Chapter 1. Introduction

1.1. Introduction

Nearly forty years ago now, Shera (1964) not only foresaw the use of computing to take some of the menial labor out of library reference work, but he also proposed a method for achieving that goal. Shera wrote that "the really great promise of automation is to be sought in… the opportunity it affords to analyze the reference process and re-define reference service" (p. 203). He saw this redefinition as removing the "fetch and carry" aspects, and the potential to raise the intellectual level of reference work. To achieve this end, Shera proposed an agenda for action: first, analyze the processes involved in reference service, and how questions are handled by humans in those processes, and second, create algorithms to represent these processes. Forty years later, Shera's agenda still provides a sound course of action.

One development that Shera (1964) did not anticipate, however, was the invention and popularization of the Internet, and the evolution of digital reference services in that environment. Despite the fact that Shera perhaps never imagined this new environment in which reference could be performed, his prediction about automation redefining reference service remains as true today as it did forty years ago.

The growth in the past decade of both the infrastructure and the number of users of the Internet has enabled a corresponding growth in the number of users of digital reference services on the Internet. This increase in the use of digital reference services has led to increases in the number of questions received by these services, thus putting a strain on the human intermediaries in these services. As Shera (1964) foresaw, both the ability of a reference service to scale up to handle an increasingly large number of questions, and the quality of the answers provided, is directly affected by the extent of automation employed by that service: the more processes that are automated, the more of the human intermediaries' time and effort can be dedicated to tasks that cannot yet be automated.

There is, now more than ever, an increased and immediate need for automation in digital reference services.

In order to design algorithms to automate performance of any process, however, it is necessary to decompose processes into rules for action. In order to decompose processes, of course, it is necessary to determine which processes will be analyzed. As the triage process is the first step performed by a digital reference service after the receipt of a question, this provides one logical place to start.

1.2. Context of the Study

According to the Virtual Reference Desk Project (1998), triage is the assignment of a question to a reference or subject expert "answerer." This assignment of a question can occur *within* a service (when a question is received by a service, a "triager" assigns it to a specific reference or subject expert within that service) or *between* services (if a question is received by a service that for whatever reason it cannot or will not answer, the triager forwards that question to a different digital reference service).

Pomerantz and others (forthcoming) recently conducted a study validating a general process model of digital reference service. This process model, reproduced in Figure 1-1, positions the process of triage as the first step performed by a digital reference service after the receipt of a question – and thus as the first step in the process of handling questions that is within the direct control of the digital reference service.

Delving into the specific processes described in the general process model, Pomerantz, Nicholson, and Lankes (2003) conducted a Delphi study of digital reference triagers, to identify factors that affect the process of routing and assigning reference questions. Fifteen factors were determined to be important to triagers in their decision-making concerning routing and assigning of reference questions. One of these fifteen factors was question type, demonstrating not only that question type affects triagers' triage decisions, but that triagers consciously recognize that this is the case.

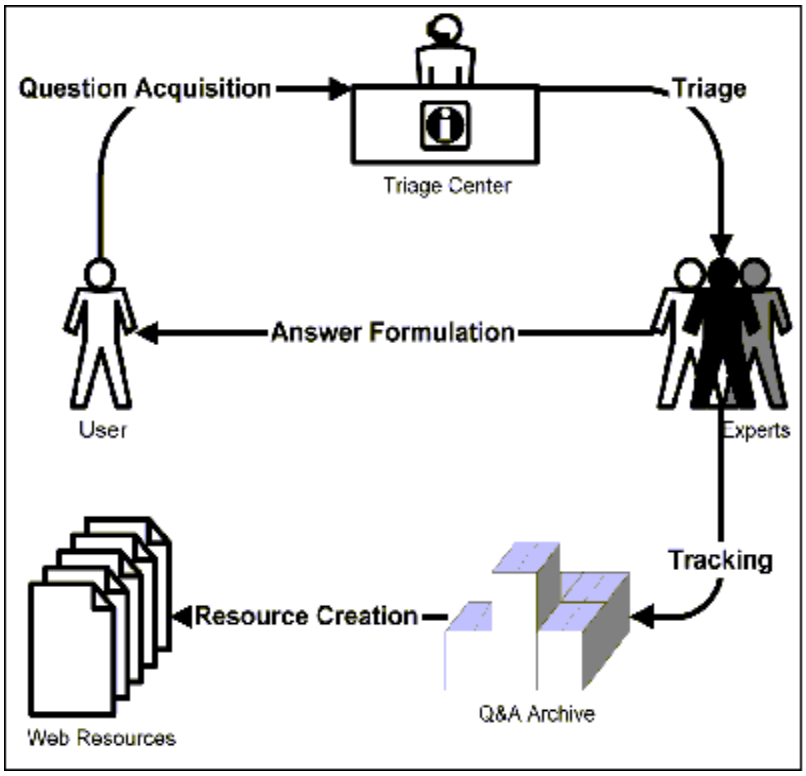

Figure 1-1: General Digital Reference Model

Other studies report similar findings. Wildemuth, de Bliek, and Friedman (1994) found that question type influences medical students' choice of experts of whom to ask the question. White and Iivonen (2001) found that question type influences Web searchers' choice of search strategies. These studies, of very different user populations, provide clear evidence that question type influences the actions taken on that question, whatever that action may be.

Building on the work of Pomerantz, Nicholson, and Lankes (2003), the first goal of this study was to learn from direct observation of the actions performed by triagers how question type affects those actions. The second goal of this study was to use what was discovered about the triage process to draw up a set of rules for the performance of triage based on the question type being triaged, which rules could be utilized as the basis for designing and building a system to automate part or all of the triage process.

1.3. Research Questions

The research questions for this study follow from these goals:

RQ1. What attributes of questions affect the triage process?

RQ2. How does question type correlate with the action taken on a question in the triage process?

The first research question was exploratory, and sought to discover what attributes of questions influence the triage decisions made by digital reference triagers. Attributes of other factors extrinsic to the question were also discovered to influence triage decisions, but these were not the primary focus of this study. The second research question tests the hypothesis that question type correlates with how that question is handled in the triage process.

1.4. Overview of Method

This study employed a two-phase design approach (Creswell, 1994), conducting first a qualitative and then a quantitative phase to investigate the research questions. The steps in the study methodology are represented in Figure 1-2.

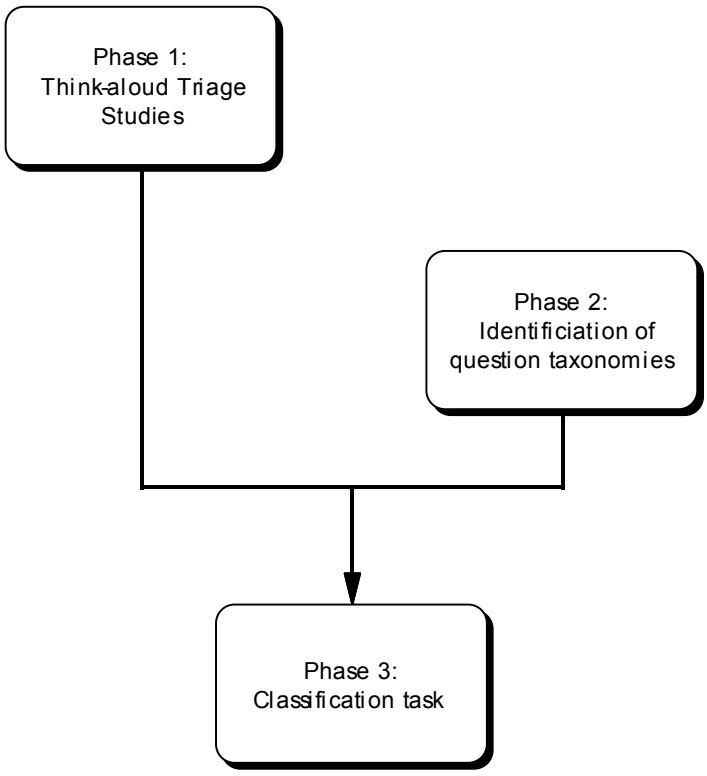

Figure 1-2: Research Methodology

1.4.1. Think-aloud Triage Studies

This phase of the study addressed Research Question 1. The goal of this phase was to elicit from expert digital reference triagers: 1) the attributes of questions that they take into account during the triage process, and; 2) how these attributes affect their decisions on actions to take on questions in the triage process.

In order to elicit this data, triagers were observed performing the task of triage. Data on the decisions triagers made on actions to take on questions was elicited utilizing the think-aloud methodology. Respondents for this phase of the study were triagers in digital reference services affiliated with public and academic libraries, as well as those in AskA services (unaffiliated with any physical library). Think-aloud studies were conducted until saturation was achieved, and no new attributes of questions that affect triage decisions were discovered.

Pomerantz, Nicholson, and Lankes (2003) identified fifteen factors that digital reference triagers agree affect the process of triage. The present study built on Pomerantz, Nicholson, and Lankes' findings by utilizing The present study built on Pomerantz, Nicholson, and Lankes' findings by utilizing these fifteen factors as a "partial framework" (Glaser and Strauss, 1967, p. 45) for this study's analysis and discovery of additional attributes of questions which affect the triage process. The present study discovered twenty-three factors as the think-aloud data were analyzed, utilizing a combination of inductive category development and the Constant Comparative Method, for a total of thirty-eight factors. A total of eight attributes of questions were discovered that affect triagers' decisions on actions to take on questions in the triage process.

1.4.2. Identification of Question Taxonomies

Four taxonomies of questions were identified through an extensive review of the literature from several fields that deal with questions: desk and digital reference, question answering, and linguistics. These taxonomies are as follows:

1. Wh- words
2. Subjects of questions
3. The functions of expected answers to questions
4. The forms of expected answers to questions

1.4.3. Classification Task

This phase of the study enabled the answering of Research Question 2, by classifying a subset of the questions collected during the previous phase of this study, so that question type could be correlated with the action taken on it in the triage process. This phase of the study had the added benefit of allowing the determination of the degree of intercoder reliability with which questions received by digital reference services can be classified according to the identified taxonomies of question.

This phase of the study classified questions according to three of the four taxonomies identified in the literature review – the taxonomy of subjects of questions was not utilized – for one simple reason. Several well-developed schemes exist, in a variety of disciplinary areas, which classify materials according to subject. While it is undeniable that classifying materials by subject is useful, it is a matter of preference which subject classification scheme is used, and different digital reference services use different schemes. The argument will be made that in developing an automated system for performing triage on questions received by digital reference services, all four taxonomies should be employed. The argument will also be made, however, that given the availability of several such schemes, the particular taxonomy of subjects utilized should be determined according to the particular disciplinary specialization of the digital reference service using the automated system.

In order to elicit data concerning the intercoder reliability with which questions can be classified according to the identified taxonomies, a randomly selected group of nine of the triagers who were studied in Phase 1 of this study were provided with a stratified random sample of 30 of the questions collected during the think-aloud studies, and instructed to classify these questions according to three of the taxonomies: wh- words, functions of expected answers to questions, and forms of expected answers to questions. The intercoder reliability statistic Cohen's kappa (Cohen, 1960) was then computed on these nine coders' classifications.

Finally, the strength of correlation was computed between:

- the classes assigned to the 30 questions by the nine coders in Phase 3 of this study, and
- the triage actions taken on these 30 questions, as determined by analysis of the think-aloud data in Phase 1 of this study.

1.5. Overview of Findings

1.5.1. Think-aloud Triage Studies

A total of eight attributes of questions – attributes intrinsic to the question – were discovered that affect triagers' decisions on actions to take on questions in the triage process. Attributes of other factors were also discovered to influence triage decisions – attributes extrinsic to the question, which situate it in a context for the user and the service. A total of thirty-eight attributes were discovered in all. These thirty-eight attributes fell into eight categories:

- Attributes of the question
- Attributes of the answer
- Attributes of the patron
- Attributes of the patron's current information need
- Attributes of the triaging service
- Attributes of the receiving service
- Attributes of the receiving service or the answerer
- Attributes of the answerer

A simple categorization of "triagees" – the recipients of a question – was proposed: questions received by digital reference services can be triaged to one of two possible destinations, to a recipient within the service, or to another digital reference service.

By determining the full range of attributes of questions and other factors that contextualize the question, it was possible to decompose the triage process, thus building on current models of the digital reference process by "zooming in" on the triage process. Using these attributes, finely detailed models of the triage process was built, specific to individual services or types of services, consisting of the rules for actions taken on questions received by digital reference services.

1.5.2. Classification Task

The values for the intercoder reliability statistic Cohen's κ ranged from 0.53 to 1, indicating moderate to perfect agreement, for the different groups of coders.

The values for the correlation statistic Cramér's V ranged from 0.15 to 0.71, indicating some weak and some moderately strong correlations. Unexpectedly, the values of V are larger for questions on which two of the three coders agreed, perhaps indicating that there are stronger correlations between question type and question attribute when intercoder reliability is lower. The questions and the triage actions taken upon them that were most strongly correlated were analyzed, in order to more fully answer Research question 2.

1.6. Contributions of the Study

This study makes contributions to theory and practice in both digital reference. The contribution to theory is the development of current models of the digital reference process by "zooming in" on the triage process. The contribution to practice is the development of a set of rules that can be utilized as the basis for designing and building a system to automate part or all of the triage process.

1.6.1. Contribution to Theory

A large body of research and theory concerning library desk reference work exists, from which reference librarians can draw. Less research and theory exists concerning digital reference. In part, this is due to the natural progression of any field of study: discovery of phenomena must necessarily come before theories of those phenomena can be developed. Within the past few years, a few if not fully-fledged theories, then at least models of digital reference have been proposed and studied (Robinson, 1990; Lankes, 1998a; McClennen, 2001; Pomerantz et al. (forthcoming)). The current drawback of these models is that they offer a view from a very high altitude, as it were, encompassing a broad domain in little detail.

This study builds on and develops current models of the digital reference process by "zooming in" on the triage process. Pomerantz, Nicholson, and Lankes (2003) began the task of delving into the triage process, by identifying a set of fifteen factors that influence the triage process. The present study has built on the work conducted by Pomerantz, Nicholson, and Lankes, adding an additional twenty-three factors. The present study has further decomposed the triage process, building a simple categorization scheme of triage recipients. The argument is made that the methods employed by this study can be utilized to build a more fully developed scheme for individual services. It is also argued that the set of thirty-eight factors that influence the triage process and a categorization scheme of triage recipients can be utilized as the basis for designing and building a system to automate part or all of the triage process. Finally, the argument is made that the methodology employed by this study to "zoom in" on the triage process, and thereby build a detailed model of this process, is generalizable to model-building for the processes "downstream" from the triage process: answer formulation, tracking, and resource creation.

1.6.2. Contribution to Practice

Ever since computers began to be used in libraries, there has been interest in developing "expert systems" (Jörgensen and Jörgensen, 1991) – also referred to as "knowledge-based systems" (Richardson, 1995; Richardson and Reyes, 1995) – to automate the reference process. These systems attempt to automate the selection of information sources for a user, generally by leading the user (a patron or a reference librarian) through a series of closed-ended questions to progressively narrow the subject area of the reference question, ultimately providing the user with a citation for an information source that is likely to contain the information sought (Richardson, 1998). Most reference expert systems, however, have been "one-off" creations, never implemented outside of their initial test-bed environments. The quest for an entirely automated reference process is more than thirty years old, and has so far failed to produce a system used across reference settings.

Digital reference services address this same issue of bringing computing to the reference process. While reference expert systems have failed to flourish, however, digital reference services have succeeded: while it is unclear how many digital reference services exist, a great many libraries in the United States these days have an affiliated digital reference service, and there are a number of AskA services unaffiliated with any library that receive a great deal of use. As stated above, this increase in the use of digital reference services has led to increases in the number of questions received by these services, thus putting a strain on the human intermediaries employed by these services. The ability of a digital reference service to "scale up" to handle an increasingly large number of questions is directly affected by the amount of automation employed by that service: the more processes that are automated, the more of the human intermediaries' time and effort can be dedicated to tasks that cannot yet be automated. By developing a set of rules that can be utilized as the basis for designing and building a system to automate part or all of the triage process, this study will be making a significant contribution to the future development of automation for digital reference.

1.7. Limitations of the Study

1.7.1. Focuses on Only One Step in the Process of Providing Digital Reference

Figure 1-1, above, illustrates the five processes involved in providing digital reference service, of which the process of triage is only one. This study focuses on the triage process, and the correlation between question type and the action taken on that question in the triage process. The actions taken on questions in the triage process are different than actions taken on questions in the other processes involved in providing digital reference service, thus limiting the generalizability of this study's findings to this one process. The argument will be made, however, that the methodology employed by this study to elicit the actions taken in the triage process, and the existence of a correlation between question type and action taken, are both generalizable to the processes

"downstream" from the triage process: answer formulation, tracking, and resource creation.

1.7.2. Not System-Building

This study does not seek to build an automated system for performing triage on questions received by digital reference services, but rather to develop specifications according to which a system may be designed. This study develops a faceted classification scheme for questions, and rules for action based on classes in that scheme, that can be utilized as a basis for the future design and implementation of a system to automatically perform triage of digital reference questions. The actual design and implementation of such a system, however, was not conducted as part of this study.

1.8. Chapter Summary

This chapter provides an introduction to the motivating problem behind this study, and the context in which that problem was studied. The research questions investigated in this study, the methodology employed to answer those research questions, the contributions of this study to research and practice, and the limitations of this study were briefly reviewed. This study proposes observing the triage process as it is performed manually in digital reference services, to discover how question type affects that process. Once that has been accomplished, a set of rules may be drawn up for the performance of triage based on the question type being triaged. These rules could be utilized as the basis for designing and building a system to automate part or all of the triage process. The following chapters present more detailed discussion of these topics.