Not Very Familiar	Somewhat Familiar	Reasonably Familiar	Extremely Familiar
Truncation	○	○	○	○	○
Quotes	○	○	○	○	○
Boolean logic (AND OR NOT)	○	○	○	○	○
Limit by publish date	○	○	○	○	○
Limit by location	○	○	○	○	○
Limit by type of information	○	○	○	○	○
Limit by price	○	○	○	○	○
Exclude specific sites	○	○	○	○	○

If you needed to perform an online search, how confident are you that you could ...

	Not At All Confident	Not very Confident	Somewhat Confident	Reasonably Confident	Extremely Confident
Find articles similar in quality to those obtained by a professional searcher?	○	○	○	○	○
Create a query that would return every useful document?	○	○	○	○	○
Create a query that would return only a few very useful documents?	○	○	○	○	○

Skills

These questions ask you to apply some of your search skills by selecting the proper tools to accomplish each task. You may choose as many tools as you wish, but **please do not guess**.



Select the tools or techniques you would use to make sure that all the results contained both words typed into the search box. (select all that apply)

- ☐ Not sure
- ☐ Truncation
- ☐ Quotes
- ☐ Boolean AND
- ☐ Boolean OR
- ☐ Capitalize query terms
- ☐ Use dash/underscore
- ☐ Limit by publish date
- ☐ Limit by location
- ☐ Limit by type of information
- ☐ Limit by operating system
- ☐ Exclude specific sites
- ☐ Adding search terms
- ☐ Deleting Search terms

Select the tools or techniques you would use to make sure that you search for all forms of a word. (select all that apply)

- ☐ Not sure
- ☐ Truncation
- ☐ Quotes
- ☐ Boolean AND
- ☐ Boolean OR
- ☐ Capitalize query terms
- ☐ Use dash/underscore
- ☐ Limit by publish date
- ☐ Limit by location
- ☐ Limit by type of information
- ☐ Limit by operating system
- ☐ Exclude specific sites
- ☐ Adding search terms
- ☐ Deleting Search terms

Select the tools or techniques you would use to search for words in a specific order. (select all that apply)

- ☐ Not sure
- ☐ Truncation
- ☐ Quotes
- ☐ Boolean AND
- ☐ Boolean OR
- ☐ Capitalize query terms
- ☐ Use dash/underscore
- ☐ Limit by publish date
- ☐ Limit by location
- ☐ Limit by type of information
- ☐ Limit by operating system
- ☐ Exclude specific sites
- ☐ Adding search terms
- ☐ Deleting Search terms

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