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Not Dead Yet! A Longitudinal Study of Query Type and Ready Reference Accuracy in Live Chat and IM Reference

Abstract
Research reveals that users of virtual reference services (VRS) value accurate answers to their queries and a pleasant interpersonal encounter. Findings from a longitudinal study compare two sets of randomly selected VRS transcripts, one of 850 live chat sessions from 2004 to 2006, and the second of 560 live chat and instant messaging (Qwidget) sessions from 2010.The investigation of the international QuestionPoint (OCLC, 2012) transcripts includes comparisons by query type (e.g., ready reference, policy and procedural, subject search) and by accuracy of answers to the subset identified as ready reference (e.g., fact-based queries). Findings indicate that percentages of ready reference queries are remaining stable, having increased slightly from 27% (243 of 915 queries found in 850 transcripts) in 2004 to 2006 to 31% (179 of 575 queries found in 560 transcripts) in the 2010 dataset. Additionally, accuracy of answers was found to have improved. The percentage of correct and complete responses with citations given by VRS librarians or staff members answering ready reference questions was found to have increased from 78% (141) in 2004-2006 to 90% (151) in 2010.

1. **Introduction**

Libraries provide human-mediated, web-based information assistance to users through various modes of virtual reference service (VRS). As a pioneering format of synchronous VRS, live chat reference has become "an integral part of a library's reference portfolio" (Luo, 2007, p. 195). Currently, "digital reference services are one of the most expanding services in public libraries" (Numminen & Vakkari, 2009, p. 1249), as well as in libraries of all types. VRS providers have simultaneously extended their reach and expanded user horizons by responding to changing communication preferences and behaviors by adopting new "technologies of choice" (Agosto, Rozklis, MacDonald, & Abels, 2011, p. 238).

As instant messaging (IM) has grown increasingly popular with users, librarians have responded by adding IM reference to their VRS suite. The IM format achieved widespread acceptance with the introduction of OCLC's QuestionPoint (QP) Qwidget (QW) (QuestionPoint 24/7 Reference Services, 2008).Both live chat and QW reference modes generate verbatim text transcripts of completed VRS interactions between users and librarians. One major benefit of the chat and IM formats is the record of complete transcripts of all the conversational text, pre-written scripts, and web links (or other resources) given to the user for each reference session. These fascinating mirrors of practice allow researchers to unobtrusively capture the nuances of reference encounters. In-depth qualitative analysis of the transcripts generates data and insights, which are unattainable in face-to-face (FtF) settings (Maximiek, Rushton, & Brown, 2010). Transcript analysis does have limitations, especially due to privacy concerns, which require that transcript data are stripped of personal information for analysis (Radford & Connaway, 2005-2008). Once transcript data are made anonymous, it is difficult to discern librarian and user characteristics, such as gender, age, among other characteristics. It also is impossible to connect transcript to participants to directly ask them questions about their perceptions of success and satisfaction. However, the transcripts are useful in revealing the nature of the query negotiation and of the ways in which the interpersonal encounter unfolds. Since the text of the transaction is fully available, behaviors can be tracked and traced to reveal the librarian's ability to evaluate the information need, as well as provide a successful answer in a professional manner that invites an ongoing relationship with users.

As VRS has entered mainstream reference, researchers are investigating both the interpersonal and the content-delivery aspects of this complex encounter in traditional (Radford, 1999) and virtual environments (Connaway & Radford, 2011; Radford, 2006). On the content side, scholars have evaluated types and frequencies of questions asked, as

well as investigated accuracy of answers, which are aided by transcripts. Like traditional FtF reference, VRS is held to librarian behavior quality standards and guidelines. For example, the American Library Association's Reference and User Services Association (RUSA) "Guidelines for Implementing and Maintaining Virtual Reference Services" (Reference and User Services Association, 2004) recommend regular assessments of VRS and propose methods, such as transcript analysis, "to evaluate its effectiveness and efficiency, with the goal of providing a high-quality service" (para. 4.6.1). This study aims to contribute methods and findings to inform VRS assessment.

2. Problem statement

Interpersonal interactions are highly complex with multiple facets. The reference encounter adds additional layers of intricacy because it involves the library professional efforts to discover and solve the user's information need. Both participants are usually strangers, especially in virtual encounters. VRS communication adds another challenge as nonverbal cues, such as facial expressions, context cues, and user/librarian characteristics are not apparent. The participants only have each other's written text and temporal cues (e.g., how long it takes for question pick-up and turn-taking) as guides (Connaway & Radford, 2011). Watzlawick, Beavin, and Jackson's (1967) relational theory allows a holistic view of interpersonal engagement and posits that each message between people has both a relational (interpersonal relationship) and content (information delivery) aspect. The Seeking Synchronicity (Radford & Connaway, 2005-2008) research program has worked to uncover the importance of relational dimensions in the success of live chat reference. This research found that VR should stand for "Virtual Relationships" because of the importance of interpersonal aspects, such as greeting and closing rituals, acts of politeness, deference, rapport building, and compensation for lack of nonverbal cues (Connaway & Radford, 2011). During a series of telephone and online surveys with VRS users and non-users, Seeking Synchronicity research also discovered that information-related components, particularly completeness and accuracy are critically important criteria for the measure of success in VRS, more so than have been found for users' perceptions of success in FtF encounters (Radford, 1999).

Although accuracy is important to VRS users, are they able to easily find information on the Web, especially simple facts? With the advent of increasing access to search engines and the enhanced ability of users to find answers to fact-based queries, researchers such as Joe Janes (2003) have speculated that ready reference is dead or dying. The research reported here questions whether the assertion is true. What types of questions are asked in virtual environments over time? How often are ready reference questions still appearing in VRS? Also, when these questions do get asked, are users getting correct answers with citations to sources? The following research questions addressing the content of VRS were developed:

- How frequently are ready reference questions asked in VRS?
- How have the mix and frequency of types of VRS questions changed?
- How has the accuracy rate of answers to VRS ready reference questions changed?

- What differences are there in mix, frequency, and accuracy for live chat compared to instant messaging (IM)/Qwidget (QW) VRS modes?

As one of the first longitudinal studies examining a large number of VRS questions, determining types and frequency of reference questions, as well as verifying accuracy has been a focus for library literature. Reference remains important in the provision of high-quality service. If reference is not accurate and complete, serious repercussions could result if users turn elsewhere for their information needs. As VRS becomes more prevalent, research-based guidelines for service excellence are necessary. These research questions must be addressed to gain insight into how well questions are answered, as well as to better serve users and to ensure the sustainability of traditional and virtual reference modes.

3. Literature review

3.1 Types of reference queries

Research into the different types of reference queries extends back to the pre-Web days of traditional in-person and telephone environments (Singer, 2010). Several scholars developed useful question typologies, including Sears (2001) and Katz (1997, 2002). Before chat, email reference has existed for more than 20 years (Sloan & Cox, 2006); Veal (2012) provides a detailed review of email research, including question categorization. Numminen and Vakkari (2009) identified taxonomies useful for categorizing VRS questions and discuss different approaches taken by researchers (Arnold & Kaske, 2005; Desai, 2003; Garnsey & Powell, 2000; Hodges, 2002; Kibbee, Ward, & Ma, 2002; Kwon, 2006; and Smyth, 2003). Numminen and Vakkari (2009) expanded Katz's (2002) and Sears' (2001) taxonomies to conduct a longitudinal analysis of questions from a Finnish VRS. The resulting taxonomy divided the main categories of reference (e.g., policy and procedural, and directional questions) into detailed subcategories. Numminen and Vakkari (2000) compared a 1999 dataset ($N = 467$) to a 2006 dataset ($N =513$) and found that 90% of VRS queries could be categorized as reference questions; the percent of ready reference increased 12% from 33% (calculated as 154 of 467 questions) in 1999 to 45% (calculated as 231 of 513 questions) in 2006.

3.2 Accuracy of reference queries in service evaluation

There are a range of qualitative and quantitative methods for measuring reference quality, including: user satisfaction, completeness, dimensions of relational or interpersonal communication, and content delivery (e.g., see Kocevar-Weidinger, Benjes-Small, Ackermann, & Kinman, 2010; Radford, 1999; Stock, 2010; Ward, 2004). Accuracy is one reliable and objective measure, especially for factual questions (Ross, Nilsen, & Dewdney, 2002). One way to assess accuracy is through unobtrusive testing, which is described as "the process of asking reference questions (for which answers have been predetermined) of library staff members who are unaware that they are being evaluated" (Hernon & McClure, 1986). Hernon and McClure (1986), Childers (1978), and Crowley (1968), called reference accuracy into question with surprising and

controversial results (Hubbertz, 2005), suggesting that only 50% to 60% of responses to reference questions are correct (Buckland, 2008).

Hernon and McClure's (1986) series of unobtrusive tests led them to propose the "55 percent rule," suggesting reference staff correctly answer only a little better than half of questions. In 1987, Hernon and McClure reported results from their unobtrusive measure of 26 academic and public government documents depository FtF reference services, analyzing their "correct answer fill rate" (p. 27). Library and information science (LIS) graduate students in a government documents course, as well as researchers, acted as proxies to pose 15 questions at these 26 libraries. Using Katz's (1997) question categorization, an analysis of the government document-related questions revealed that seven (47%) were ready reference and eight (53%) were holdings questions (i.e., materials owned or accessible). Correct responses involved: (a) answering the question or identifying the document, or (b) making a correct referral. Hernon and McClure (1987) found that 61.8% of 390 questions asked at both the central reference and government documents areas were answered correctly. Although the Hernon and McClure's methods and rationale have been contested (e.g., Bailey, 1987; Durrance, 1989; Hubbertz, 2005) and modified (Pomerantz, Luo, & McClure, 2006), the idea of "half-right" reference accuracy has remained as a benchmark (Ward, 2004; Arnold & Kaske, 2005; Agosto & Anderton, 2007). The benchmark persists, despite challenges to the generalizability of findings and the specialized nature of this method, which emphasized predetermined questions and answers, as well as employed surrogate users. Durrance (1989) asserted that undue emphasis may have been placed on accuracy, maintaining that "interpersonal variables of friendliness, interest in the question, or comfort level" (p.35) are also crucial factors in successful reference encounters (c.f. Radford, 1999).

Scholars also have studied telephone reference (Agosto & Anderton, 2007) and email reference accuracy (Janes, Hill, & Rolfe, 2001; Moeller, 2003; Profeta, 2006; Stacy-Bates, 2003). Stacy-Bates (2003) studied academic library email reference by sending three queries to 111 libraries, which were members of the Association of Research Libraries. Answers were analyzed for accuracy, response time, service to non-affiliates, reference interview elements, and technology-enabled features. The three queries had differing accuracy rates, ranging from 65% to 99% depending on query type (Stacy-Bates, 2003).

In another study, Profeta (2006) examined 240 email transcripts from distance learning community college students in Florida. Findings included a low accuracy percentage, including 24% as accurate with source information, four percent as accurate without source information, 20% as partly accurate with source information, and 7% as partly accurate without source information. Janes et al. (2001) also appraised email reference, testing response rate and time, and verifiable answers for "non-library commercial and non-commercial" online information services or "expert services," such as Askme.com (p. 1106). Graduate students in a reference course posed 150 questions in various subjects to these 20 sites, 10 of which were commercial, such as ExpertCentral (http://www.expertcentral.com) and Frenzi (http://www.frenzi.com), and 10 of which

were non-commercial, such as Ask Eric (http://askeric.org/) and Go Ask Alice (http://www.goaskalice.columbia.edu/). The graduate students evaluated their experiences. They found 69% accuracy, higher than Profeta's (2006) findings, concluding in 2001 that "commercial and non-commercial expert services are developing and providing digital reference services that succeed, where libraries…have not" (Janes et al., 2001, p. 1119).

Live chat VRS transcript analysis suggests that accuracy for this type of service exceeds the 55% benchmark. Arnold and Kaske (2005) analyzed 351 VRS academic chat sessions, which included 419 questions that examined question type, user status, and accuracy. They reported nearly 92% of 302 responses given were correct. Of these responses, 38% were correct and complete with references cited. The results excluded 117 of 419 questions that were deferred, referred, or lost due to technical difficulties.

Pomerantz et al. (2006) analyzed chat transcripts from a statewide service, including public and academic librarians. Peer reviewers found that almost 80% (calculated as 342 of 428 questions) were answered correctly. However, 27% of these were found to be incomplete, a status that was not considered in the original Hernon and McClure (1987) study. VRS transcript analyses by Pomerantz et al. (2006), as well as by Arnold and Kaske (2005), have operationalized accuracy differently than methods used for the "55 percent rule" benchmark studies. These findings of higher VRS accuracy rates cannot be directly compared to earlier unobtrusive studies because of differing testing methods, question taxonomies, and evaluation criteria.

Ready reference was among the question types studied by Hernon and McClure (1987) and Arnold and Kaske (2005). The questions types are defined as fact-based queries, requiring "only a single, usually uncomplicated, straightforward answer" (Katz, 1997, p. 15-16). Hernon and McClure (1987) asked 172 ready reference questions in 26 libraries. They reported 129 correct answers for 75% accuracy. Arnold and Kaske (2005) found 14% (59) of the questions studied were ready reference. Of the 31 ready reference questions answered, 97% (30) were correct and only 3% (1) were incorrect. In both studies, ready reference accuracy was found to be higher than overall accuracy rates.

Some authors recommend that questions be additionally coded along a range of specificity (Cousins, 1992; Nordlie, 1999; Saracevic & Kantor, 1988), clarity (Lee, 2004; Saracevic & Kantor, 1988), and complexity (Saracevic & Kantor, 1988). These conceptualizations help define ready reference questions as being at one end of the close-ended question spectrum: they are specific, clear, and simple to answer.

4. Method

The Seeking Synchronicity: Evaluating Virtual Reference Services from User, Non-User, and Librarian Perspectives project involved four phases of data collection, one of which was an analysis of 915 live chat transcripts, of which 850 were found to be usable (Connaway & Radford, 2011; Radford & Connaway, 2005-2008). The transcripts were randomly selected from July 2004 to October 2006 from a corpus of 651,687

sessions from QuestionPoint (QP) and the QuestionPoint 24/7 (QuestionPoint 24/7 Reference Services) reference service that OCLC acquired (OCLC, 2012). Of the 850 transcripts, 550 were from QP and 300 were from QP 24/7.

For longitudinal comparison, a second sample of 575 transcripts was drawn from a corpus of 296,797 QP live chat and QW sessions from June 2010 to December 2010. Of these, 560 were found to be usable, including 350 live chat from QP from the 2010 dataset (QP2) and 210 QW. Note that the QW software was added in 2008 to QP; thus, it was not present in the 2004 to 2006 dataset.

All transcripts were stripped of identifying information (e.g., name, email address, IP address, etc.) at OCLC. Transcripts were then subjected to several different analyses by teams of coders; each analysis was conducted by a minimum of two coders, including researchers and graduate assistants from OCLC and Rutgers University. The analysis was supervised by the co-authors.

A team of two coders first classified the type of reference questions from each chat and QW transcript. Criteria and category schemes from Katz (1997), Kaske and Arnold (2002), and Arnold and Kaske (2005) were used for the initial coding of question types. Six categories were included: *directional, ready reference, subject search* (note that Katz, 1997 and Arnold and Kaske, 2005, called this "specific search"), *research, policy and procedural*, and *holdings*. During the 2004 to 2006 coding process, two additional categories: "no question" and "inappropriate" emerged (Radford & Connaway, 2005-2008). In addition, *reader's advisory* questions were also found, as defined by Ross et al. (2002) and Ross, Nilsen, and Radford (2009). An in-depth review of these categories with definitions and examples from the data is provided.

The subset of ready reference questions were further analyzed for accuracy, using criteria and category schemes from Arnold and Kaske (2005), Radford and Connaway (2005-2008), and Radford, Connaway, Confer, Sabolsci-Boros, and Kwon (2011). Although the user may have disconnected before the librarian or staff member supplied the answer, these inquiries were also evaluated and coded for accuracy. Disconnects were included because the QP system will deliver the transcript with the answer to the user, as long as the user has provided an email address. Although the user may appear to be gone, the transcript could be sent   via email. Following the method as described by Arnold and Kaske (2005), ready reference queries were dropped out of the accuracy analysis if they were referred for follow-up via email, phone, fax, or to another library or librarian or if there were technical difficulties, such as abrupt disconnect prior to an answer being offered. Referrals are not included because the transcript ends at the point of referral and it is not possible to determine the accuracy of the answer, or whether the referral itself is successful. On this basis, 63 of the 243 ready reference questions in the 2004 to 2006 dataset and 11 of the 179 ready reference questions in the 2010 dataset were eliminated.

For both data sets, teams of coders evaluated the accuracy of chat ready reference answers by thoroughly checking responses using authoritative web sites, subscription-based databases, and any citations or links provided by the librarian or staff member. In

cases where links were incorrect or not provided, coders used the above tools to determine the correct response. In the 2004 to 2006 dataset, each question was analyzed by two coders from a team of four. In the 2010 sample, two coders judged each answer. For both samples, coders placed each answer into only one of the following categories:

1. Correct with citation
2. Correct without citation
3. Correct without citation, no citation needed
4. Incorrect with citation
5. Incorrect without citation
6. Incorrect (without specific information requested, with only general/ related resource)
7. Other

Categories one through five are consistent with Arnold and Kaske's (2005) taxonomy. To be considered correct and coded into categories one to three, the answer must have been accurate and complete. Further, correct responses must provide information that answers the specific question rather than gives general information about the topic. In cases where users refined their questions through the course of the interaction, a series of questions and references may need to be considered. If one of several links provided the correct answer, the answer was considered correct.

The *Seeking Synchronicity* (Radford & Connaway, 2005-2008; Radford et al., 2011) coders created category six for answers that were incorrect because they provided general information and/or a citation(s) that did not answer the specific question. Category seven was created to identify complete ready reference interactions that did not fit into other categories (Radford & Connaway, 2005-2008; Radford et al., 2011). See Table 1 for descriptions, explanatory notes, and examples for categories from the 2004 to 2006 (QP1, QP 24/7), 2010 live chat QP2 and QW data sets. Quotations from transcripts are verbatim; spelling and grammatical mistakes have not been corrected.

Table 1: Accuracy Category Descriptions with Transcript Examples

Accuracy Category	Description with Citation	Explanatory Notes	Examples
1. Correct with Citation	Question is answered completely and accurately with appropriate reference (Arnold & Kaske, 2005)	The answer can be complete, accurate and cited even when the answer is no.	User (U): "can you please send me song lyrics for Under pressure by my chemical romance?" Librarian (L) sent lyrics along with link http://www.plyrics.com/lyrics/mychemicalromance/underpressure.html (QP1-001)

2. Correct without Citation	Question is answered completely and accurately without appropriate reference (Arnold & Kaske, 2005)	A citation would have been appropriate but would not have changed the accuracy of the response.	U: "What is the definition of alliumphobia?" L: "Fear of gralic [garlic]" (QP1- 038)
3. Correct, no Citation Needed	Question is answered completely and accurately without appropriate reference and none is needed (Arnold & Kaske, 2005)	Answers are so obvious or well-known no citations are needed.	U: "how do ypu say test plurally. Is tests acceptable?" L: "Yes, tests is the correct form of the plural" (QP 24/7-191) -------- U: Hi. I'm looking for the disc about a rat that becomes a celebrated French chef. It"s all computer animation, of course. Could you help me with the name of this film so I can look up its availability? L: Answer: Ratatouille. No citation needed because it's in popular culture, general knowledge. Ratatouille (2007) Disney film. See http: disney.go.com/disneypictures/ratatouille / (QW- 030)
4. Incorrect with Citations	Question is answered incompletely or inaccurately with appropriate reference (Arnold & Kaske, 2005)	The question was not answered, but the user could find the answer from the site provided.	U: "How far is it from Maryland to the North Pole?" L provided the North Pole website and general location information (QP1-14)
5. Incorrect without Citations	Question is answered incompletely or inaccurately without appropriate reference (Arnold & Kaske, 2005)	Further research finds that answer was wrong and no citations were provided.	U: "How do I know when a journal is peer reviewed or are all journals peer reviewed?" L: "When instructors say 'peer reviewed' they usually mean simply scholarly journals. 'Peer reviewed' journals are a small subset of scholarly journals" (QP 24/7-225)

6. Incorrect (without specific information requested, with only general/ related resource)	Question is answered incompletely or inaccurately with reference that is related to inquiry but does not address specific question (new category)	General answer to the inquiry without responding to specific information request but cites provide general information on the topic.	U: "Where is the great wall of china on a map with longitude, lattitude with near by cities on scale?" L: pushed this link (http://www.travelchinaguide.com/china_great_wall/) which is about the Great Wall but has no map or information about longitude, latitude or nearby cities. (QP 24/7-261)
7. Other	Miscellaneous (new category)	A variety of circumstances, including librarian unable to find answer and users finding information themselves. Does not include responses that were terminated without an answer due to technical problems or inquiries that were referred elsewhere.	U: "What is the number to financial aid" L: "Okay. Let me see if I can find the number for you. Please hold on." U: "thanks sorry found it" (QP 24/7-100) -------- U: who is selena? (Then signs off.) (QP2- 199) -------- U asks for information about an animal? then answers the librarian's follow up question what animal?? with ?a short tail weasel?. Then the user signs off. (QW-003).

5. VRS question types

Two teams of two coders sorted question sets from both 2004 to 2006 and 2010 into the following nine categories derived from Arnold and Kaske (2005), Radford and Connaway (2005-2008), and Ross et al. (2009):

- Subject search
- Ready reference
- Procedural
- No question
- Holdings
- Research
- Inappropriate
- Directional
- Reader's advisory

In Table 2, each category is attributed to the researcher's work that was used to derive the categories, as well as supplies verbatim examples from the 2004 to 2006 (QP1) transcripts and the 2010 (QP2 and QW) data sets for comparison. These are presented in the order of frequency from the 2004 to 2006 sample.

Table 2: Type of Query, Definitions with Attribution, and
Verbatim Examples

Type of Query	Definition and Attribution	Verbatim Examples
1. Subject Search	Focuses on a topic, called "specific search," defined by Arnold and Kaske (2005) as a question whose answer: "Almost always takes the form of giving the user a document, for example, a list of citations, a book, or a report" (p.179).	"Can you help me find poems by Maya Angelou and criticism on them?" (QP1 230) "Where can i find information about ADHD?" (QP2 005) "How was the labeling theory important in deinstitutionalization?" (QW 023)
2. Ready Reference	"The typical ready-reference or data queries that require only a single, usually uncomplicated, straightforward answer...Who? What? When? Why? Where?" (Arnold & Kaske, 2005, p. 179).	"Who was Bentonville, NC named after?" (QP2 147) "How do i cite a political talk show in MLA format?" (QP2 013) "who won the world cup game between south africa and france?" (QW 024)
3. Procedural	"Questions pertaining to the policies or procedures within the library system" (Arnold & Kaske, 2005, p.180).	"Can I get summer long term renewals online? How?" (QP1 004) "need access logon info to lexis from scool library website" (QP2 027) "what is the max for checkout on blu ray dvids?" (QW 033)
4. No Question	VRS systems test, practice sessions, and any interaction with no discernible reference question (new).	N/A
5. Holdings	"Questions about specific holdings of a library in print or digital form" (Arnold & Kaske, 2005, p.180).	"Do you have any books on Paris Hilton? (doing a project on her)" (QP1 195) "I was wondering if you have textbooks to rent for an hour or 2?" (QP2 172) "hi there; i was wondering if you guys have Moby Dick in stock?" (QW 014)
6. Research	"involve trial-and-error searching or browsing… [and] are usually identified as coming from an adult specialist who is seeking detailed information to assist in specific work" (Arnold & Kaske, 2005, p.180).	"Hi, I am trying to find out information on how the Learn Direct initiative was started, the criteria that was set and if local government had to be involved in the first stage." (QP1 155) "Looking for information on national traffic survey and incident reports." (QP2 169)

		“Hi I'm looking for studies similar to one I've already found. How do I go about this?" (QW 013)
7. Inappropriate	Questions which are not appropriate for a reference service including personal questions and advice-seeking (new).	"How do I have sex?" (QP1 159) "WAT DOES it mean when a guy said he like me more as a friend doesnt it mean like a gf?" (QP2 153) "Are (send) You (send)Typing (send) War (send) and Peace (send)" (QW 020)
8. Directional	"The general information or directional question is of the information booth variety…" (Arnold & Kaske, 2005, p.179).	"Where is the 67th street library? Is it on the west or east side?" (QP1 387) "what is the URL for the summer reading program for teens?" (QP2 032) "I heard that you have adapted book kits for ESL speakers. Where can I find these online?" (QW 008)
9. Reader's Advisory	"Focused on helping readers find materials they want to read, listen to, or view for pleasure" (Ross, Nilsen, & Radford, 2009, p. 235).	"Hello I am looking for recommendations for the author jonathan kellerman." (QP1 218) "I was wondering if u would happen to know any good fantasy books…" (QP2 050) "Hi, my 7 year old son is looking for a copy of the Hobbit suitable for children, but we can't seem to find anything in the library catalogue. Can you please offer any advice? Thanks." (QW 120)

After the team of two coders completed analysis and coding for query types, they compared results to determine inter-coder reliability (ICR) scores. Initially, there was 65% ICR agreement. After discussion, frequent meetings were needed with coding partners to ensure consistency and clarity with the research teams. Most areas of disagreement were due to lack of clarity about the definitions of type, as some questions were difficult to assign types. For example, each of the verbatim questions could belong to two different types; it was necessary to look at the question in context to determine type.

- "I heard that you have adapted book kits for ESL speakers. Where can I find these online? is there a section on the website specific to esl lerners?" [Resolved as a directional query]

- • "Hi, how was the labeling theory important in deinstitutionalization?" [Resolved as a subject search]

Coders worked to understand the differences through discussion and investigation of the transcript context; coders and researchers were able to resolve most of these issues for a final agreement of 98%.

6. Results

As seen in Figure 1, coders identified 915 questions from the 850 usable transcripts for the 2004 to 2006 dataset. Some transcripts had more than one distinctly different query, such as questions focusing on uniquely different topics as opposed to follow-up questions on the same topic.

Figure 1: Query Type: 2004-2006
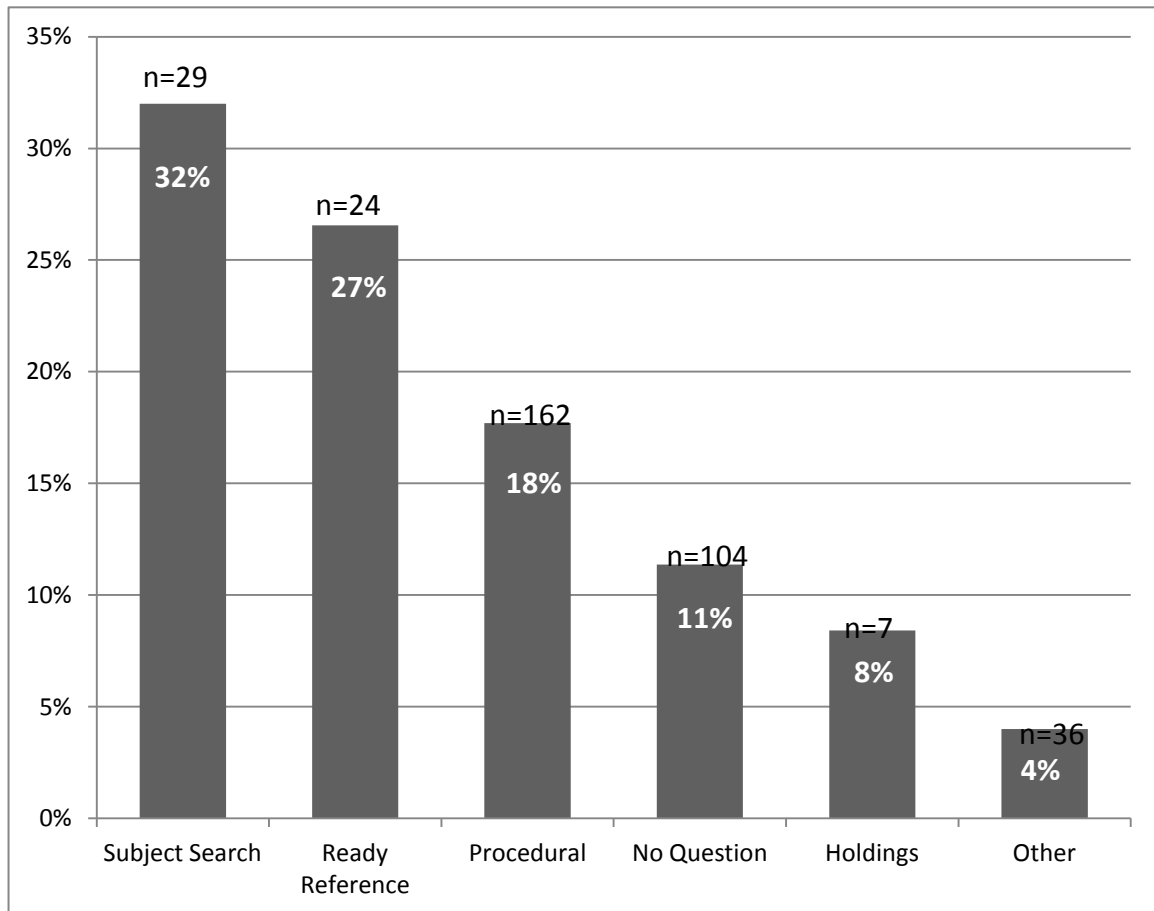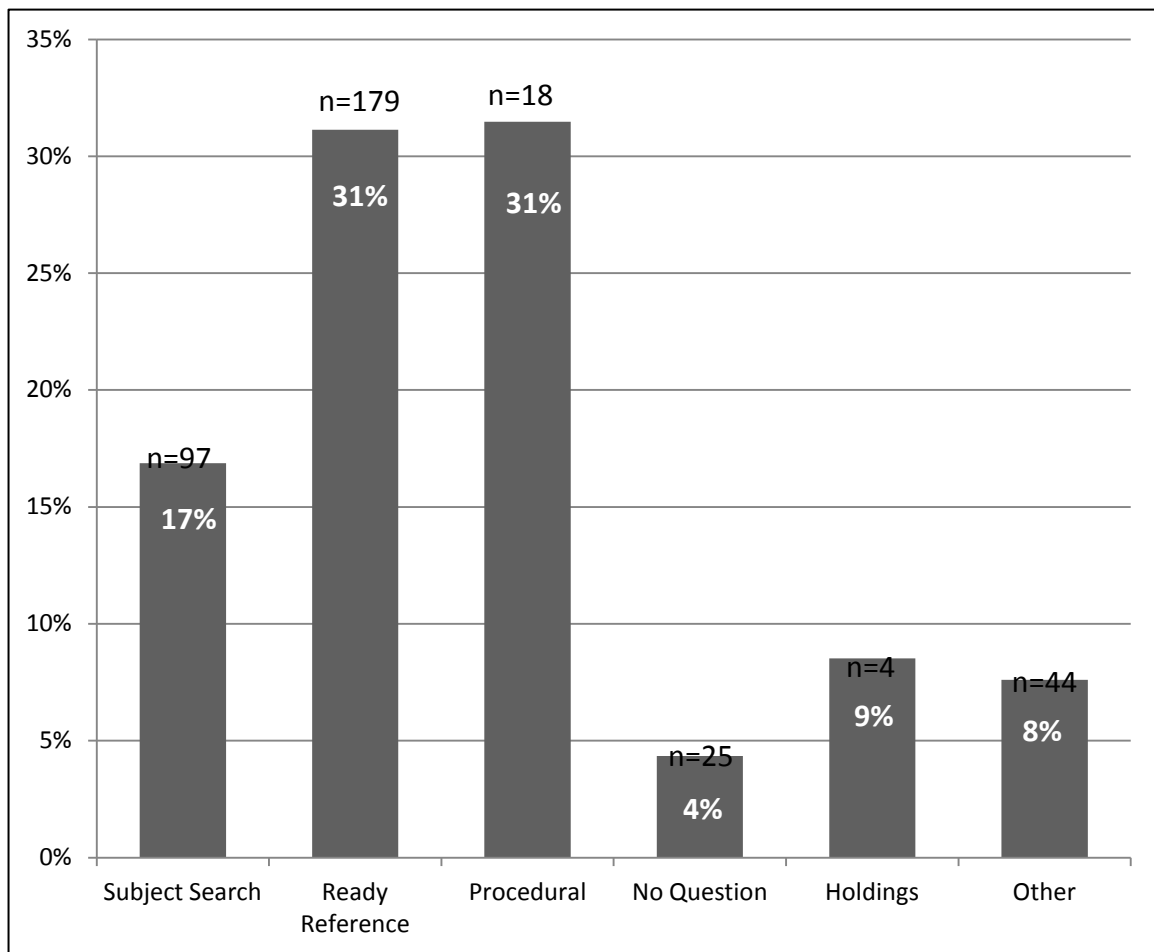**(850 Transcripts, n=915 Queries)**

Figure 1 (for the 2004 to 2006 dataset) shows that the largest number and percentage of the 915 questions (293, 32 %[1]) were determined to be subject searches. Ready reference questions were the next most frequent with 243 (27%), followed by procedural (162, 18%), no question (104, 11%), and holdings (77, 8%). Lower numbers and percentages are found for research (23, 3%), inappropriate (10, 1%), directional (2, <1%), and reader's advisory (1, <1%) and, as such, are grouped as "other."

Figure 2, which includes the 2010 data set, shows coders identified 575 questions from the 560 usable transcripts. Some transcripts had more than one distinctly different query, such as the 2004 to 2006 dataset).

Figure 2: Query Type: 2010
(560 Transcripts, n=575 Queries)

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[1] All percentages for results are rounded to the nearest whole.

Figure 2 also illustrates (for the 2010 dataset) that the largest number and percentage of the 575 questions were determined to be in two categories: procedural (181, 31%) and ready reference (179, 31%). The next most frequent were subject searches (97, 17%), holdings (49, 9%), and no question (25, 4%). Lower numbers and percentages were found for research (19, 3%), directional (15, 3%), reader's advisory (6, 1%), and inappropriate (4, <1%), and, as such, are grouped as "other."

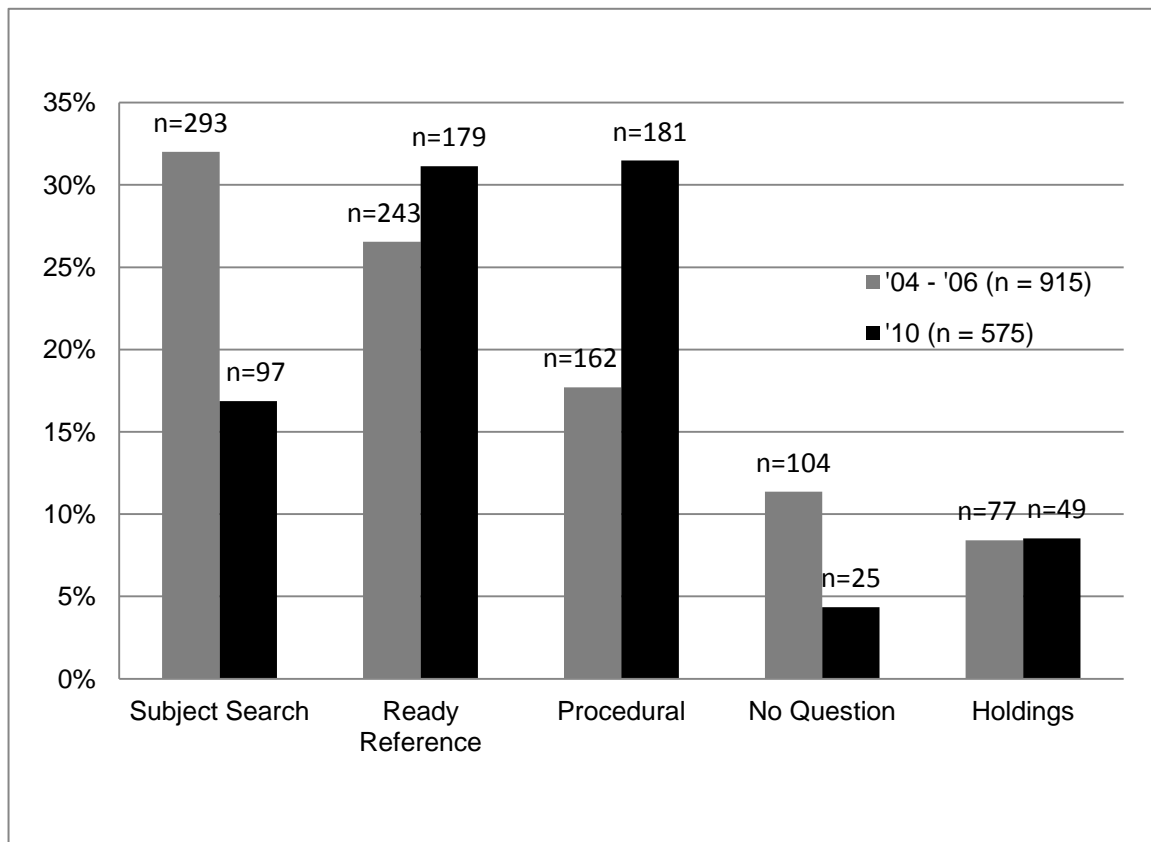**Figure 3: Query Type: 2004-2006 vs. 2010**

Figure 3 compares percentages for top five question type categories for the 2004 to 2006 dataset to the 2010 dataset. A shift can be seen in the percentages for query types. In 2004 to 2006, subject searches were the most frequent type (293, 32%), followed by ready reference (243, 27%), and procedural (162, 18%). In 2010, procedural (181, 31%) and ready reference (179, 31%) were tied in percentages for most frequent type, followed by subject search (97, 17%). Subject searches for 2004 to 2006 (293, 32%) were approximately doubled in percentage compared to 2010 (97, 17%).

Percentages of ready reference queries remained relatively stable, with a slight rise when 2004 to 2006 (243, 27%) data are compared to 2010 data (179, 31%). There were higher numbers for no question in 2004 to 2006 (104, 11%) than in 2010 (25, 4%). Holdings remained relatively stable when 2004 to 2006 (77, 8%) data were compared to that of 2010 (49, 9%). Smaller numbers were found for the categories of: inappropriate in

2004 to 2006 (10, 1%) compared to 2010 (4, 1%), directional in 2004 to 2006 (2, <1%), compared to in 2010 (15, 3%), and reader's advisory in 2004 to 2006 (1, <1%) versus 2010 (6, 1%).

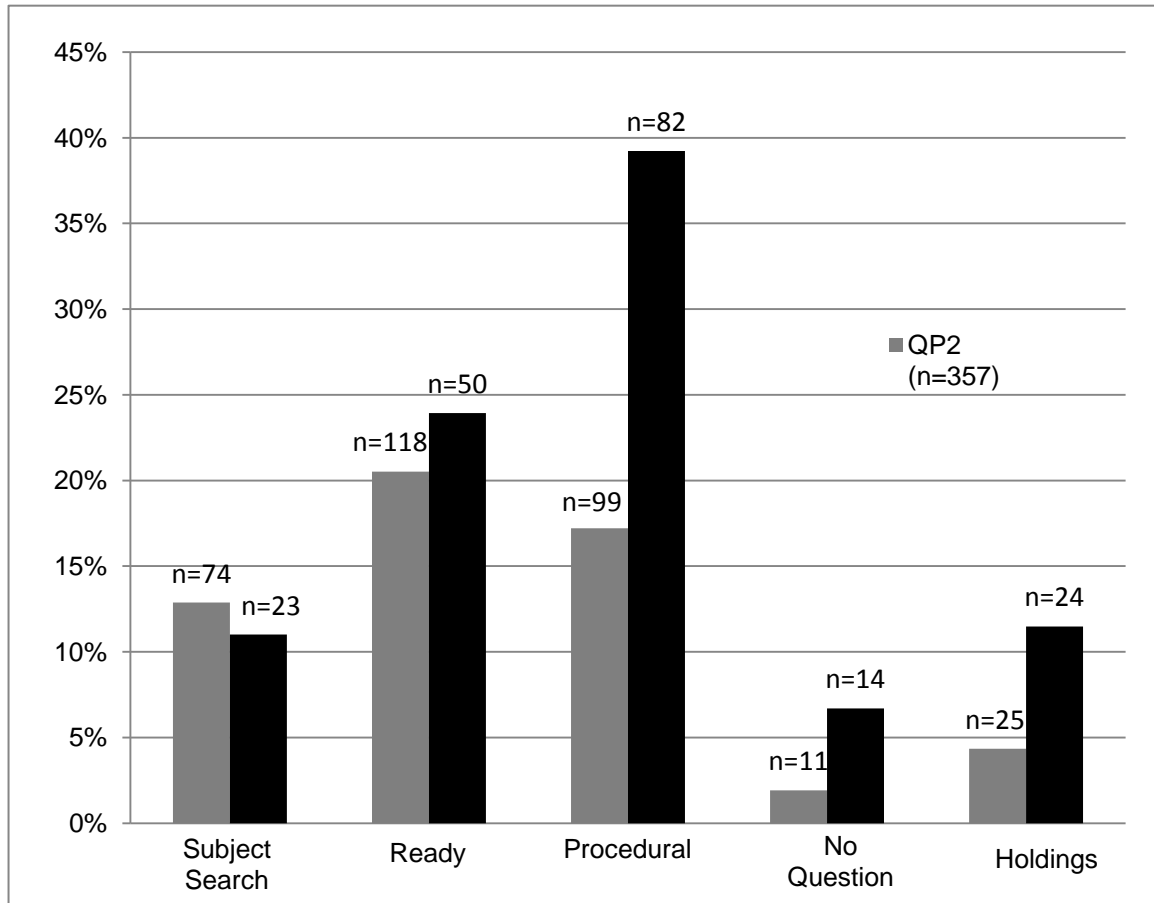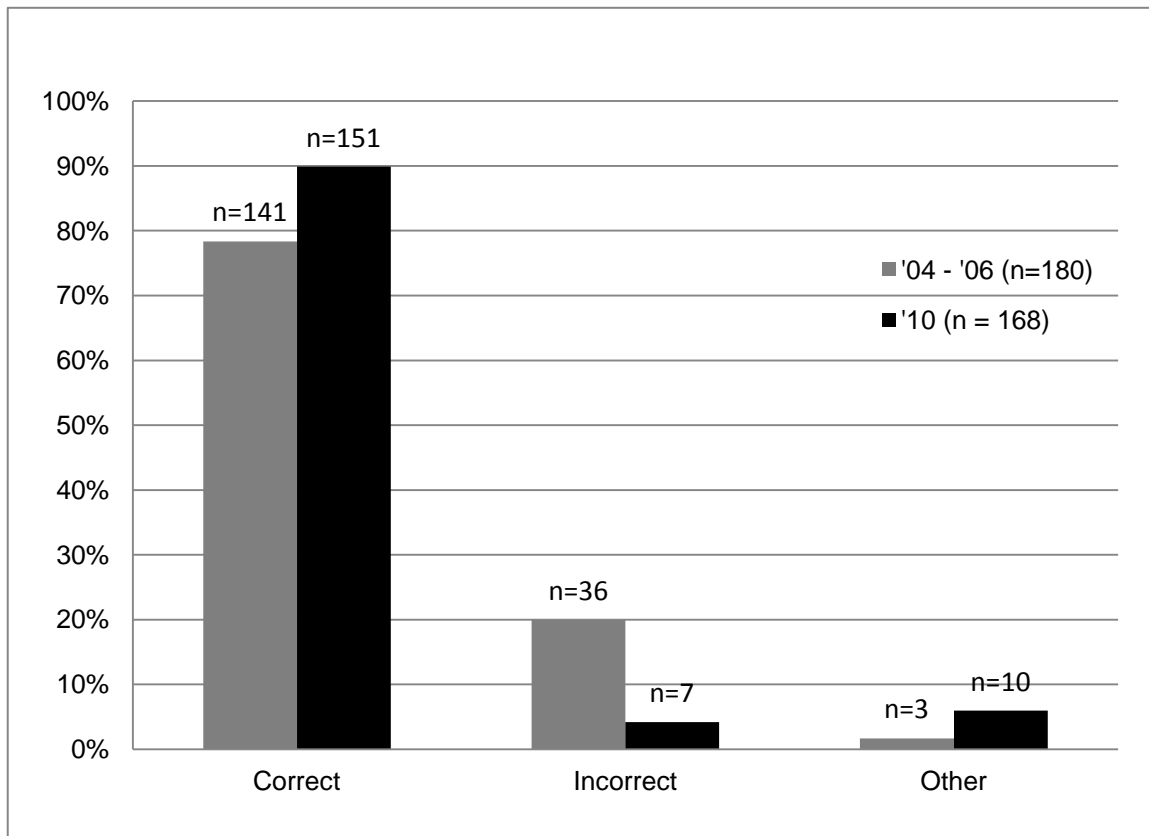**Figure 4: Query Type 2010 –Live Chat (QP2) vs. Qwidget (QW)**

Figure 4 illustrates the total numbers of question types for 2010 and compares proportions of live chat queries (QP2, 357) to the QW questions (207). When the total number of ready reference questions (179) is analyzed, a lower number of these questions is in live chat QP2 (118, 21%) when compared to QW data (50, 24%). Also, the largest percentage of questions in QP2 are ready reference queries (118, 21%) followed by procedural (99, 17%). Yet, in QW, these categories reverse in frequency with the largest percentage in procedural questions (82, 39%) followed by ready reference (50, 24%). Subject search questions are slightly reduced, in percentage of frequency for QW (23, 11%) when compared to live chat QP2 (74, 13%). Percentages for holdings questions QP2 (25, 4%) compared to QW (24, 11%) and incidence of no question for QP2 (11, 2%) compared to QW (14, 7%) were slightly lower for live chat.
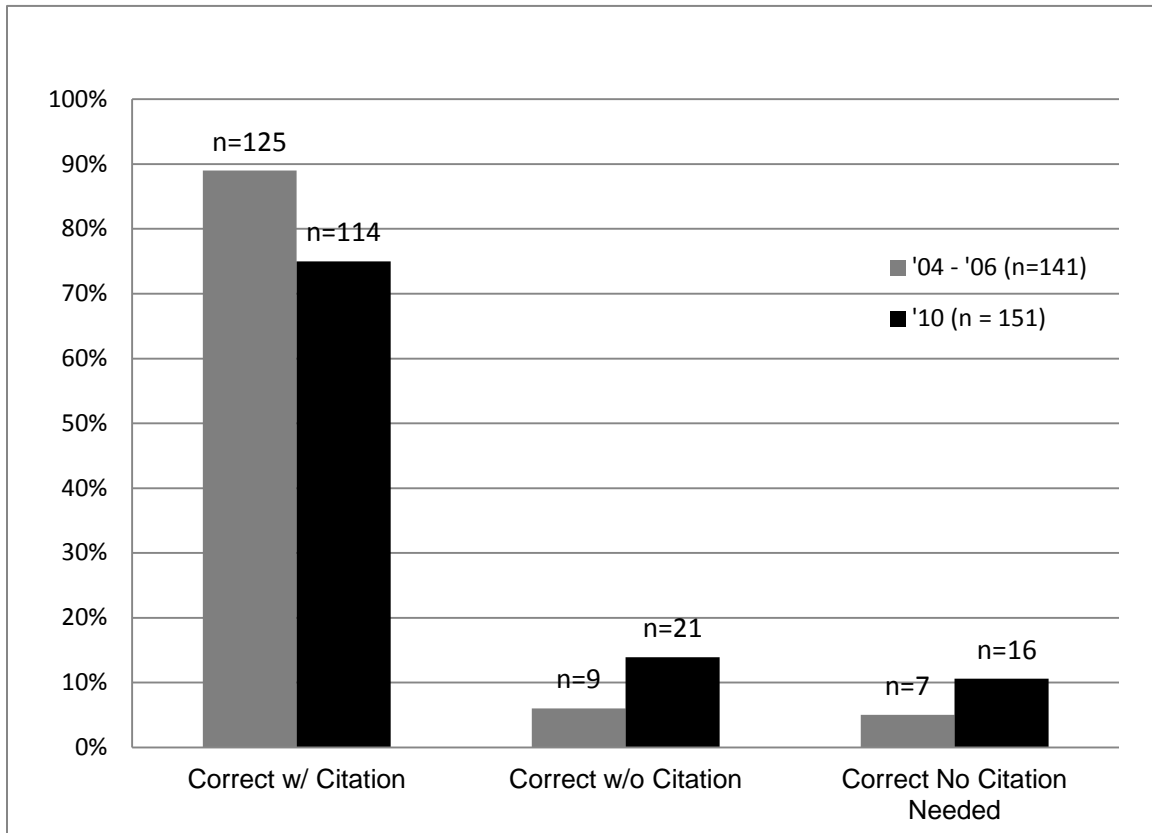
Figure 5: Ready Reference Accuracy Correct and Incorrect Answers for 2004-2006 vs. 2010

As stated above, ready reference queries were excluded from the accuracy analysis if they were referred for follow-up to another library or librarian or had technical difficulties; therefore, 63 of 243 ready reference questions in 2004 to 2006, and 11 of 179 ready reference questions in 2010 were eliminated. Accuracy for the subset of ready reference questions for 2004to 2006 (180) and 2010 (168) was verified. There were 141 correct answers (78%) in 2004 to 2006. In 2010, there were 151 correct answers (90%), as Figure 5 illustrates. In 2004 to 2006, there were 36 incorrect answers (20%); in 2010, there were 7 incorrect answers (4%). Questions coded as "other," experienced a small increase from three answers (2%) in 2004 to 2006, compared to 10 answers (6%) in 2010.

Figure 6 shows percentages of correct answers with citations, no citations, and instances where no citation was necessary. Increasing accuracy is demonstrated from the 2004 to 2006 sample to the 2010 sample. Correct with citation decreased from 89% (125 of 141 correct answers) in 2004 to 2006 to 75% (114 of 151 correct answers) in 2010. Correct without citation improved from 6% in 2004 to 2006 (9 of 141 correct answers) to 14% in 2010 (21 of 151 correct answers). Correct no citation needed improved from 5% (7 of 141 correct answers) in 2004 to 2006 to 11% (16 of 151 correct answers) in 2010.

**Figure 6: Ready Reference Accuracy Correct Answers and Citations for
2004-2006 vs. 2010**

After the team of two coders completed accuracy analysis for ready reference queries, they compared results to determine ICR scores. Initially, there was 66% ICR agreement. After discussion, it was found that most areas of disagreement were due to lack of clarity about the difference between correct with citation, correct without citation, and correct with no citation needed, as well as for how to code multiple questions in one transcript. Coders found that searching for verification of accuracy in VR is time-consuming and takes sophisticated searching skills. Since the queries were anonymous and text-based, no users were available to ask if clarification was needed. For example, the following verbatim question from 2010, although coded as ready reference, was difficult to verify:

- "Identify three most severe recessions of the 20th century? . .Because I think I may have found the answer but I don't think know if its right. . . . Please tell me if they are right ... I don't know you tell me because the teacher said three most severe recessions of the 20th century in the US."

Coders worked to resolve the differences by receiving clearer statements of category definitions and by resolving disagreements. Final agreement reached 98%. These ICR

scores are close to the ICR scores for agreement of query types (65% for initial agreement and 98% after discussion).

7. Discussion

7.1 Query type

When analyzing the query type longitudinal data, the largest shift can be seen in subject searches; 2004 to 2006 (293, 32%) data were nearly halved in percentages from 2010 (97, 17%) (see Figure 3). In 2010, the shift away from subject search was toward more procedural questions, which rose to 31% (179) compared to 18% (162) in 2004 to 2006. One explanation for the result might be that users are savvier about using chat services. Users may have used other modes (e.g., FtF, or phone) for subject questions while using chat for the "simpler" ready reference and (more difficult, or more time-consuming) procedural questions whose answers may or may not be found on library websites. Further support for this assumption can be seen in Figure 4, as procedural questions are much more prevalent in the IM-like QW service than in live chat, another indication that reference mode is influencing user choices. Rourke and Lupien (2010) report a similar finding in their comparison of live chat to IM at the University of Guelph. They found that more research-oriented questions were asked in chat. A greater number of policy, procedural, and directional questions were asked in the IM format. The pattern leads Rourke and Lupien to conclude that the two service modes were complimentary rather than redundant to users.

Additionally, the decrease in the use of VRS may possibly be attributed to users becoming more adept at finding information for subject searches through use of search engines, sites, such as Wikipedia, or online finding aids, such as Springshare's LibGuides (Forbes & Brown, 2012). If there is a shift in the types of people using VRS, this may also be driving the total numbers of subject searches. Allen (1991) found that those with greater subject knowledge of the search topic (expert) conducted broader searches. On the contrary, those with lesser subject knowledge of the search topic (novice) conducted more specific searches. Younger users (novices) may be more likely to choose IM formats and more specific searches. Although the research reported here was not able to track users' ages, generational differences are worth future study.

The frequency and percentages of other query types remained relatively unchanged. One unexpected finding is the continued prevalence of ready reference queries.

7.2 Ready reference: Alive and well in VRS

Commenting about the future of ready reference, Janes (2003) states, "I think what we call ready reference—quick, factual answers to specific questions—will always be a part of librarianship, but a diminishing part, and, in the information world that looks to be emerging, it does not make a lot of sense to have that as a primary focus" (p. 24). Data analysis found evidence to the contrary, that percentages of ready reference queries

are not diminishing, but have remained relatively stable, even increasing slightly by 4%, when 2004 to 2006 (243, 27%) data are compared to 2010 data (179, 31%). In another longitudinal study, Numminen and Vakkari (2009) tracked frequency of ready reference questions and also reported an increasing trend with ready reference questions rising 12% from 33% (calculated as 154 of 467 questions) in 1999 to 45% (calculated as 231 of 513 questions) in 2006 .

Although current perception suggests that individuals can find answers to their fact-based questions using browsers, search engines, including Google, or crowd-sourced social question and answer (SQA) services (like Yahoo! Answers), results indicate this may not be the case for all users. Some may be naïve searchers, unsure of their ability to find correct and authoritative information, or unfamiliar with, or unwilling to use, crowd-sourced SQA. Another possibility is that users have been happy with previous VRS encounters and are confident that librarians provide accurate answers. When reference questions receive accurate and complete answers in a timely manner in the digital environment, the results suggest that VRS remain valuable (Connaway & Radford, 2011). Findings also suggest that VRS is a good forum for getting quality responses to ready reference questions, as accuracy is improving.

Chat and IM reference services can provide users with convenient, fast, professional responses to basic questions that inexperienced users seek help in answering. Searches that may be simple, quickly done, and uncomplicated for an educated librarian are not necessarily easy for users. Ready reference chat questions also offer a way to demonstrate the capabilities of the professional, who has in-depth knowledge of accurate and current resources along with query clarification acumen (see Radford et al., 2011).

7.3 Ready reference accuracy and quality

Ready reference accuracy has been found to increase over time in this longitudinal study of live chat reference from 78% in the 2004 to 2006 sample to 90% in the 2010 sample. As shown in Figure 5, the percentage of correct responses to ready reference questions in both 2004 to 2006 (141, 78%) and 2010 datasets (151, 90%) are considerably higher than the benchmark 55% for FtF reference transactions reported by Hernon and McClure (1987), noting that their method and analytic categories were quite different from this transcript analysis. As shown in Figure 6, when transcripts coded as correct and complete are examined closely, responses that additionally provide the user with citations (usually in the form of URLs) also exceed the 55% benchmark. Of 243 ready reference questions in the 2004 to 2006 data set, 125 questions received a correct and complete response with citations at a rate of 51%. Of 168 ready reference questions in the 2010 data set, 114 questions received a correct and complete response with citations, for a rate of 68%, which is an increase of 17%. Overall, both ready reference accuracy, as well as percentages for providing the user with citations for correct answers, improved in this longitudinal study.

Although it is not possible to determine its cause with certainty, increased accuracy is an intriguing finding that could have several possible explanations. It may be

that VRS service providers have become more facile in working in the chat and IM environment, as these services have matured and become more commonplace. Also, providers may now feel less rushed, realizing that users are accessing VRS because of its convenience, rather than because they are in a hurry (Connaway, Dickey, & Radford, 2011, Connaway & Radford, 2011). It is also possible that VRS librarians have put into practice the previous recommendations by the authors to increase accuracy (Connaway & Radford, 2011; Radford et al., 2011).

One strongly recommended guideline was to make sure that a general page contains specific information that was requested before forwarding it to the user (Connaway & Radford, 2011; Radford et al., 2011; Radford & Connaway, 2010; Ross et al., 2009). For example, a VRS transcript from 2004 to 2006 showed that a librarian responded to a query about the longitude and latitude of the Great Wall of China and nearby cities by forwarding a general tourist URL for the Great Wall. The forwarded page did not contain the requested specific information and was coded as incorrect. Earlier analysis indicated that accuracy would rise from 78% to 93% if this one check of specificity would be done during VRS for ready reference (Radford & Connaway, 2010). It is not possible, given the limitation of the method that ensures that both user and librarian are made anonymous, to follow-up with the librarians to find out if indeed this is the case. However, it is noteworthy that the accuracy increased from 78% (141) to 90% (151), close to the same level (93%) that the previous data analysis revealed was possible given a quick check of the general page prior to forwarding the link to the user. In addition, this type of error decreased to only a few (7) instances in the 2010 data set, where previously it had been 20% (36).

Users of traditional reference expect a timely response; it is not unreasonable for VRS users to expect the same. VRS offers the convenience of anywhere access and availability to professionals from the user's desktop or mobile device. Convenience is the main reason why VRS users choose these services, with approximately two out of three of the 283 VRS non-users participating in the Seeking Synchronicity telephone interviews, noting convenience as a factor that would convince them to try VRS (Connaway & Radford, 2011). Virtual reference users also like the "speed and efficiency of VRS…availability after hours, and getting answers in an online workflow" (Connaway et al., 2011, p. 185).

The results suggest that librarians should continue to be approachable in all modes of reference service delivery. It is important to clarify the question, to provide the citations used to answer the question, and most importantly, to correctly answer the question. Analysis indicates that following these suggestions may influence users to seek out librarians for their information needs and assure continued relevance for VRS (Connaway & Radford, 2011; Radford et al., 2011).

8. Limitations

The data analyzed here are drawn from transcript analysis. As noted above, for privacy reasons, QP and QW sessions are made anonymous by removing any identifying

information, including user and librarian names, email addresses, IP addresses, etc. Thus, it is not possible to collect demographic data about users and librarians or staff. Also, researchers are unable to contact users or VRS staff to ask about their assessments of accuracy, their levels of satisfaction, nor other relevant information that cannot be gleaned from the transcripts.

These transcripts were randomly selected from large datasets for QP and QW data; the researchers believe that they are representative of this corpus for the years 2004 to 2006 and 2010, but no claim is made that these results can be generalized to other VRS consortia or to other years for QP.

9. Future research

A number of additional longitudinal analyses are being conducted with the 2004 to 2006 and 2010 VRS transcript datasets. The authors and Chirag Shah, Ph.D., from Rutgers University have obtained additional funding of $250,000 for a two year period (2011 to 2013) from IMLS, OCLC, and Rutgers University for the grant project, Cyber synergy: Seeking sustainability through collaboration between virtual reference and social Q&A sites (Radford, Connaway, & Shah, 2011-2013). One phase of this project involves in-depth analysis of VRS transcripts, as well as analysis of questions and responses from SQA sites, like Yahoo! Answers, including: subject analysis using the Dewey Decimal Classification schedules (Dewey, 2011), question types, query clarification, interpersonal communication, generational differences, level of difficulty of queries, wait and session times, presence and type of instruction, and referrals.

Another possible area for future research is to investigate answer accuracy to queries other than ready reference questions. Since the majority of VRS questions continue to be other query types, creation of a data-derived taxonomy of accuracy for subject searches and procedural queries would be of particular interest and importance to the VRS community. The OCLC and Rutgers research team's investigation to analyze the presence and type of instruction in VRS may be a first step in this process.

With regard to others doing similar research into question types and accuracy, it is highly recommended that scholars use established taxonomies, such as the ones adapted from the work of Katz (1997) and others so that standardization of categories can be achieved to enable valid longitudinal comparisons.

10. Conclusion

Previous scholarship is advanced by the longitudinal research presented here that explores query type in VRS and development of a framework for determining the accuracy of responses to ready reference inquiries in virtual environments. Relational and content dimensions are important for successful VRS encounters (Watzlawick et al., 1967; Connaway & Radford, 2011). Users highly value personal attention, which is delivered in a friendly and approachable manner, as well as provision of accurate information that specifically answers their query (Connaway & Radford, 2011).

Additional study in this area is needed, as noted by Wallace and Van Fleet (2003), "A confounding factor in interpreting studies of reference accuracy is the lack of a uniformly accepted standard for defining success…there is still a real need to explore the nature of the reference process and establish the metrics that will engender a true understanding of success" (p.110).

Several recommendations can be made from this study's findings. Research about accuracy should continue and expand to include all types of VRS queries for LIS scholarship. Differences in live chat vs. IM formats were revealed, which merit further research, especially with regard to subject questions. Scholars should consider investigating VRS staffing practices that impact accuracy (e.g., routine referrals to subject specialists or lack thereof), concurrent staffing for reference modes (e.g., individuals being responsible for both FtF and VRS desks), multiple chat windows open at once so that several users are interacting with VR librarians simultaneously, etc. Despite lean staffing models, additional research in these areas would be of great value to administrators and practitioners, especially in difficult budgeting times, as librarians continue to have service excellence as a goal (Radford & Vine, 2011).

For practitioners, the authors found the following practices to be important for increasing accuracy for ready reference in live chat: (a) making sure that specific information requested is present before forwarding a general website to user; (b) checking for broken links;(c) ensuring that all parts of the user's query (or multiple queries) are answered; and (d) clarifying the question, including a closing or follow-up question. The research that led to the above recommendations with examples is described in detail in Radford et al. (2011) and Ross et al. (2009) research. In addition, multi-tasking while doing reference may not be serving users well, especially during times of peak use when VRS staff attention is divided among several queries and multiple modes.

This research project is among the first to perform a longitudinal analysis of large random samples of international chat transcripts that addresses query types and ready reference accuracy. As VRS have become more pervasive, it is increasingly vital to have research-based guidelines for service excellence. An emerging opportunity for reference has been created as library applications are becoming more common and allow mobile access to VRS modes, including chat, IM, and short message service (texting) (Pearce, Collard, & Whatley, 2010). According to the Pew Internet and American Life Project, nearly half of American adults (Smith, 2012), and almost a third of teenagers aged 14 to 17 own smartphones (Lenhart, 2012). This trend is expected to continue, possibly resulting in future additional traffic to VRS. Benchmarking and longitudinal research are essential and have practical implications for library education, service development, and training.

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