Collaborative Information Seeking:
A Theoretical and Methodological Critique

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ABSTRACT
This paper is intended to provide an informal assessment of the theoretical foundations and methodological applications that have been used to study collaborative information seeking. The review of previous studies on collaborative information seeking reveals that most studies have been predominantly descriptive and exploratory in nature, and little has been based on existing conceptual or theoretical foundation. It was also found that there is an observable preference toward qualitative studies using observation and interviews.

General Terms
Design, Human Factors, Theory.

Keywords
Collaborative Information Seeking, Information Seeking, Theory, Methodology.

1. INTRODUCTION
The term "collaboration" can simply refer to the fact that people are working together on a task. In the field of library and information science, however, much has been written about how to best define collaborative information seeking (CIS). Terms such as "collaborative information behavior" [26] [16], "collaborative information retrieval" [3] [9], and "collaborative search" [12], all relating to CIS, frequently appear. While the profusion of terminology can undoubtedly result in a degree of confusion, the breadth of the associated meanings characterize the diverse and varied nature of information seeking that occurs in collaboration.

Before the field of CIS coalesced into the information-seeking community, scientific collaboration had been a core area of study for many researchers in the library and information science field as science itself is a collective and collaborative activity. As early as 1977, Allen [1] examined the diversities of the information-seeking behaviors of engineers and scientists whose work largely involves collaboration. Later, a few studies explored scientific collaboration by analyzing scientists' perspectives and attitudes toward collaboration and factors that impact collaboration [7] [11]. Since the early 1990s, with the shift from cognitive

approaches to social approaches in information seeking, researchers have expressed a need for exploring various aspects of collaboration in support of information seeking as information-seeking activities can be performed collaboratively and individually. For instance, Sonnenwald [22] viewed information behavior as a collaborative process among individuals and information resources, even though she did not use the term "CIS" explicitly. Since then, a number of studies have concentrated more on focused groups of individuals within various settings, including, but not limited to, information-sharing strategies and patterns [14] [25], information-seeking roles [14] [23], triggers for CIS [16] [24], and spatial and temporal context [15] [20].

The purpose of this paper is to examine the state of the art in CIS research published in the 2000-2012 period and probe trends and approaches in the field in terms of the substance of theory development and conceptual framework as well as methodologies employed.

2. THEORETICAL CRITIQUES
2.1 CIS Models
Most information-seeking behavior theories are accompanied by explicatory models that play guiding and directing roles in the development of theories, especially "at the description and prediction stages of understanding a phenomenon" [2]. Wilson [28] states that models of information seeking typically attempt to describe an information-seeking activity, the causes and consequences of that activity, or the relationships among the stages of information-seeking behavior. A number of models have been proposed to characterize various aspects of information behavior. Furthermore, they were used as a theoretical lens to analyze the contextual and dynamic nature of information seeking at micro and macro levels.

The construction of new conceptual models often requires conceptual and terminological development. As a foundational basis, Shah [18] addressed the notion of collaboration and attempted to incorporate collaboration into the CIS model. Other empirical models in the field of CIS have come into being based on observations of real collaborative actions and practices. One model proposed by Reddy and Jansen [16] and another model by Yue and He [27] are good examples that articulate stages in CIS. The former model suggested that there are triggers for transitioning from individual to collaborative information behavior, whereas the latter model identified factors that attribute to each stage. Even though such models synthesized findings of past CIS research, they have not been extensively applied and tested in subsequent empirical studies. Additionally, two or more models have not been compared or debated.

2.2 Theoretical and Conceptual Framework for CIS

Few studies in CIS are based on an earlier theoretical framework. Rather, most studies are exploratory; they are primarily concerned with generating and building theory and were conducted to develop a conceptual framework for the description of CIS practices.

However, traditional models of information-seeking behavior were deployed as a conceptual framework in several CIS studies. Among such models, Kuhlthau's Information Search Process (ISP) was used as an underlying model for phenomena it investigates [8] [10] [18] [20]. For instance, Hyldegård [8] investigated the applicability of the model to a group-based academic setting. She concluded that the ISP model does not fully comply with group members' problem-solving processes and involved information-seeking behaviors; group-based problem solving and information seeking is further influenced by contextual and social factors not addressed in the ISP model.

It is interesting to note that studies based on the ISP model observed students engaged in learning. This may imply that there is little reliance on theoretical underpinnings in CIS research. As Fidel et al. [5] pointed out, in some work situations, CIS is interwoven with work and cannot be studied separately; instead, it is most focused on the context and situation in which CIS actually takes place.

3. METHODOLOGICAL CRITIQUES

3.1 Research Approaches

CIS studies have been predominantly descriptive and exploratory in nature. They frequently employ a variety of research methods with the goal of learning more about a phenomenon, rather than making specific predictions. Thus, they explored collaboration in various contexts and settings, including military personnel [14] [22], health care teams [16] [23], design teams [3] [5] [13], patent engineers [6], students in learning [8] [10] [17], and so forth.

Recently, a number of studies were conducted in experimental settings where subjects were often asked to perform a certain task and were provided with a search tool and a set of collaborative tools [4] [19] [20] [21] [27].

3.2 Data Collection Methods

Traditionally, the information-seeking community has asserted that the use of multiple methods for collecting data is a way of overcoming possible deficiencies, limitations, and defects in a research method and increasing theoretical understanding of studied phenomena. In a similar vein, a variety of data collection methods have been employed in CIS studies to produce a comprehensive view of CIS. The majority of studies is ethnographic and relies primarily on direct observation [15] and/or in-depth interviewing [25].

In particular, observation seemed to be an appropriate research method in CIS as it could result not only in increased site-specific knowledge, but also in rich data on various aspects of work. Observation, which allows real-time data collection, however, requires the researcher to spend considerable time in the field. For instance, Reddy and Dourish [15] spent seven months observing the work of the group they studied. Instead of observing on-site group meetings, Prekp [14] collected the minutes of the working group's meetings to identify patterns of collaborative interaction. As another alternative to observation, a diary or journal was administered to capture individuals' daily activities and experiences [6] [8].

In fact, a combination of observation and in-depth interviews was most frequently implemented in many CIS studies to identify specific collaborative actions and practices [3] [5] [6] [13] [16] [22]. In such cases, interview was often conducted as a follow-up to observation or as a tool to collect additional information. Alternatively, an open-ended questionnaire served as the cornerstone of soliciting specific information about individuals' collaborative activities [10] [17] [24].

Most experimental studies followed a general experimental design in interactive information retrieval evaluation where subjects are asked to complete a questionnaire both prior to and after a given task while their interactions are captured using recording software.

3.3 Levels of Analysis

CIS can be analyzed at many different levels. One of the most basic dichotomies is between individual and group levels of analysis. From one perspective, all actions and behaviors can be seen as individual-it is individuals who act and behave-and the group-level observation must be derived from these basic building blocks. Yet, collective information seeking must be seen as more than just a sum of isolated individual acts and behaviors.

The review of CIS studies shows that a large number of studies collected data from individuals. Interviews were conducted on a one-on-one basis and diaries were individually completed. There is a small number of studies that seek to reconcile different levels of analysis, i.e., both individual and group levels. For instance, Reddy and Jansen [16] observed the team as a group but interviewed each individual team member on their information-seeking practices.

3.4 Sample Size

The sample size in empirical studies affects the robustness of the results. Along with the sample size, the representativeness of the sample needs to be carefully examined.

A wide variation was found in the size of the samples. Studies that used a questionnaire had a larger individual sample size than those that used a qualitative data research tool, such as interview and observation. Spence, Reddy, and Hall [22], for instance, received 70 responses out of 150 potential participants in their survey study. Like surveys, determining an appropriate sample size for an experiment may depend on the desired levels of confidence and precision. In Shah and González-Ibáñez's [20] study, 60 participants in 30 pairs were recruited from randomly selected students.

It seems that there is no agreement on the ideal sample size in other case-oriented studies that observed one or two groups consisting of three to nine group members within a specific field [3] [6] [13] [14] [16]. Furthermore, such studies did not provide justification of the sample size used; convenience sampling was the predominant sampling technique.

4. CONCLUSIONS

CIS is a complex phenomenon; it involves larger processes with a variety of factors. Moreover, CIS can be different from individual information seeking. During the last decade, the field of CIS has expanded with new research that explores this complex phenomenon.

As far as the theoretical foundation of CIS is concerned, we may conclude that the field has started to make progress in terms of the development of new concepts and models. However, further empirical testing and refinement of those concepts and models is needed. For methodological application in CIS, observation seems to be proven as firsthand data on processes, activities, and practices being studied. The use of several data collection methods has become more popular, which potentially increases the validity of the findings.

There is certainly the need for further work in CIS. More studies need to be carried out to increase the theoretical understanding of studied phenomena in CIS.

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