The Effect of Need to Belong on Online Social Behaviors and Cognitive Interactions

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Abstract

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The ubiquity of the online and social networking community has changed how people communicate with friends and strangers. The need to belong, one of the fundamental social needs in human's society, plays an important role in building quality communication and social connection.

The studies reported here contribute to our understanding of 1) relationship between the need to belong and online social participation, 2) people's strategies in consuming belongingness-related information, and 3) how the need to belong affects people's cognitive skills in solving problem online.

Our research confirmed the roles that the need to belong is significantly associated with how people to come online for social interactions. Our study provided evidence that a deprived sense of belonging disabled people's ability to sense social cues online and initiate new social

connections. With a manipulated sense of belonging, participants obtained a less rich impression of the member formation in a social group and retained less socially relevant information and remembered fewer socially significant details.

A jeopardized sense of belonging also had significant impact on people's problem-solving ability in scanning and processing information in common online search tasks. While the impact for easy problem solving tasks is minimal, participants who have lower sense of belonging were not able to effectively solve the problem.

In addition to contributing to the fundamental understanding of need to belong, this research is also the first to empirically confirm the validity and reliability of stimulated retrospective think aloud (RTA). Our study supported the validity of stimulated RTA in that people's recounting of what went on in their task performance describes the same sequence of objects in the same order as what they attended to during the original task performance.

The results of this research provide researchers of online social networking sites with insights about what matters to people in terms of promoting need to belong. The findings also benefit the designers of online social networking sites by providing them with a different way of looking at the impact of their site - fulfilling people's fundamental need to belong.

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Chapter 1. INTRODUCTION

1.1 INTRODUCTION

The concept of “Cyberspace” was first invented and used in science fiction and movies in the 1980s. It represents "a notional environment in which communication over computer networks occurs.”[1]. In the 1990s, computer professionals began to develop computer systems to the point that they could formulate real cyberspace environments. The maturity of the Internet and the uses of network communication have greatly promoted the widespread use of such cyberspace environments.

In a cyberspace, individuals can interact, share ideas and information, provide social support, play games, have meaningful discussion, and so on. This often occurs in online community. An online community is a virtual community where the members come to a shared space online and engage in conversation about topics of shared interest. Individuals often officially join the community by signing up for membership, and become regularly present members of the community [2].

An online community is often a supplemental form of communication between people who know each other or are connected with the same organization in real life. It can exist in a lot of different formats: from Bulletin Board Systems (BBSs) where anyone can post content and share information, to Blogs where the owners post their thoughts and receive comments and feedback, to the Facebook type of Social Networking Sites (SNSs) where friends and strangers connect with each other through networks of friends.

The interaction in online communities has also evolved from a few simple behaviors (e.g. posting and replying to messages), to a wide variety of rich interactions (e.g. annotate

replies, ping, like, tag, share and reshare). Online communities have become additional channels of communication between people who know each other primarily in real life. The current social networking communities, such as Facebook, utilizes various means to support communication, from asynchronous text-based chat and messaging to forums that use voice, video, or text to deliver rich communication. This new type of social networking site is becoming very popular. Among them, Facebook is the most popular with over one billion active users, 699 million of whom log onto the site daily [3].

The ubiquity of the online and social networking community has changed how people communicate with friends and strangers. With rich communication, the online social networking community in some ways has touched every aspect of people's lives, including connecting with old friends after being strangers for 20 years, maintaining contacts with family members who live far away, making new acquaintances by peeking into friends' circles, etc. [4].

1.2 Background and Rationale

With computing technologies becoming ubiquitous, people have begun transmitting socially meaningful information and communicating with others via media such as online systems, mobile phones, and chat systems. The development of the Internet has greatly changed the way people interact and communicate socially with others. Online communities have become one of the most important parts of people's everyday life. This communication has become so convenient that it has created an "ambient intimacy" around us [5]. Social media enable us to "keep in touch with people with a level of regularity and intimacy that you wouldn't usually have access to, because time and space conspire to make it impossible [6]." They are everywhere around us no matter where we go and where we are [2].

Currently, people use online communities to share news, information, jokes, music, discussions, pictures, and social support in hundreds of online environments [7]. In various domains, such as health [8], education [9], e-commerce and knowledge management [10], online communities are seen as the glue that holds people together so that they can collectively create and disseminate knowledge.

Applications for social computing, such as chat systems and online communities, are by nature different from other standalone and work-related applications. In general, online social communication systems allow people to interact and communicate with other like-minded individuals despite their lack of physical proximity. These systems generally involve much larger groups than work-related systems. Participants in the online environment could be in the same room or far away in different cities, countries, or even continents. They could be friends who have known each other for a long time or be strangers who never met before and won't meet in the future either.

Many online environments exist mainly for social interaction rather than work. The activities carried out in online environments generally have less obvious hierarchical structure and are closer to everyday life [7]. In terms of skills and knowledge, online communities often don't require specific knowledge or skill for participation even though members may have broad expertise, while work-oriented collaborative systems often require a certain minimal knowledge or complementary skills for different roles in the shared work.

In addition, people have different goals in communicating online. When people interact with others, they are often driven by a range of motives or needs [4]. Different from workplace interaction driven by task completion, interpersonal communication online is often informal and driven by participants' various social psychological needs (e.g., obtaining companionship,

seeking friendship, etc.). For example, researchers have found that people who express their "true self" on Facebook post more frequently and post more personally revealing and emotional content for the purpose of getting individual attention and feeling included [4].

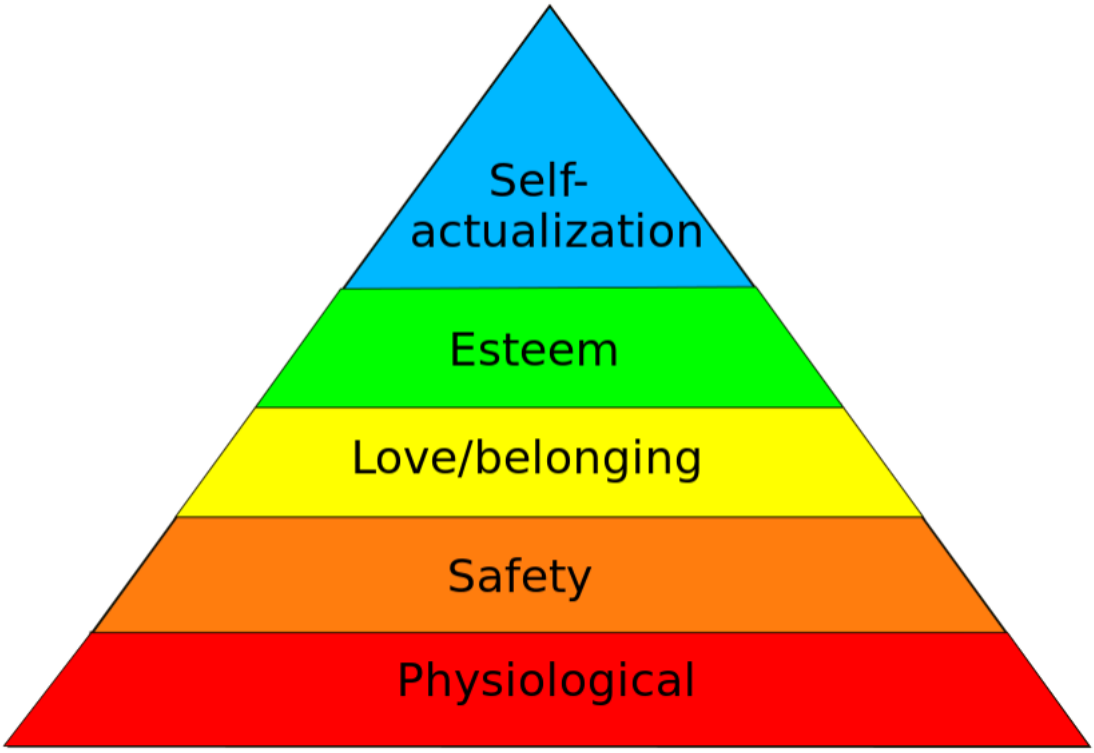


Figure 1.1 Need to belong in Maslow's Hierarchy of Needs

Among human needs, the need to belong has been discussed as one of the fundamental motivations regarding human interpersonal behavior [11] and the most basic of all social motives [12]. Baumeister and Leary [11] argued that, just as hunger or thirst disrupts normal patterns of behavior, feeling, and thoughts, the threats of social exclusion (e.g., deprivation of a sense of belonging) also could affect an individual's cognition, affective reaction, and behavior. People may respond to threats of social exclusion to facilitate the satisfaction of unmet needs to belong.

There are many means to satisfy the need to belong [13] [14] [15] [16]. People, as social animals, naturally want to be with others. They find friends and form close relationships. They form families to build intimate connections with their significant others. With more social interaction happening online, participating in an online social community is also considered one of the ways to enhance the individual's sense of belonging. Different from prior work-related applications, an online social community is designed to support a multi-dimensional, cohesive social grouping that includes shared spatial relations, social conventions, a sense of membership and boundaries, and an ongoing rhythm of social interaction [17].

Even though social networking sites have becoming a norm in people's social life, there has not been any research done to answer questions such as: are social networking communities doing what we want them to do? How does the design of online community affect participants' effort at seeking connections? Do people who participate in online social interaction really have their social needs fulfilled? Do they feel that they have achieved their social goals online? What are the benefits of having a fulfilled need to belong, other than not feeling alone? Does participating in online social interaction make them more capable of doing other things that require more cognitive skills?

The research reported in this dissertation takes the importance of the need to belong further to the land of social network services, and explores how the individual's psychological state affects feelings and behaviors in that domain. The focus of this work is to look at how people participate in an online community and how their online social interaction supports or hinders them in seeking companionship and connection. The work then explores the possible implications for future design.

1.3 STATEMENT OF THE PROBLEM (WHY RESEARCH THE NEED TO BELONG?)

The design of social networks may have an enormous impact on how people behave in this new ecosystem. The sites often simplify and amplify connections between people online. They can create a thriving ecosystem of small programs that let friends interact through messages, posts, games, greetings, video clips and more. Social networking sites may also offer a more intimate setting for friends to share information.

When people conduct activities or interact with others in such social-networking settings, they are driven by a range of needs or motives, just as they are in other settings. Unlike workplace interaction that is primarily driven by completing tasks, interpersonal communication online is often informal and driven by participants' various desires and social psychological needs. Their online encounters might start with obtaining companions and seeking friendships. Some might enhance their social networking experience by engaging in playing games with others. Of course, in addition to meeting social needs, social networking sites also provide opportunities for people to obtain objective information such as trending news or content that pertains to the individual's interests. The work reported here focuses on the social psychological issues, specifically the need to belong.

Back in 1930, Alfred Adler formulated the thesis that humans have a fundamental need to belong. It has been put by Adler that "social feeling is the crucial and deciding factor in normal development." In 1995, Baumeister and Leary[11] presented in their landmark paper a collage of evidence that supports the argument that belongingness is a fundamental human need. Since then, researchers have begun to empirically study the need to belong, from immediate reactions to experimental manipulation of social exclusion [18] to social inclusion and acceptance [19]

[20]. Before we can look at the operation of the need to belong in social-networking environments, we need to understand it on its own terms.

1.3.1 *Fundamental Need Affecting Cognitive Reaction*

Similar to our other fundamental needs, such as hunger or thirst, which disrupt normal behavior and thoughts to help fulfillment of the unmet need for food or water, the threats to belonging can also affect individuals' cognition and behavior to facilitate satisfaction of the unmet need to belong. Baumeister and Leary (1995) stated that threats to belonging should lead to increased cognitive focus on relationships and social connections. And, since cognitive resources are limited, inevitably, utilizing cognitive resources on social relationships should lead to impairments in processing in other tasks.

Indeed, research in the past has shown that an unmet need to belong is associated with better memory of interpersonal and social events, greater attention to and capability in identifying emotions in faces, and higher accuracy in understanding others' thoughts and feelings [20] [21]. These studies tell us that if someone is deprived of a sense of belonging, he or she is more likely to pay greater attention to social-related information.

Research has also demonstrated that participants whose need to belong is threatened show signs of decreased cognitive processing of non-social or complex information [22]. Participants who were told that they would have a lonely future ended up performing worse on tasks that were designed to test intelligence. They also failed more in recalling messages with complex content. This confirms Baumeister and Leary's theory that threats to belongingness may redistribute cognitive resources to social domains and result in limited cognitive resources in non-social areas. Similar results have been reported in studies where participants were asked to perform complex cognitive tasks [23]. Interestingly, the performance on easy tasks and simple

recall was not significantly affected by the negative experience in the area of need to belong [22] [23].

These findings suggest that the need to belong affects human beings in a way that is very similar to the way that other basic human needs affect us. When the need to belong is threatened, human beings often try to redistribute limited cognitive resources to support the satisfaction of the need to belong, which often leads to impairments in complex and high-order cognitive processing.

1.3.2 *Social Motives for Seeking Contacts with Others*

Social psychology has found that the need to belong originates from the human desire for interpersonal attachments. We have an intrinsic motivation to affiliate with others and be socially accepted. The belongingness theory posits that human beings have a pervasive drive to form and maintain at least a minimum quantity of lasting, positive, and significant interpersonal relationships. This need is particularly satisfied by the combination of frequent interaction and persistent caring [11]. It plays an important role in a number of social phenomena such as self presentation [24] and social comparison [25].

In researching people's need to belong online, factors that could affect the sense of belonging include personal involvement in the group, self-representation, evaluation/impression received from others, observed group and individual behaviors, perceived values and personality etc.

When people are prompted to seek social contact, their social behavior can be driven by the need to belong. The sense of belongingness could be fulfilled by seeking affiliation and/or by having an enhanced intimacy experience with their social contacts. Affiliation and intimacy

characterize two different aspects of social behavior and result in different types of social relationships.

Those who most often seek *affiliation* are attracted by broad harmonious relationships with a number of other people and the need to feel accepted by other people. These people tend to conform to the norms of their work group and prefer work that provides significant personal interaction with a range of others [5].

Those who most often seek *intimacy* view a smaller number of closer relationships as more important. People with high levels of intimacy motivation tend to form and maintain a smaller and rich network of close friendships and other social bonds. They tend to enjoy higher levels of happiness and subjective well-being than those that most often seek affiliation [5].

These two different motives were both associated with the general need to belong. Often these two motives induce different behaviors and lead people to form different types of social connections. In this research, we will look at the two motives to see if they differ in their effect on behavior in online environments. Different people may respond to the need to belong differently to achieve the same goal of feeling that they belong to groups or feeling closer to others.

The need to belong has also proved to be associated with ostracism [26] [27, 28]. Human beings inherently want to belong and to be recognized. We need to feel a sense of belonging or else we suffer psychologically and physically [11]. Studies have found that thwarted needs to belong are likely fortified by directing the individual's attention more toward socially related information and toward behaviors that encourage others to respond favorably. Individuals who are ostracized would attempt to pay more attention to others, and to ingratiate themselves into others' favor. They are more likely to conform, comply, work harder for the group, cooperate,

attempt interpersonal reconnections, and express liking for new, even unusual groups [21, 25, 28].

1.3.3 *Seeking Contacts and Group Association Online*

The need to belong is found to be important for human life not only in the physical environment, but also in online interaction. The need to belong plays an important role in online life. But research has also shown a paradox of the Internet: it is associated with both enhanced social communication and decreased social involvement [29], and not all social interaction makes meaningful contributions to people's social being [30].

Studies have reported that not all online activity inherently promotes or supports the need to belong or group association [31]. Kraut's early study of the Internet demonstrated that the Internet is a social technology used for communication with individuals and groups, but is also associated with *declines* in social involvement [29]. Internet use takes time away from face-to-face contacts and replaces strong ties with weaker ties. Communicating with people through computer-mediated communication (CMC) systems potentially reduces the importance of physical proximity in creating and maintaining networks of strong social ties. Longer use of the Internet for communication was associated with declines in the size of the physical social circles of those in the study. As a result, their quality of interaction decreased. Their feelings of loneliness and depression increased, and the sense of belonging diminished.

Individual difference was also found in the level of the need to belong. Some people may have a higher need to belong. These people tend to be more lonely [32]. And Mellor et al. [32] found that there is a weak correlation between the need to belong measure and the loneliness measure. Instead, they found that loneliness is strongly associated with the discrepancy between the need to belong and the satisfaction with personal relationships, which can be also stated as

"unmet need for belonging". People with many friends may still feel lonely (that is, may have a higher unmet need for belonging) if they have a higher innate need to belong and a lower level of satisfaction with their personal relationships. On the other hand, people with few friends and acquaintances may not be lonely if they in general are low in the need to belong.

Leary et al. [33] have reported that the Need to Belong scale correlates with variables that involve a desire for social contact, such as extraversion, sociability, and need for affiliation. Mellor et al. [32] found that people's need to belong is weakly correlated with social connections, such as friendships, created online. The connections formed purely online were said to be likely more limited than those supported by physical proximity. It was also found that decreased physical proximity couldn't be compensated for by using media, i.e. video conferencing and instant messaging, in cooperation, persuasion and deception tasks [34]. A further study on ostracism over the Internet also showed that individuals who were ignored and excluded in an online group activity (a triadic game of toss) reported feeling bad, having less control, and losing a sense of belonging [28].

1.3.4 *Unsatisfied Need to Belong Could Harm Interaction Online*

A low sense of belonging may change how people behave online [12] [25] [21]. Research has shown a series of effects of the need to belong on human cognitive and social behaviors online. Similar to the physical impact of hunger that results in selective memory for food-related stimuli, a social hunger appears when belongingness needs are unmet online. Social hunger results in selective memory for socially relevant stimuli. Studies were conducted in a simulated computer chat room [25]. Participants received a brief acceptance or rejection experience. They then read a diary document that contains both social and individual events. In this study, after having an acceptance or rejection experience, participants who received negative

feedback biased their memory for relevant information and recalled a greater proportion of both positive and negative social events. This demonstrated that the need to belong significantly affects people's sensitivity to social information and influences their memory for social events [25].

Past studies have shown that the need to belong is one important feeling that people have in their online communication and lacking of such feeling could greatly affect their experience of online interaction [35] [36] [12]. It has been found that some less desired social behaviors online are associated with the lack of a sense of belonging, e.g., lurkers or social loafers engage less in community activities and have a lower sense of belonging to a community than those who post [35] [36]. A further study also showed that individuals who are especially concerned with social connectedness and high in the need to belong would be particularly attentive to and accurate in decoding social cues [12].

1.4 RESEARCH QUESTIONS

Past research has established that the need to belong acts as a fundamental human need that is deeply rooted in our social life. It drives how we pursue relationships and find connections. Threats to the need to belong could result in impairments in solving problems. The research to date was mainly conducted in the social psychology domain [37] [38] [39] [32] [21] [25] [11]. Less research has been done regarding online social communities, which often claim to foster relationships and support making connections [3] [14].

The goal of the research reported here is to understand how the need to belong, as a fundamental human social need, affects people's online behaviors. Since much of people's time is spent engaging in online environments, both social and non-social, this research will unfold the impact of the need to belong on a users' life, that is, on a macro behavior level. In addition,

this research will look at how the need to belong affects users' behavior in seconds or minutes, that is, on a micro behavior level.

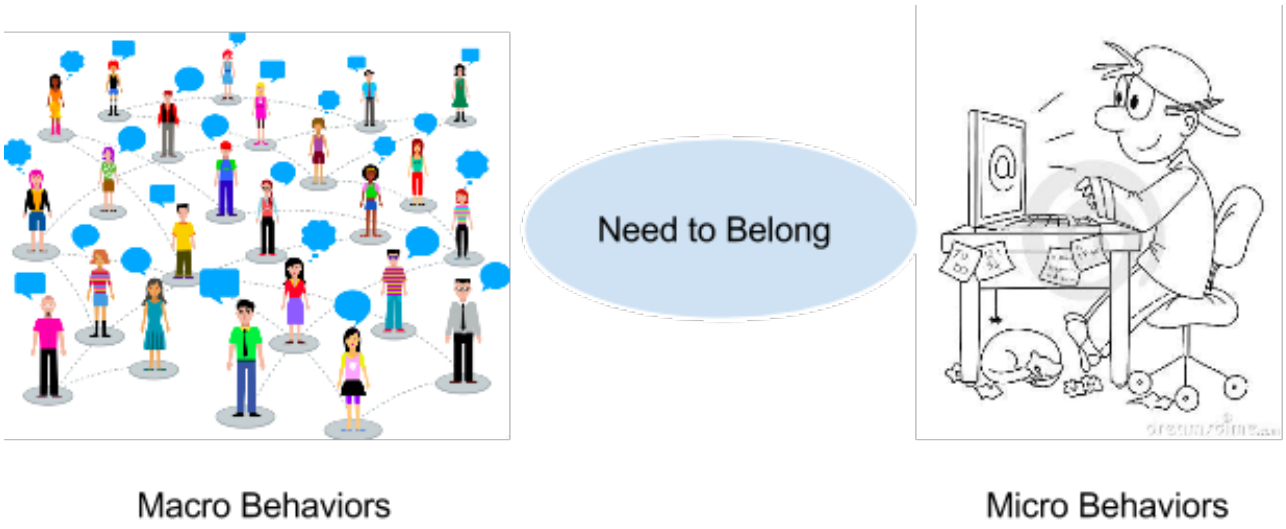


Figure 1.2 Impact of Need to Belong

Macro Behaviors: These behaviors are characterized as aggregated actions across a somewhat longer period of time (e.g., days, weeks, or months) and/or clustered around a group of people. Macro Behaviors present what we know about a population and what long-term behaviors we see at a glance. In this research, Macro Behaviors refer to behaviors that are measured in the field over time, e.g., how many times people sign in to an online social environment.

Micro Behaviors: These behaviors are characterized as short-term reactions to certain stimuli. These actions are often harder to observe and capture because they often last for a short amount of time (e.g., in minutes or seconds). In this research, we use the term "Micro Behaviors" to present behaviors that are studied in a lab by engaging participants in specified groups and conditions, e.g., how long a group takes to complete a given task.

Four major research questions will be explored in this body of research:

RQ1: How does the need to belong affect people's online behaviors as a whole? Do people who have higher or lower need to belong visit online social networking sites more or less?

RQ2: How does the need to belong affect people's social behavior online? Do people who participate more online have higher or lower need to belong?

RQ3: How does the need to belong affect people's social behavior, when the need is threatened?

RQ4: How does the need to belong affect people's cognitive skills in conducting online searches, when the need is threatened?

1.5 Significance of This Research

Although the need to belong is an important social need for each individual, there is very little research about interactions for seeking belongingness in the online environment, especially in online communities. Past research has found that people experienced a strong sense of others that helped them establish effective communication zones [40] [41]. Other research suggests various designs for increasing group awareness and accountability, which could be beneficial for supporting individual belongingness [42] [43] [44] [45] [46] [47].

The need to belong, one of the fundamental social needs in human's society, plays an important role in building quality communication and social connection. Together with existing literature on social connection (e.g., group awareness and accountability), findings on how the need to belong is associated with social activities could also be used to design systems that are better at supporting group awareness and group association.

It is important for us to understand the mechanism behind how online social interaction contributes to people' sense of belonging. The studies we present in this body of work reveal how online users' belongingness need is associated with their behaviors. This knowledge provides empirical foundation to support future design of online social communication for people's well-being. These studies expand our understanding of the social phenomena of group affiliation and intimacy that happen in online interaction. Observations of online interaction revealed the detailed communication patterns adopted by the users to satisfy their particular needs for belonging with affiliated and intimate connections. The final results from these studies support future successful design cases to ensure better support of online communication and interaction through CMC technologies.

1.6 CONTRIBUTIONS

The studies reported here contribute to our understanding of 1) what are the effects of the need to belong on online social participants, 2) people's strategies in consuming belongingness-related information, and 3) how the need to belong affects people's cognitive skills in solving problem online.

Our research confirmed the roles that the need to belong, as one of the most fundamental social needs, play in driving people to come online for social interactions. The results show that the need to belong is significantly associated with the size of people's online social circle. People who have a higher need to belong are more motivated to come to a social networking site more frequently. The results also showed that the need to belong significantly correlates with how often people participate in social activities to create connections online, e.g., posting a status update or broadcasting messages or questions. The study confirmed our hypothesis that the need

to belong plays a significant role in how people react to other's social interaction (e.g. posts or comments).

Our study provided evidence that a deprived sense of belonging disabled people's ability to sense social cues online and initiate new social connections. With a manipulated sense of belonging, participants obtained a less rich impression of the member formation in a social group. They retained less socially relevant information and remembered fewer socially significant details. With a lower sense of belonging, participants were less active in initiating new social connections and shared less information about themselves to others.

A jeopardized sense of belonging also had significant impact on people's problem-solving ability in scanning and processing information in common online search tasks. When the problems that need to be solved are easy, the impact is minimal. When the problems are hard and require more cognition and concentration, participants who had lower sense of belonging were not able to effectively engage with the problem. Their eye movement fixation duration remains the same as encountering easy problems, whereas participants in the control group exhibit significantly shorter fixation duration, likely as a result of increased concentration.

In addition to contributing to the fundamental understanding of need to belong, this research is also the first to empirically confirm the validity and reliability of stimulated retrospective think aloud (RTA). Our study supported the validity of stimulated RTA in that people's recounting of what went on in their task performance describes the same sequence of objects in the same order as what they attended to during the original task performance. These findings are useful in any field that uses RTA to collect user's performance information.

The results of this research provide researchers of online social networking sites with insights about what matters to people in terms of promoting need to belong. The findings also

benefit the designers of online social networking sites by providing them with a different way of looking at the impact of their site - fulfilling people's fundamental need to belong.

1.7 How Is This Work Organized

The remainder of this dissertation is organized as follows:

Chapter 2 is a review of the relevant literature. I will start with an overview of the literature that is related to the need to belong as a fundamental human need. As it has been realized that the need to belong acts in ways similar to other basic human needs, e.g., hunger or thirst, a variety of work has been done in the social psychology domain to understand its mechanisms and its capacity. Then, I will review the common theories around social motives for group belongingness that are related to need to belong, and mechanisms and theories around how social cues are processed. While our focus is on the need to belong, it is helpful to understand its complexity and the intertwined connections between need to belong, affiliation, and intimacy.

In a domain that is interdisciplinary, different theories can be drawn from social psychology or information and communication science to understand how social cues are often processed. Specifically, I will review the appealing theory of social information processing that focuses on interchange of social cues, and information foraging theory to understand the process of attending to cues. As the focus of this research is to understand specific dimensions of the online social networking environment, I will include a section of literature review on the common aspects of non-face-to-face communication online. I then discuss the two-direction dynamics between the technology and social interaction. My discussion will be around the effect of interface design on social interaction as well as the social psychological effects of technology use. Finally, I will draw on this literature to establish a theoretical framework I will use to

understand the effect of need to belong at a large scale (macro behaviors) and at a small scale (micro behaviors).

Chapter 3 presents a further decomposition of research questions. Each research question is elaborated into several sub-questions that can be directly answered later. Then I will present a study design that can adequately answer the questions that were identified immediately before. To help the audience to fully understand the rationales behind the study design, I will discuss the "What", "How", and "Why" in detail to help the audience of this work to understand how I approach this topic. Next, I will provide an explanation of the site selection and reasons behind selecting the target social online networking site. After the site selection, I will discuss my methodology choice of mixed methods: the combination of survey, in-lab interview, and eye tracking studies. I will contrast my approaches with other methods that are commonly used to study social online networking sites. The survey method was used to understand how the need to belong is associated with people's long-term behaviors. The lab study with retrospective think-aloud and eye tracking was set up to understand the immediate effect of need to belong on people's memory and recall, as well as the cognitive skills in solving easy and difficult search tasks. Finally, I will discuss the measurement we used to gauge need to belong, our recruiting methods, as well as the data analysis approaches for the qualitative and quantitative data we collected in those two studies.

Chapter 4 presents the survey we conducted with 200+ social networking site users to understand how the need to belong is associated with their online social networking site participation on the macro level. I will first briefly review the literature about metrics that are related to need to belong. Then, I present the hypotheses about the need to belong and online social networking activities. After that, I will describe the methodology in detail, including

various aspects of online participation, the participants, as well as the design of the questionnaire and procedure for conducting the survey. Finally, I will present the findings on how the need to belong is related or not related to the metrics that we collected.

Chapter 5 presents the second study, an experiment that lays the groundwork for utilizing the retrospective think aloud protocol (RTA) in the laboratory. Retrospective think aloud collects the verbalization of a user's performance after the performance is over. To efficiently and confidently use the method to collect useful information, I conducted an experiment to investigate the validity and reliability of RTA using the method called stimulated RTA. By comparing subjects' verbalizations with their eye movements, we examined the stimulated RTA in terms of how it represents what was actually happening when users were performing tasks. I will go through the hypotheses and elaborate on the experiment design. I will then describe the steps to pre-process the eye tracking data and verbalization data to bring them on the same scale in order to compare them. By conducting a distance alignment analysis, we found stimulated RTA to be valid and reliable: the method provides a valid account of what people attended to in completing tasks, it has a low risk of introducing fabrications, and its validity is unaffected by task complexity. I will conclude with more detailed analysis of RTA, which provides additional information about user's inferences and strategies in completing tasks. The findings of this study provide solid support for using this method in the following lab study to collect users' feedback while they are performing the tasks in the study.

Chapter 6 presents the third study on the need to belong and people's micro-social behaviors. I will first start with the motivation behind this lab study, and then with a detailed description of the methodology. I chose to conduct an experiment with an ostracism game to manipulate participants' sense of belonging. Participants then performed a series of tasks to

evaluate their responses to and processing of social information as well as their ability to perform tasks that require using their cognitive skills (e.g. search tasks). Then, I will present the findings about whether and how participants' sense of belonging affected their social skills in processing social-heavy information and the ability to find correct answers for search tasks. I will conclude this chapter with key findings on how the need to belong affects the short-term memory of social and non-social information, and its ability to affect the search efficiency for finding the right search results.

Chapter 7 brings the two main studies together by merging the findings on macro and micro behaviors and synthesizing the impacts of need to belong. In this chapter, I will discuss the key findings from both studies. The discussion will integrate the findings in both the social psychology and information science literature to highlight the characteristics and importance of the need to belong and its largely neglected effect on online social interaction. As a functional human social need, the need to belong can determine what people do on a social networking site, and dramatically change people's behaviors in the seconds immediately following the events that affect the sense of belonging. I will conclude this chapter with a discussion about the insights it offers researchers about online social networking and collaborative work and its implications for designers who are trying to design features to improve social engagement and community participation.

Chapter 8 summarizes the dissertation as a whole. I will start by restating the study motivation and brief account of the methodologies used in this research, followed by the key findings we've discovered related to the research question and findings. I will then summarize the core contributions of this work to the field of academics and practice. I will then discuss the limitations of this work and various constraints I had to work around to obtain meaningful

results. I will conclude with a discussion of directions for future research, particularly around the ways to research the need to belong, and strategies for taking the need to belong into consideration in the future design and implementation of online social networking environment.

1.8 Summary of the Chapter

An online community is often a supplemental form of communication between people who know each other or are connected with the same organization in real life. The interaction in online communities has evolved from the simple behaviors supported by early technologies (posting and replying to a message), to a wider variety of interactions (e.g., ping, like, tag, share and reshare). The growth in online and social networking communities has changed how people communicate with friends and strangers. Despite the obvious importance of online social networking sites/environments, limited research has been done to understand the real impact of and connections between an individual's fundamental need to belong and their online behaviors. This chapter presents the research questions that focus on revealing those connections.

Chapter 2. LITERATURE REVIEW

2.1 INTRODUCTORY COMMENTS

Studying how design affects people's communication in online communities crosses several different fields. Among other fields, researchers from social psychology, computer mediated communication (CMC), and social science are trying to understand the community and social networking phenomenon and uncover the mechanisms underlying online community participation.

In social psychology, need to belong has been identified as one of the fundamental needs for human beings [48] [11]. As with hunger or thirst, deprivation of this need often results in suspension of individuals' other thoughts, feelings, and behaviors in order to facilitate the satisfaction of the unmet need. This domain of knowledge has established the basis for the understanding of the need to belong as one of the fundamental human needs, and has elaborated on its characteristics and mechanisms and how it works in general (reviewed in Section 2.2).

While social psychology studies have focused on the social psychological effects of the need to belong on individuals, researchers in computer mediated communication (CMC) have focused more on the effect on groups and how groups interact with each other. This CMC research has focused on understanding how people interact and communicate, especially in a non-face-to-face environment. Section 2.3 reviews studies that were done to develop theories about how the limited resources in CMC affect the efficiency and mechanisms of communication. What happens when the channel that was previously used is no longer available? Can people communicate the meaning accurately and efficiently? Will miscommunication arise in those contexts? How do people address the miscommunication?

Researchers have also studied the social psychological effect of technology use - what the Internet and CMC mean to people, and whether and how they affect how we live our life. This body of knowledge also extends to how technology design affects people's lives. Researchers are studying whether a limited communication channel will result in positive or negative social impact, such as improving or harming participation in community life and social relationships or leading to increases or decreases in social capital. The inclusive nature of the Internet and the fact that people are increasingly dependent on it suggests that use of the Internet and CMC are becoming the norm in people's daily life. The questions addressed include where CMC will position itself in people's life and the extent to which CMC bridges online and offline activities. In particular, we are interested in how the online community connects people and their activities and how the participants in an online community who have different levels of the need to belong conduct their online and offline activities differently. The details are summarized in the Section 2.4.

To understand how the need to belong manifests itself on a social networking site, this dissertation will use Facebook as the object of study. Section 2.5 reviews the past research done to understand Facebook's social effects. Researchers have tried to understand what impact Facebook has had in the online society and how Facebook participants' behavior varies under differing circumstances. Although all Facebook participants are provided with the same functionalities on a Facebook site, their engagement in the activities and their social responses are different among individuals. These past studies have established a theoretical basis for exploring individuality more in depth along the line of psychological need to belong.

In the following sections, I will review the research that has been done in each of these fields that relates to the research questions presented later.

2.2 NEED TO BELONG AS A FUNDAMENTAL HUMAN NEED

2.2.1 *What is Need to Belong*

Need to belong was first identified by Alfred Adler in 1930 [48] as a fundamental need for human beings. Adler emphasized the importance of social need and posits that “social feeling is the crucial and deciding factor in normal development”.

In 1995, Baumeister and Leary [11] presented a collage of evidence arguing that belongingness is a fundamental human need. The need to belong was defined as "a need to form and maintain at least a minimum quantity of interpersonal relationships". This particular need universally exists among human beings. Human beings are naturally driven toward establishing and sustaining belongingness.

Similar to the basic thriving needs, such as hunger, the need to belong represents an individual’s personal need to form relationships. It is personal in that different people have different levels of need to belong, just like different people need different amount of foods to feel satisfied. Similar to hunger, the need to belong can fluctuate and be affected by the environment an individual is in. The need can be raised higher if someone is placed in a socially-deprived situation, or can be lowered when the individual is in a socially-rich environment.

In Baumeister and Leary’s words, “[t]he need is for frequent, non-aversive interactions within an ongoing relational bond. Belongingness appears to have multiple and strong effects on emotional patterns and on cognitive processes.”

The threats of social exclusion and deprivation of need to belong could affect an individual’s cognition, affective reactions, and behaviors. Deprivation of basic needs, such as hunger or thirst, often results in disruption of individual’s thoughts, feelings, and behaviors in

order to facilitate satisfaction of the unmet needs, such as for food and water. The unmet need to belong, in the same way, may influence individuals' patterns of thinking, feeling, and behaviors.

2.2.2 *Cognitive, Emotional, and Behavioral Reactions*

Baumeister and Leary [11] in their landmark paper argued that an individual's deprived need to belong would result in increased focus on social connections and relationships. With limited cognitive resources, an increase in cognition spent in social connections means a decrease in cognition spent on other domains.

Gardner et. al. conducted studies that randomly assigned individuals into groups to experience socially based exclusion (i.e., failing in matching partners because no one has selected him/her as a partner) or non-socially-based exclusion (failing in matching partners because the group is full) [25]. Then, each participant completed two social-sensitivity tasks. Their need to belong and mood were measured together with other demographic information.

The study found that unmet need for belongingness is associated with better memory for interpersonal and social events, greater attention to and processing of vocal tone in speech, greater accuracy in identifying emotions in faces, and more accuracy in understanding others' thoughts and feelings [20] [21]. To successfully establish and maintain social relationships, individuals tend to be sensitive to the feelings and thinking of others. Individuals who are high in the need to belong (have higher concerns regarding social connectedness) become more attentive to and precise in interpreting and decoding social signals. They are more accurate in completing a complex social-sensitivity task (e.g. an empathic accuracy task - viewing a videotape of a woman discussing a personal issue and writing down what they thought the target woman was thinking or feeling at the pre-determined tape stops). The higher performance in interpreting social cues was specific to social perception skills rather than to cognitive problem solving (as

tested by two nonsocial tasks) in general. It was reflected as a higher accuracy in a social perception task where participants were asked to judge the emotional expression conveyed by the face depicting major emotions (anger, fear, happiness, and sadness) of various levels of intensity.

Kipling D. Williams, who studied the effect of ostracism, has found that people's need to belong can be easily thwarted by even the most minimal forms of ostracism, which often resulted in initial (reflexive) reactions that are painful and distressing. The effect happens in both the physical world and online world [23] [49] [50].

In several studies, they used a face-to-face ball-tossing game as the intervention to manipulate the ostracism effect. As the participants were waiting for the experiment to begin, the experimental confederates follow a script to either include or ostracize the actual participants. The participants who received the inclusion treatment were included in the ball tossing game and were passed the ball regularly. The participants who received the ostracism treatment got the ball at the beginning, but were gradually excluded from getting the ball. Participants who were ostracized in a 5-minute game of toss came to have more negative affect, sadness and anger. Similar studies were conducted using Cyberball - an online Internet ball tossing game as a plot to exercise participants' mental visualization skills. They found the effects were as strong, even though the whole process happened online and participants were unclear about the other players in the game.

DeWall et. al. conducted a series of experiments to investigate the effects of social feedback and the prospect of future acceptance (belonging vs. alone) on self-regulatory performance [51]. Participants were randomly assigned to one of two social feedback conditions: future belonging and future alone. “Future belonging” participants were told that they had a personality type according to which they are likely to have positive and lasting relationships

throughout life. In contrast, “future alone” participants were informed that they had a personality type according to which they would end up alone later in life. Then, they went on to complete an operation game. Half of the participants were in the social diagnostic group in which they were told that their game performance is associated with traits that are beneficial in relationships (e.g. empathy and social sensitivity). The other half of the participants who didn’t receive such comments were in a nondiagnostic control condition. Self-regulation was measured using the time and errors made in playing the game.

They found that “excluded” participants, who received a suggestion that they were likely to be alone, indeed wanted to be accepted and willingly exercised self-regulation when told that performance in self-regulation would increase the promise of future acceptance. The effect disappears if self-regulation tasks were perceived as being socially irrelevant. Self-regulation in this case was measured as the performance (speed and accuracy) on an Operation game in which participants were instructed to extract 11 different objects from holes using tweezers without touching the side of the holes. “Accepted” participants performed relatively poorly when the task was framed as being socially relevant (half of the participants were told that performance on the upcoming self-regulation task was diagnostic of traits that were good for relationships). The findings provide evidence that the need to belong works in a way similar to other motives where thwarting the need intensifies the motive and satiating it leads to temporary reduction in motive. Participants whose belongingness was threatened appeared to focus cognitive energies on tasks that could demonstrate improved social prospects [51].

Similar effects have been found in group identities [52]. The studies investigated the activation and amplification of group identities and memberships following rejections. Participants were asked to recall and write about a previous experience where they were either

intensely rejected or felt very accepted. These types of recall are commonly used to manipulate social rejection, and act as a mood induction mechanism. Then, participants were asked to complete a word completion task. For half of the group the task was to work with word fragments to create group-relevant words and social identities (e.g. team, family, club, etc.), and the other half's task were to create group-irrelevant words (e.g. tent, clot, make, etc.) Results showed that rejected participants exhibited heightened activation of group constructs, social identities, and idiosyncratic group membership and rated their own groups to be more important and cohesive than other groups.

In another study [53] where the participants' need to belong was threatened by a suggestion that they would have a lonely future or by watching a movie intended to induce a feeling of loneliness, the participants reported stronger beliefs in supernatural agents and described pets with more social-connection traits than participants in the control group.

While belongingness-deprived individuals appear to be more socially sensitive and to value group membership more, belongingness deprivation could also result in cognitive impairments. Research demonstrated that the thwarting of need to belong could make cognitive processing of non-social and complex stimuli suffer, as also suggested by Baumeister and Leary [11].

Baumeister and Leary originally predicted that belongingness threats may tax cognitive resources. Indeed, Baumeister, Twenge, & Nuss [22]found that significant and large decreases in IQ and Graduate Record Examination test performance were found among people who received cues that they would end up alone in the future. Interestingly, only complex cognitive tasks such as performing effortful logic and reasoning were affected. Social exclusion didn't have a significant effect on simple information processing. This effect was found only with social

exclusion cues since cues about other nonsocial misfortunes in the future (such as accidents and injuries)-didn't have any significant effect on how participants completed cognitive tasks. With a deprived sense of belonging, the cognitive impairment directly resulted in reductions in both speed and accuracy in completing complex cognitive tasks.

Similar effects were found in other contexts. Individuals who relived a past socially painful event (such as a betrayal) performed worse on cognitively demanding tasks than after reliving a past physically painful event, whereas their performance on easy tasks (such as recall) was not affected [23].

In Baumeister and Leary's initial landmark paper, they also argued that there should be a strong consequence and impact on someone's emotion if this individual faces threats to the need to belong. The threats to social connections signal danger to someone's survival. Related research has found that social exclusion can trigger negative emotional reactions [22] or lower level of positive mood [54]. Some studies found that socially threatened participants reported more anger and sadness [26] and self-conscious emotions such as shame and embarrassment [8].

In addition to the impact of social exclusion on emotions, studies also have investigated how threats to the need to belong affect people's actual behaviors towards individuals and society. While it seems more straightforward to predict that threats to belongingness would lead excluded individuals to be more proactive in seeking relationship and connections and to want to seek reparative sources of connections [11], studies have found that the effect can go both ways.

There is evidence that the deprivation of need to belong results in a desire for reconnection. Experiments designed to understand whether the experience of social exclusion increases the motivation to forge social bonds with new sources of potential affiliation yield findings that show both pro-social and antisocial behaviors [18]. Individuals who were

threatened with social exclusion showed greater interest in making new friends. They had a higher desire to work with others as a group. They also formed more plausible impressions of newly formed social targets. They also gave better rewards to new interaction partners. However, the experiments also found that excluded individuals showed less interest in establishing reconnection with the individual who initiated exclusion or with new interaction partners with whom no face-to-face interaction was expected.

Another study also found that when participants received encouraging interpersonal evaluations after being cued about living alone in the future, they viewed the confederate positively [54].

Students who are cued about the deprivation of need to belong by writing about a previous experience of exclusion show a greater interest in getting help from student services to make new friends. People who were told that nobody wants to work with them considered new people to be more attractive and sociable [18].

The behavior consequence after being cued on belongingness seems to diverge between the source who triggered the sensation and a new partner. While the reaction towards the new partners are positive (e.g. providing a higher rating), some studies seem to suggest that rejected participants are more motivated to retaliate against the person who has rejected them than to seek connection with them. For example, in one study, the participants who were excluded by other players in a ball-toss game picked up more unpleasant snakes for other players in the game [26]. This effect remains even when the participants are financially rewarded for being excluded [55].

Similarly, a series of studies [54] found that individuals who were told that they would end up alone later in life or who were rejected by others demonstrated more aggressive behaviors rather than less. The rejected participants provided a more negative job evaluation towards the

confederate after receiving both false feedback on being alone in the future and a negative evaluation from the confederate [54].

Though the effect of social exclusion on behavior is powerful, its effects on mood and emotional distress were consistently weak. It was suggested that the effects of social exclusion appear to have bypassed mood and gone straight to producing hostile and antagonistic behavior. These findings on behavioral responses to threats to belonging suggest that rejected people are more motivated to retaliate against the person who has rejected them than to seek connection with others.

It is commonplace to note that human beings are social creatures. The research findings presented here highlight the sociality of individuals as well as how the sociality aspect of human beings can easily be affected and disrupted by social exclusion (as simple as being rejected in a ball tossing game, or as strong as receiving an unreal prediction about one's future life). The threat to the need to belong works like threats to the other basic needs (e.g. hunger, cold) to jeopardize the individual's ability to solve complicated problems. People can respond to social exclusion by quickly relinquishing their positive and helpful prosocial orientation toward promoting social acceptance and friendship.

2.2.3 *Summary and Implications for the Current Work*

The need for belongingness is a fundamental human need. The threat of social exclusion and deprivation of the need to belong affects an individual's cognition, affective reactions, and behaviors. That is, they affect the individual's patterns of thinking, feeling, and ultimately what they do in real life. Research has shown that the deprivation of need to belong is associated with better memory for interpersonality and social events, and greater attention to social cues in communication. People whose belongingness was threatened appear to rebalance their cognition

distribution so that social events and tasks received higher cognition than less socially important tasks. The effect of belongingness on behaviors is also significant. On one hand, the belongingness-deprived participants appear to respond to others in a more socially applaudable way, but they also respond negatively towards the source of rejection. Unlike its effect on cognition and behavior, the disruption of belongingness doesn't seem to have a big effect on emotion. Research has suggested that the effects of social exclusion appear to bypass mood and go straight to producing hostile and antagonistic behavior.

Most research to date has been conducted in an experimental setting. But it is natural to think about the effect of need to belong beyond the laboratory. Social interaction is expanding rapidly in the online world. The mass development of social-networking sites enables diverse forms of computer-mediated communication. Research can now explore the effects of the need to belong in the context of an online social-networking site. How is the need to belong affecting people's online behavior? Does manipulating the need to belong affect people's cognitive skills in solving social and nonsocial problems online? Is the deprived belongingness more likely to improve the social interaction?

2.3 THEORIES IN COMPUTER MEDIATED COMMUNICATION (CMC)

In the field of computer mediated communication (CMC), one of the biggest debates is whether and how the social meaning of interaction is affected by the absence of nonverbal cues when communicators substitute text-based electronic messaging for face-to-face (FTF) encounters [56]. The theories so far have been proposed around two threads of thought. One thread of thought tends to treat CMC as simple information delivery, where only certain cues could be delivered through certain media. This group of thinking has also been called "cue-filter-out" theories.

Another thread of thought speaks against "media determinism" and believes that people can transmit socially meaningful information by adapting their communicative behaviors to the media and the environmental context. The shared views and the contradictions between these two camps lead to an argument (preferred here) provided by social information processing theory. These three lines of thought are discussed in the following sections.

2.3.1 *Communication as Information Delivery*

Researchers that think of CMC as information delivery posit that the absence of nonverbal cues (including vocal and physical cues) prohibits sharing of important characteristics of interaction, such as communicators' characteristics, emotions, attitudes, environmental context, etc. Theories and models that explain the effects and mechanisms of media prohibition are often called cue-filtered-out models or the bandwidth hypothesis [9] [57] [58]. These theories and models share the assumption of a one-to-one correspondence between communicative cues and communicative functions [58]. They often emphasize the prohibition effect of computer media on communication. Studies are often oriented around the differences in capacities between the face-to-face (FTF) setting and computer use in various aspects of communication capacity, such as bandwidth, media types, cues delivered, etc.

One typical theory under the "information delivery" paradigm is *the social presence theory*. Social presence is defined as a quality of the communication medium and refers to the medium's ability to convey a communicator's presence. For example, direct face-to-face communication is considered to have the highest social presence, while a chat communication has a lower level of social presence because the conversations are mainly in text. Social presence theory states that the social presence of a medium affects the way individuals perceive their discussions and their relationships to the persons with whom they are communicating. It is

hypothesized that communication media vary in their degree of social presence, which determines the way individuals interact. Accordingly, the fewer channels or codes available within a medium, the less attention is paid by the user to the presence of other social participants. As the social presence declines, messages and interaction become less personal and more task-oriented. Based on this theory, online communication by nature is less capable of delivering social presence and supporting communication.

Although the cue-filtered-out studies reveal the limitation of media, they treat CMC as a process of information delivery, often used to describe workplace interaction. In the workplace, interaction efficiency is often concerned with the correctness of the information delivered, time spend on presenting and receiving information, and whether people could successfully complete the tasks (cooperation, or collaborative tasks) for achieving certain goals. In these applications, information exchange is considered a key goal of interaction and communication [40].

In a similar way, cue-filtered-out models study communication for the purpose of performance goals. They often explore the natural quality of a medium, questioning its ability to support communication and how it will affect the way individuals interact. Communication is modeled as the passage of information from one person to another [59]. The efficiency and effectiveness of interaction is narrowly determined by the design of interactive techniques. Similar to various cognitive models, such as GOMS and MHP, where cognitive processes are the major building blocks of workplace interaction, cue-filtered-out models treat social cueing processes as cognitive processes that exist independently of the participants and context. The determining power of media and technologies is overemphasized without considering other aspects of the context.

2.3.2 *Communication as an Adaptive Interaction*

Instead of treating social communication as a rigid information delivery process or as a workplace interaction, other researchers suggest that it is often the users' perceptions of the medium that will influence how users communicate. They think of CMC as an adaptive interaction between users and the social environment [60] [56] [61]. As opposed to cue-filtered-out models that treat communication as cognitive processes, the adaptive view of CMC thinks that CMC for life interaction is more dynamic and more individual-centered. The psychological processes in CMC have more in common with human-to-human interaction than with human-computer interactions that put more emphasis on cognitive processes. In this view, informal interpersonal communication encompasses the holistic effects of technology, communicators, and environment. Social functions of physical appearance, co-presence, and dynamic nonverbal behaviors can also affect and determine the efficiency of communication. Immediacy, composure, receptivity, and social orientation are also important aspects in evaluating communication efficiency. These aspects serve as necessary anchors in the development of conversation [59]. Besides the social dynamics in an online environment interaction, context is also an important component in formulating communication. The interaction often is not the execution of a ready-conceived plan, but the subject's adaptation to context.

Following this more flexible view of CMC, theories and models associated with this perspective focus on how people adapt to the medium's capacity of communication to conduct normal relational communication. Often, the signs that people can use to express themselves through CMC systems have different levels of efficacy and effectiveness in different contexts [36], which include the places in which the communication happens, the person with whom the user is communicating, and the level of interpersonal relationship between these two individuals.

These studies often provide explanations of how people, in different communication contexts, use viable media in CMC to deliver information that is traditionally delivered using nonverbal cues. Whereas face-to-face partners draw on numerous visual, auditory, and verbal cues at their disposal, CMC users readily take advantage of the remaining strategies (e.g. emoticons) for effective interpersonal information acquisition, although it has been reported that it simply takes longer to achieve the same level of content exchange in CMC as in normal face-to-face communication [60] [58].

2.3.3 *Social Information Processing Theory*

Among various adaptive CMC theories, ***the social information processing theory*** is the most developed one [Walther 1992] that established the adaptive nature of CMC systems. The theory studies the adaptation mechanisms people used in a CMC environment [Walther 1992] [62]. At the time it was first introduced, it exhibited a significant departure from other traditional models about CMC communication (namely the cue-filtered-out models). Though the theory grew out of pre-video/photo CMC, it is still useful in understanding the underlying CMC dynamics. It has been tested in various studies [56] [62], and widely used in the literature to explain the adaptive nature of computer mediated communication [63] [61] and social network communication [64] [65] [13].

The social information processing theory articulated hypotheses about the CMC media. It defines the relationships between nonverbal and verbal cue systems and how users adapt to media [66] [62]. It rejects the general view that the absence of nonverbal cues restricts communicators' capability to exchange individual information. It reinforced the notion of cue substitutability, in which nonverbal and verbal cues may comprise equivalent forms of communication.

The overall argument of social information processing theory is that individuals adapt the textual cues of CMC (as well as cues on Social Networking sites) to meet their needs when faced with a communication situation that deprives them of aural and visual cues [56]. It argues that people adapt to the absence of nonverbal cues in the CMC environment for interpersonal communication and employ the verbal characteristics presented in CMC to convey relational information that may normally be transmitted via nonverbal cues in face-to-face contexts. With limited aural and visual cues, people attend to other viable cues to compensate for the lack of traditional cues to meet their needs.

It emphasizes the interchangeability of cues that people use in their communication. It posits that communicators exchange social information through the content, style, and timing of verbal messages online. The model provides an alternative view suggesting that people can adapt their communication and assessment of relational information to the constraints of the text-based channel.

The process of decoding social information from different communication channels has been studied in various settings. Nardi et.al. observed that, when there are established relationships between participants, the so-called "leaner" media such as email and the phone can indeed be very expressive and adequately fulfill the demands of many situations, such as team members working at home [41].

When people communicate in an online community where nonverbal cues are not presented [67] [68], it was also found that they could decode communicators' characteristics through their conversational content, styles of addressing, and other interaction patterns. These studies show that people indeed adapt to the environment in conducting their social interaction. When certain cues couldn't be transferred through the naturally associated communication

channel, people often change their strategies and use other channels to complete the communication.

Walther et. al. have studied affective expression in computer chat systems and face-to-face settings [56] [62]. They found that CMC users achieve interpersonal affect more through their verbal behaviors than face-to-face communicators, who rely to a greater extent to nonverbal cues for affective expression. Verbal cues that were mostly ignored in face-to-face setting show a robust effect in CMC expression.

The study of online impression-making revealed that online users look to small cues in order to develop impressions of others [69], such as a poster's email address, the links on a person's homepage, even the timing of email messages. Hancock et. al. have shown that emotion could be expressed via CMC [61]. Users often develop strategies to adapt their emotional expression to the text-based communication environment. The expressers relied on at least four methods for differentiating between their positive and negative emotional states. The strategies include exaggerating the agreement expression, repetitively expressing affections (for negative affect terms), increasing the use of punctuation (for positive emotion expression), and using speed of response and verbosity in the conversation.

Quercia et. al. studied Facebook popularity and also found that people who are extroversive were able to do what they often do offline - be able to adapt themselves to new forms of communication and present themselves in likeable ways to maintain friendships [64].

Similarly, Xu studied how consumers used personal profile information to establish trust and confidence in reviewers when shopping online [65]. The study investigated number of trusted members (small, large), review valence (positive, negative), and profile picture (with, without). The experiment explores how two personal profile characteristics, reputation cues and

profile pictures, influence trust (both cognitive and affective) towards the reviewers, and consequently the perceived review credibility. The study showed that the presence of a profile can elicit an emotional response, and reputation cues (number of reviewers) elicit the bandwagon effect and result in the perception of collective endorsement. The results proved that trust can be developed purely based on interface cues, which is consistent with the argument made in social information processing theory - online impression formation may not necessarily be determined only by past interactions and time [65].

In another study done by Winter et.al [13], the status updates on social networks were examined. The study investigated who uses the self-presentational opportunities of providing status updates. They related the measurement of users' personality traits (extraversion, narcissism, self-efficacy, need to belong, need for popularity) with the actual use of Facebook status updates. The results support the idea that Facebook users can effectively use this new form of one-to-many communication in a way that is consistent with their personality traits. People who are narcissistic often provided deeper self-disclosures and more self-promotional content, and people who are high in need to belong disclosed more intimate messages. In the absence of face-to-face communication cues, social networking site users can effectively adopt the status updates to suit their personal social needs.

The interchange of various cues in a CMC environment has also been observed in people's lying behaviors [63], expressing emotions [61], and managing impression [70].

2.3.4 *Summary and Implications for the Current Work*

On social network sites such as Facebook, how Facebook users use the site to formulate connections and develop their relationships is of great interest to us. Facebook users can use lightweight interactions such as posting or re-posting articles to make their appearance and make

the other party aware of their passive participation in the social networking. They can also start their interaction with the other party by initiating small interactions, such as "Poke", "Like", "Comment" etc., to express their attention and start the interaction with the other party. They can also be more proactive and approach the other party to chat or message, actions that formally start a one-on-one communication. We believe that Facebook users are flexibly utilizing various communication channels to achieve their social goals by using practices consistent with social information processing theory. In this research, we will explore how people with higher need to belong and people with lower need to belong behave differently in order to satisfy the deprived need to belong. In the following chapters, Social Information Processing theory will inform our hypotheses on how social network users utilize the communication channels that are unique to CMC and social network site.

2.4 CMC'S IMPACT ON SOCIAL INTERACTION

Most communications via Internet are through computer-mediated communication. Instead of face to face communication, people are using various tools (e.g. chat, messaging, post, etc.) to communicate meaning and information. Unlike the literature reviewed in the previous section, the studies reported here focus more on the extended effect of technology use in communication. It is unquestionable that the Internet, technology use, and CMC have changed how we live our lives. This section looks at studies about how CMC impacts the communication and delivery of meaning, and how CMC impacts people's daily life.

2.4.1 *CMC's Impact on the Social Meaning of Interaction*

Researchers in social psychology have studied CMC from a point of view that is different from both social science and computer science. Their consistent interest is to study whether and

how the social meaning of interaction is affected by CMC, specifically the absence of nonverbal cues, when communicators substitute text-based electronic messaging for face-to-face (FTF) encounters.

Early theories held a negative opinion of CMC, and argued that the absence of nonverbal vocal and physical cues hinders users' understanding of the environment and meaning expressed by other communicators. As a result of this absence, communicative exchanges between the communicators becomes less sociable, relational, understandable, and/or effective. Studies are often oriented around the differences in capacities between the face-to-face setting and the computer in various aspects of communication capacity, such as bandwidth, media types, cues delivered, etc. These theories and models share the assumption of a one-to-one correspondence between communicative cues and communicative functions [9] [58] [57]. They posit that the absence of nonverbal cues (including vocal and physical cues) prohibits sharing of important characteristics of interaction, such as communicators' characteristics, emotions, attitudes, environmental context, etc. They also often emphasize the prohibition effect of computer media on communication.

With more understanding of how people communicate through CMC, researchers have started to extend their understanding beyond the "thinness" of certain media. They emphasize more of the adaptation power of humans--that people adapt to the medium by combining verbal messages with contextual and stylistic cues, information about participants' characteristics, attitudes, and emotions, allowing for normal or enhanced relational communication to happen. These studies often provide explanations of how people, in different communication contexts, use media available in CMC to deliver information that is traditionally delivered using nonverbal cues.

For example, Jacobson studied how people form impressions of those with whom they interact in text-based virtual communities [70]. In face-to-face interaction, physical appearance, vocabulary, grammar, other linguistic markers (including tone and accent) and nonverbal cues ordinarily influence the ways people initially form impressions of one another. They found that in the text-based virtual communities of cyberspace, people do develop images of one another despite the paucity of visual and auditory cues. They often base their images of players on stereotypes inferred from the screen name, the way people spoke and acted online, and characteristics of familiar people in reality [70].

Walther et. al. also studied how people form affinity such as immediacy and affectionate communication in CMC [56]. They found that people use significantly more verbal cues, including explicit positive affection, changing the subject, indirect disagreement, praise plus novel proposition, to formulate affinity in a chat system. Other research includes studies that evaluate the usefulness of the current interface design on people's communication. One example is a study of emoticons, which found little impact of emoticons in messages when the verbal conversations are attitudinally rich. The result indicates that emoticons' contributions were outweighed by verbal content, but a negativity effect appeared such that any negative message aspect- verbal or graphic - shifts message interpretation in the direction of the negative element [71].

2.4.2 *CMC's Impact on People's Life*

Starting from the early days (mid-90s) when the Internet become available for people's communication, social scientists have tried to understand what the Internet and CMC mean to people, and whether and how they might affect how we live our life. Differing from the social

psychologists, researchers in sociology focus more on how the technology design affects people's life.

At the beginning of the Internet era, the Internet was seen by researchers in sociology as a brilliant innovation that possessed a great promise to transform human life. The innovation of CMC technologies, such as bulletin boards and online chatting, raised numerous thoughts on how it could affect people's everyday concerns. Researchers and social critics were debating whether the Internet is improving or harming participation in community life and social relationships.

They have recognized the inclusiveness of the Internet and the fact that people are increasingly dependent on it. Internet access has spread globally and across class boundaries. It brings more diverse populations of communicators online [72] [73]. Lots of studies have made important explorations into and observations about cyberspace. Cyberspace was further defined as "incontrovertibly social spaces" in which people still meet face-to-face, but under new definitions of both 'meet' and 'face'. The Internet offered users lots of new opportunities for creating and participating in collective communities and expressing individual identities in their communication [73]. Research has started to seriously think about what the Internet is and how it becomes part of our life.

Some scholars have argued that the Internet could lead to improved social life by enabling people to communicate with others despite the constraints of geography or isolation because of illness or schedule. The Internet could allow people to join groups on the basis of common interests rather than convenience. However, others have pessimistically argued that excessive use of Internet will lead to declining social capital [74], and will decrease participants' communication with family members. It was found that Internet use takes time away from face-

to-face contacts and replaces strong ties with weaker ties [29], which will result in decreases of people's social circles, and increases in their depression and loneliness.

Abundant studies have counted the number of Internet users, compared demographic differences, and learned what basic things people have been doing on the Internet. Gender difference was seen in various uses of Internet--women's use of the Internet differs significantly from that of men. For CMC specifically, women are significantly more likely to look forward to receiving email and use email to maintain close relationships than men. It was found that gender and the roles associated with it will influence the amount and type of internet use, and the satisfaction gained from that use [75].

Another finding is that user strategy is commonly applied to people's selection of media and how to use it [75] [76]. The users and social context influence users' choice of media as well as the goals of the technology adoption. One example is that people often use chat for more intimate interaction and email for lengthy or more official conversations [75]. It was also observed that teenagers often use cell phones not for voice communication only, but to coordinate with their friends via instant messages [76]. Social context, such as time and location, were found to significantly affect how people use communication technologies to fulfill their communication needs. Text messaging is more quiet and convenient than calling. It gives teenagers a way of communicating silently with their intimate friends without disturbing others.

Studies of CMC and the Internet have found that the lines between online and offline communication blur out as people inhabit both the Internet and their real life. The Internet has become embedded in everyday life and is essential for lots of our routine activities. Using the web and communicating with others online are taken for granted [77]. People often adopt Internet and online communication systems to suit their own needs.

One trend in the use of CMC systems is the integration of people's online life and offline activities so that one side of communication is a natural extension of another. CMC are simplified and adjusted for ordinary interactional purposes [77]. The Internet is becoming wires that connect persons for sharing their contacts, networks, institutions, and resources. Research in this area has studied what roles the Internet plays in connecting online and offline communication, and how online interactions resonate with communications in real life. For example, one of the many projects conducted in the Netlab is looking at the kinds of relationships that the internet does (and does not) foster [78] [72].

2.4.3 *Summary and Implication for the Current Work*

CMC affects people's life. The inclusiveness of the Internet and the high dependency people have on it make it part of people's daily lives. CMC presents many new opportunities for interacting and collaborating with others, and expressing individual identities in communication. Gender and roles in communication influence the amount and the type of Internet use and satisfaction gained from that use. It is also found that people can fluently pick different tools for different types of communication. Social context also determines the type of communication channels that people use. Communication nowadays is composed of some traditional communication channels (e.g. face to face, facial expression, etc.), and new ways via technology (e.g. chat, messaging, community post, etc.). It is unequivocally true that the Internet and its technology have changed how we communicate and how the meaning is coded and delivered to other parties. Research has found that users of technology are very innovative and adaptive to the tools that are available to them and use those tools efficiently to deliver meanings. With different communication contexts, participants use media available in CMC to deliver information that is traditionally delivered using nonverbal cues. CMC use in communication demonstrates the

highly adaptive nature of technology use. This type of adaptability also applies to how people use tools that are available to them on social network sites to communicate meaning and build up relationships.

This group of findings is important and relevant to the research questions pursued in this body of work. When we ask whether and how the need to belong affects people's use of a social network site, we hypothesize that individuals will efficiently use the best means to achieve their communication goals. People who have different levels of need to belong will use different parts of social network tools to express themselves and communicate with others. As a result, we expect to see the adaptive nature of social network behaviors exhibited by users that were driven by seeking for need to belong and/or striving to fulfill the deprived need to belong.

2.5 Social Networking Site as a New Form of CMC

Among various computer-mediated communication platforms, Social Network Sites (SNSs) have emerged as the major online communication platform above other older forms of communities (e.g. chat room, online bulletin board, etc.). SNSs has shown wide popularity, highly diversified user groups, and an increasing number of features.

Most apparently, Facebook is currently leading the others in attracting users as well as providing a continuously evolving feature set. It had one billion monthly active users as of 2014. The majority (81%) of them are from outside the U.S. and Canada, and 604 million of them access the site via mobile devices [3]. Given this diversity, Facebook has been the subject of many social networking research studies and has become the major study testbed for social psychology and technology use. Researchers have tried to obtain a good understanding of motives for using the services to understand the intricate mechanisms supporting important aspects of SNSs.

2.5.1 *SNS's Impact on Social Meaning of Interaction*

Social networking sites connect people by providing an infrastructure for their users to share information through media. Facebook, for example, is used for a wide range of purposes, and individuals utilize different networking channels to achieve different goals.

Various studies have researched why and how Facebook users are using the site to achieve their goals [75] [79] [80]. Joinson investigated the uses of Facebook sites and the ultimate gratifications that users derive from those uses [75]. The study first generated 46 use and gratification items from words or phrases people use to describe how they used Facebook and what they enjoyed about their use. Then, 241 Facebook users were asked to rate the use and gratification items on a 7-point Likert scale. The analysis identified seven unique uses and gratifications: social connection, shared identities, content, social investigation, social network surfing, and status updating. It was also found that user demographics, site visit patterns, and use of privacy settings were associated with different motives.

Smock et. al. studied SNSs by reconceptualizing social networking sites as collections of features [79]. Survey data collected from 267 users revealed that users' motivations for using Facebook predict their use of different features, such as status updates and Wall posts. Different motivations for using Facebook predict the use of different features. Motivations for the general use of Facebook differ from motivations for the use of specific features. This analysis shows that granular approaches to studying Facebook use reveal patterns otherwise hidden when only general use is studied.

Gilbert and Karahalio studied the association between tie strength and social media use [81]. A predictive model was created to map social media data to tie strength by utilizing a dataset of over 2,000 social media ties. The model distinguished between strong and weak ties

with over 85% accuracy. This research illustrated how modeling tie strength can improve social media design elements, such as privacy controls, message delivering, building up friend connections and information prioritization.

Past research has also extended our understanding of what role Facebook is playing in people's life, both in formulating social connection and in seeking for useful information. The ability of individuals or groups to access and utilize resources embedded in their social network is often called "social capital" [82] [83]. This is a type of investment of time and effort in social relationships with expected returns in achieving goals in other domains of people's life. Social capital exists in its abstract form - social relationships; however, when needed, it can be converted to other forms of capital. For example, it can be transferred as human capital (such as help or favors), or intellectual capital (such as getting new information) [83].

Papacharissi et. al. researched the salient motives for Facebook use, and how motives and social and psychological antecedents interact with social capital generated on Facebook [80]. Eleven categories of possible Facebook motives were constructed and used: passing time, relaxation, entertainment, information sharing, professional advancement, companionship, social interaction, cool and new technology, self-expression, habit, and escape. They found substantial links between Facebook motives, social and psychological predispositions, and the generation of different forms of social capital.

Lampe et. al. studied 614 staff members at a large university and show how social capital, network characteristics, and use of Facebook are related to how useful individuals find Facebook to be for informational purposes, and their propensity to seek different types of information on the site [84]. They found that bridging social capital (the ability to access non-redundant information and diverse perspectives, typically through weaker ties) and engagement with one's

network through directed communication behaviors (e.g. “when I see someone asking for advice on Facebook, I try to respond”, “when a Facebook friend has a birthday, I try to post something on their wall”) are important predictors of these dimensions of information seeking. In addition, demographics, usage behavior differences, users’ perception of Facebook as appropriate for purposes beyond the purely social and their engagement with their network also affect whether they would engage in information-seeking behaviors on Facebook.

Burke et al. (2010) found that while Facebook use overall was associated with social capital, there was a stronger association between social capital and active contributions to the site (versus passive consumption of others’ information) [85].

Later, Burke, Kraut, et. al examined how Facebook affects social capital depending upon the types of site activities and individual differences among users, including social communication skill and self-esteem [86]. By combining server logs with longitudinal surveys from 415 Facebook users, the study revealed that receiving messages from friends is associated with increases in bridging social capital (resources embedded in the social network), but that other uses are not. Only directed, person-to-person exchanges were shown to be associated with increases in bridging social capital.

Their longitudinal analysis shows that frequent Facebook users tend to be already rich in bonding social capital (reflecting the physical, social, and emotional support that close ties typically provide), and their use of the site does not directly increase the value of those relationships. Facebook is less efficient in strengthening already-strong relationships, but it can be very useful in increasing the value of less strong and nascent relationships, for example using the site to passively consume news can assist people who have lower social fluency to draw value from their connections. This result showed that the site can be designed to promote

different activities to increase social connectedness as well as the value obtained from those connections.

Similarly, Panovich et al. [87] evaluated the role of tie strength in question answers and used the same tie-strength approach to understand the connection between tie strength and information seeking. They found that, while sociological studies have indicated that strong ties are able to provide better information to help people answer questions, weak ties on Facebook do not have the same effect. Participants in their study rated answers from close friends (strong ties) as having contributed more to their overall knowledge. Less close friends (weaker ties) were more likely to provide an answer that participants had already known. Therefore, participants valued answers from closer friends more in general. Both strong and weak ties provided information to help participants in making decisions, though the information is equally from strong tie connections and weak tie connections.

2.5.2 *Diversity of Behavior on Facebook*

Not all sites are the same, and not all users are the same. When the social network sites first came out, their use was often considered to be a monolithic activity. The time the users spent on the site was considered to be equally devoted to social purposes. The activity was also considered to impact users in the same way. In recent years, this claim has been re-examined on Facebook. Researchers had more insights about diversity of behavior on social network sites as well as individual differences among site users [64] [85] [86] [88] [13].

Quercia et al. looked at the association between Facebook popularity and personality [64]. They tested whether popular users who have many social contacts are the ones whose personality traits either predict many offline friends in the real world or predict propensity to maintain superficial relationships. They found that the predictor for number of friends in the real

world is also a predictor for number of Facebook contacts. People who are popular on Facebook tend to have the same personality as people who are popular and have a lot of friends in the real world. This means that extroversion in the offline real world also related to popularity in the online world. No statistical evidence was found to make the connection between people who have many social contacts on Facebook and ones who are skilled at self-monitoring (more prone to pick up on social cues and adjust how they act and how they are perceived by others). In other words, the nature of online interactions does not significantly differ from that of real world interactions. Fundamentally, Facebook may have reconfigured our ways of communicating with each other, but there are equal opportunities for people who possess high or low self-monitoring skills to successfully maintain their online relationships. Though people who are high in self-monitoring automatically have the advantage of adapting themselves to new forms of communication and of presenting themselves in likeable ways–over people who are low in self-monitoring, their self-monitoring skill doesn't directly translate to having more friends, which is more closely related to their extraversion.

Seidman published a study in 2013 that reported that people with different personality traits use social networking sites differently [88]. Among others, the study focused on extroversion, agreeableness, openness, neuroticism, and conscientiousness. All of these traits are related to belongingness and therefore were hypothesized to results in different use of social networking sites.

Extroverts and people who are more agreeable often have more friends and their friendships are often of higher quality than introverts [89]. They are also more likely to have more satisfying romantic relationships than others [90]. Openness is correlated with greater social media use [91]. Neuroticism is associated with several outcomes relating to belongingness

needs, for instance neurotic individuals are less satisfied with romantic partners (White et al., 2004) and more sensitive to rejection. Conscientiousness is positively associated with the overall interpersonal relationships both in quality and quantity [89]. but negatively associated with SNS use [92].

Therefore, the author hypothesized that the personality traits that are pro-belonging would be positively associated with belongingness-related behaviors and motivation. Namely, two types of belongingness-related behaviors were examined: information seeking (use Facebook to learn about others) and communication (use Facebook to communicate with others). The two types of belongingness-related motivations included were acceptance-seeking and connection/caring (connecting with or supporting others).

Data was collected from 184 undergraduates who completed a survey assessing personality and Facebook behaviors and motivations. It was found that high agreeableness and neuroticism had the biggest effect on the use of Facebook to look for information and communicate with others. They were also highly associated with seeking acceptance from others, and connecting with or supporting others. Results suggest that conscientious users of social networking site were very careful about how they were presented in the online world. Neuroticism, agreeableness, and extroversion were positively related to wanting to express one's actual self [88].

Researcher also studied how different social networking site users use status updates to manage their self-presentation [13]. Status updates as a new one-to-many communication model presents an opportunity for presenting the self, and allows users to engage in riskier self-disclosures than other communication channels. Data was collected from 172 users on their

personality traits (extroversion, narcissism, self-efficacy, need to belong, need for popularity) and the actual status updates they made on Facebook.

The actual content, tone, and self-presentational style of the collected status updates were analyzed. Combing with self-reports on users' personality traits collected using a questionnaire, the researchers tested their hypothesis about the relationships between the personality traits and measurements (e.g. the number of posted status updates, depth of self-disclosure, degree of self-promotional content, and degree of mass suitability).

The content analysis of the copied status updates showed that status messages cover a wide variety of topics and often include both personal issues and social life. Results of the analysis showed that people who have a higher degree of narcissism engage in deeper self-disclosure and post more content with a self-promotional nature. Users with higher need to belong include more intimate information in their messages, which can be seen as an attempt to initiate and maintain contacts. This research also found that people with a high need to belong do not seem to take advantage of opportunities of posting status updates. Given that the focus of belongingness is on stable and intimate relationships, it is possible that they'd rather engage in private messages over public postings. Results showed that differences in the frequency and style of these messages can be related to users' personality traits [13].

2.5.3 *Summary and Implication for the Current Work*

Social Network Sites (SNSs) have been established as the major online communication platform, above other online communities (e.g. chat room, online bulletin board, etc.). They are now having the largest number of daily participants and have highly diversified user groups. The sites are providing an increasing number of features to support their users to express themselves and communicate with online and offline friends. Among many, Facebook is the leading

platform for people around world to share ideas and deliver meanings. Because of Facebook's diversity and the use population, the work reported here will use Facebook as the platform for our study. Past research has provided a good understanding of motives for using the services, such as social connections, status updating, etc. It has also been found that people's social media use on Facebook has a close correlation to participants' social ties and is highly dependent on their motivation for obtaining social connections or seeking for useful information [85] [86].

It was also found that the social media use is highly diverse. Close correlations were found between personality and Facebook popularity. Different ways of interacting and communicating with others were also found among different users who have different personality traits, who chose strategies to suit their individual needs.

In this research, we will use Facebook as the platform to understand how Facebook users behave differently when they have different levels of the need to belong. Based on what we've seen in the literature about Facebook regarding motives for using it and the ways people use it, I hypothesize that the users with different levels of need to belong will behave differently. People with a higher need to belong will take on different activities on Facebook from people with a lower need to belong. The findings of this work will contribute to the field's knowledge about motives behind Facebook use, and a deeper understanding of the individuality of Facebook users.

2.6 SUMMARY OF THE CHAPTER

It has become clear that the CMC in general, and particularly social networks, have penetrated into people's everyday life. A wide range of research topics related to social networks has been investigated, which cover the community and social networking phenomena and the mechanisms underlying online community participation.

Among those topics, the need to belong was identified as one of the fundamental needs for human beings [48] [11] that essentially affects how we seek for relationships. Theories in social psychology have sought to understand how the need to belong resonates with the individual's social needs and how individuals try to fulfill their need to belong. Theories developed by researchers in computer-mediated communication fields were formed to uncover how social signals were transferred between individuals, and, when the traditional communication channels became inaccessible, how people reformed the signals in other media to accomplish their communication goals.

The research reported here draws theories from the fields of social psychology, social science, and computer-mediated communication to help us understand how the need to belong plays out in the computer-mediated communication domain - how the need to belong is reflected in people's social life, and if manipulated, how the need to belong affects users' behaviors on social networking.

Chapter 3. RESEARCH QUESTIONS AND METHODS

3.1 INTRODUCTORY COMMENTS

This dissertation examined how online community members with varying degrees of the need to belong participate in community interaction. The assumption of this research is that human beings, as social animals, share the basic need for group interaction and communication, to seek broad associations with others and to seek for depth in relationships. This dissertation explored how online community members conceptualize other people's presence online and accordingly initiate their communication. In particular, this work looks at how people behave and communicate with each other to create and maintain associations.

Because of the vast number of online communities that are available, it is impossible to cover all of them. Rather than studying multiple online communities, this dissertation proposes to select one of the most predominant communities to study typical conceptualization and communication processes shared among its community members. The online community should encompass the typical functions online communities share: posting personal updates, sharing photos, videos, blogs, and user generated content.

Since this research is targeted at general questions commonly shared by online communities, Facebook is best suited as the testbed because of its general usage in making friends and its ubiquity. Facebook is also picked for this study because of its security. It has been the safest networking community of its type, as users can only view the profile and personal information of other users in their network. People who are outside of their network won't be able to access the private information unless being given access by its owner.

Among various computer-mediated communication platforms, Social Network Sites (SNSs) like Facebook have emerged as the major online communication platform over other

older forms of communities (e.g., chat rooms, or online bulletin boards). SNSs have shown wide popularity, highly diversified user groups, and an increasing number of features.

Facebook is currently leading the others in attracting users as well as providing a continuously evolving feature set. It had 1.71 billion monthly active users as of the second quarter of 2016. The majority (81%) of them are from outside the U.S. and Canada, and 604 million of them access the site via mobile devices [3]. Given this diversity, Facebook has been the subject of many social networking research studies and has become the major study bed for social psychology and technology use. Researchers have tried to obtain a good understanding of motives for using the services to understand the mechanisms supporting important aspects of SNSs.

Various studies have researched why and how Facebook users are using the site to achieve their goals [75] [79] [79]. Past research has also extended our understanding of what roles Facebook is playing in people's lives, both in formulating social connection and in seeking for useful information [30] [86] [85] [13] [83] [80] [84].

Not all sites are the same, and not all users are the same. Researchers have had a number of insights about the diversity of behavior on social network sites as well as individual differences among site users [64] [85] [86] [86] [13, 88].

In this work, we will use Facebook as the platform to understand how Facebook users behave differently when they have different levels of the need to belong. Based on what we've seen in the literature about Facebook regarding motives for using it and the ways people use it, I hypothesize that users with different levels of need to belong will behave differently. People with a higher need to belong will take on different activities on Facebook from people with a lower

need to belong. The findings of this work will contribute to the field of knowledge about motives behind Facebook use, and a deeper understanding of the individuality of Facebook users.

This research is composed of four major research questions. Each research question is further decomposed into sub-questions that could be clearly defined and studied by the methods proposed later.

3.2 Research Goals and Questions

The goal of the research here is to understand how the need to belong, as a fundamental human social need, affects people's online behaviors. Since much of people's time is spent engaging in online environments, both social and non-social, this research unfolds the impact of the need to belong on a user's life broadly speaking on a Macro behavior level, so to speak. In addition, this research shows how the need to belong affects users' behavior in seconds or minutes, that is, on a Micro behavior level.

In this body of work, we will investigate how the need to belong impacts people's general online behaviors as well as social online behaviors, which are decomposed in the following four high level research questions.

3.2.1 *Effect of Need to Belong on Social Connections*

RQ1: How does the need to belong affect people's motivation to come online? Do people who have higher or lower need to belong come online more or less?

Social networking sites are often considered as places where people make new friends and connect with their old friends. They are also places where communities are built for members to give updates and organize events. Some social networking sites were reported to make members feel that they belong to the groups. Therefore, it is reasonable for us to ask, to

what extent are social networking sites helping people to achieve their social goals and satisfy their belongingness needs? To answer this question, we hypothesize that:

Hypothesis 1: People who have a higher need to belong have more connections on a social site than people who have a lower need to belong.

Hypothesis 2: People who have a higher need to belong come to a social site more often than people who have a lower need to belong.

3.2.2 *Effect of need to belong on social behaviors*

RQ2: How does the need to belong affect people's social behavior online? Do people who participate more online have higher or lower need to belong?

Since one of the claimed goals for coming to such social networking sites is to join a community and make friends, it is important and interesting to understand whether people with different levels of need to belong have different motives or use the site differently. This second research question is concerned with the relationship between people's need to belong, on the one hand, and site motives and uses on Facebook.

Hypothesis 3: People who have a higher need to belong post a status update more often than people who have a lower need to belong.

Hypothesis 4: People who have a higher need to belong broadcast messages more often than people who have a lower need to belong.

Hypothesis 5: People who have a higher need to belong respond to other's posts or comments more often than people who have a lower need to belong.

Hypothesis 6: People who have a higher need to belong share or reshare more often than people who have a lower need to belong.

Hypothesis 7: People who have a higher need to belong like posts more often than people who have a lower need to belong.

Hypothesis 8: People who have a higher need to belong stay on a social site longer than people who have a lower need to belong.

Hypothesis 9: People who have a higher need to belong have different motives as people who have a lower need to belong.

Hypothesis 10: People who have a higher need to belong have higher levels of concerns about privacy than people who have a lower need to belong.

3.2.3 *Effect of Need to Belong on Social Information Processing*

RQ3: How does the need to belong affect people's social information processing, when the need is threatened?

Do people who were primed with different levels of need to belong spend attention differently on a social networking page? Do people who were primed with different levels of need to belong remember the information differently? How do people scan, select, and parse the elements on Facebook page?

Past research has shown that people's need to belong can affect their ability to attend to social information. Baumeister and Leary [11] in their landmark paper argued that an individual's deprived need to belong would result in increased focus on social connections and relationships. Gardner et al.'s studies found that unmet belongingness need is associated with better memory for interpersonal and social events, greater attention to and processing of vocal tone in speech, greater accuracy in identifying emotions in faces, and more accuracy in understanding others' thoughts and feeling [20, 21].

Individuals tend to be sensitive to the feelings and thinking of others in order to successfully establish and maintain social relationships. Individuals who are high in the need to belong tend to have higher concerns regarding social connectedness, therefore they are more attentive to and precise in interpreting and decoding social signals. To understand how this phenomenon exposes itself on social networking sites, our third research question is concerned with how much the need to belong helps or hinders how people process social information online.

Hypothesis 11: People who were primed with need to belong are more likely to scan the designed Facebook page (with shorter fixations) than to read the content carefully (with longer fixations).

Hypothesis 12: People who were primed with need to belong pay different attention to social information (e.g., people's posts) and objective content (e.g., company's posts or ads) than people who were not primed.

Hypothesis 13: People who were primed with need to belong pay different attention to the content itself (e.g., the core social posts) and the social interaction (e.g., the replies) than people who were not primed.

Hypothesis 14: People who were primed with need to belong pay different attention to the posts made by the main contributor and the posts made by others than people who were not primed.

Hypothesis 15: People who were primed with need to belong pay different attention on visual posts and textual posts than people who were not primed.

Hypothesis 16: People who were primed with need to belong remember more content from the designed Facebook page than people who were not primed.

Hypothesis 17: People who were primed with need to belong remember more people from the designed Facebook page than people who were not primed.

Hypothesis 18: People who were primed with need to belong are more likely to talk about themselves in a future encounter than people who were not primed.

3.2.4 *Effect of Need to Belong on Cognitive Behaviors*

RQ4: How does the need to belong, when it is threatened, affect people's cognitive skills in conducting online searches?

Some evidence has been seen in the past that suggests that an increase in cognition spent on social connections means a decrease in cognition spent on other domains. While belongingness-primed users may be more sensitive to social information, belongingness deprivation could result in suffering cognitive impairments in processing non-social and complex stimuli [11]. The hypothesis was that belongingness threats may tax cognitive resources. Baumeister, Twenge, & Nuss found that significant and large decreases in IQ and Graduate Record Examination test performance were found among people who received cues that they would end up alone in the future [22]. So far, this effect was seen only when users were completing complex cognitive tasks such as performing effortful logic, where reasoning was affected. In this research, we are extending this question to the online search domain to see if belongingness deprivation will result in less efficient online search.

Hypothesis 19: People who were primed with need to belong read more search results to find the right answers than people who were not primed.

Hypothesis 20: People who were primed with need to belong spend more time finding answers for search tasks than people who were not primed.

Hypothesis 21: People who were primed with need to belong apply different scanning strategy to find answers for search tasks than people who were not primed.

In the following sections, we discuss the methods we chose to investigate these research questions.

3.3 Using a Survey to Measure Macro Behaviors

We want to explore questions about how the need to belong affects people's motivation to come online, what they actually do on social networking sites, as well as how they process social information. When social networking participants engage with social networking sites, they spend a fair amount of time consuming social information. The consumption of social information is often driven by a broad interest to browse, rather than by a goal-driven task or a specific need. As a result, the actual action to read, digest, and follow up on social information is often brief. Fifteen minutes of browsing a Facebook site may be composed of reading and glimpsing a long Facebook stream which may contain more than 20 individual posts. To reveal the impact of different levels of need to belong on users' overall behavior, as described in RQ1 above, we chose to step back and measure the social information engagement in an aggregated manner. We investigate the broad contours of behavior over relatively longer periods (e.g., habits, or profile of typical sessions). The measurement is done at scale where data is collected from a large number of participants, which we refer to as measurement on a macro level.

In summary, to understand the impact of need to belong on general social information consumption and engagement, we conducted a survey to measure aggregated actions lasting for longer periods of time.

3.3.1 *Survey Methodology*

A survey is a simple tool for gathering information, and can be an extremely effective way to gather information from a large sample in a relatively short period of time. The survey is often used by researchers in HCI to collect users' feedback about specific aspects of system use, for example to examine reported patterns of usage for established technologies [57].

In general, a survey can provide researchers a broad range of feedback. It can be used to collect users' subjective opinions of their needs, as well as their experience of interacting and communicating on the Internet. Online surveys are commonly used by user experience researchers, marketing researchers, product managers and others to gather feedback. Using surveys, researchers can easily assess a participant's preferences, attitudes, characteristics and opinions on a given topic.

Surveys conducted via email and the World Wide Web are the easiest way to gather input from a large number of people in a fairly short period of time at a very low cost. Date collected via email or on the web can be immediately accessed and transferred into a database for further analysis. The data are also easy to analyze.

As a research method, surveys allow us to quantify concepts using a sample or subset of the broader audience. The findings from the sample or the small subset of users can be generalized and applied to the broader population.

Surveys have been used in a lot of domains to gather information and answer research questions. In recent years, the survey has become a common tool to study behaviors and attitudes in digital space. It is an effective method to understand who your users are, what your users want, what they use or do, where they go, what they own, and what they think of a product. Here are some examples where survey can be an effective tool:

- Collecting feedback on a live product or during a pilot;
- Exploring the reasons people visit a website and assessing their experience of that visit (such as a True Intent survey);
- Quantifying results from qualitative research activities such as contextual enquiry or interviews; and
- Evaluating usability, such as the System Usability Scale.

3.3.2 *Using Surveys to Understand Social Behaviors*

In this study, we chose to use a survey to collect measurements about people's social involvement in a social networking site, including their active and passive participation on the site with other members of the site. This survey took the format of an online questionnaire to explore aspects of the users' experience. The goal was to understand whether people with different levels of need to belong have different motives and use the site differently. The survey questions asked participants about their past experience in using social networking sites. The aspects included looked at:

- Frequency of coming online
- Frequency of posting a status update
- Frequency of broadcasting messages
- Frequency of responding to other's posts or comments
- Frequency of sharing or resharing posts
- Frequency of liking
- Intensity of participating in social networking activities
- Number of online contacts
- Length of time staying on a social site

- Motivation
- Levels of concerns about privacy

3.3.3 *Summary of the Section*

The first research methodology that we are going to apply in the following study is a survey. Surveys allow us to understand people's social behaviors at large. We will administer the survey to members of the general public who have participated in social networking sites. By collecting information about their social motives, social activities, as well as demographics, we will be able to analyze the relationships between their social motive on the need to belong scale and their behaviors on social networking sites.

3.4 USING EYE TRACKING TO MEASURE MICRO BEHAVIORS

Eye tracking is a technology that monitors people's eye movements. The measurement can be used as a means to detect abnormalities or to study how people interact with text or online documents. Eye tracking is the measurement of eye activity that is often hard to access and measure. Nielson & Pernice have put it in a very simple way: "Eye tracking is simply following the trail of where a person is looking" [93].

Eye tracking reveals the place where we look, the object that we ignore, the event that makes us blink. Eye tracking can help us understand when and how different stimuli lead to pupil reaction. Even though the concept of eye tracking is easy to understand, the process and interpretation can be quite complex.

In this body of work, we investigate the detailed process that online community participants use to seek group affiliation and group intimacy. Because these interactions often

happen privately, it's hard to obtain a clear picture of what actually happened at the time they initiated the interaction.

In this study, users perform several typical social tasks related to need for group affiliation and group intimacy. Their eye movement is recorded to reveal the sequence of attention. Finer-grained questions about how people process the information presented in an online community (specifically here, RQ2-RQ4) can be addressed based on the quantitative information from task performance steps and steps of eye movement.

3.4.1 *Eye Tracking Technology*

Eye tracking data is collected using either a remote or head-mounted 'eye tracker' connected to a computer. In the old days, eye tracking was implemented by tortuous means, such as physically gluing something to a test subject's eye balls. In the past 10 years, the eye tracking technology has been greatly improved - the devices have become much less intrusive.

There are many different types of non-intrusive eye trackers. Most eye tracking technology works on the same basic principle, which includes two common components: a light source and a video camera that focuses on a person's eye. The light source (usually infrared) is directed toward the eye. The video camera records the interaction and tracks the reflection of the light source along with visible ocular features such as the pupil. The light, along with some back-end analysis, helps deduce in which direction the person is looking.

The camera that tracks users' eyes shoots a light into the eyes to bounce a beam of invisible infrared light off the users' face. The wavelength of light is reflected differently by the retina in the users' eye than the rest of the eye. The retina in the users' eye absorbs visible light and reflects infrared light. This allows the eye tracker to identify the position of the pupils. The light reflection recorded by the video camera in turn gives the eye tracker a sense of how the eye

is turning within the socket. This data is used to extrapolate the rotation of the eye and ultimately the direction of gaze. Additional information such as blink frequency and changes in pupil diameter are also detected by the eye tracker [94].

Besides knowing how the eye is turning in responding to different stimuli, the eye tracking device also need to calculate where the person is looking by calculating where the head is. The very first eye tracker that was invented in 1980s used a very intrusive approach by strapping participants' head into a fixed position. Even though it provides reliable data about where the user's head is, the approach results a very unpleasant experience for test participants.

In the 2000s, the eye tracker began to adopt two camera models where one video camera is looking at the user's head and calculating the head's position in real time and the other video camera is focusing on the users' eye to capture the light reflected from the eye. The camera that is used to track the users' eye tracks where the user is looking by averaging the calculations for the two eyes.

Eye tracking devices have been proved useful to study how people consume information and how their behaviors are affected by interface design [93] [95]. Users' eye movements as well as their behaviors are recorded in lab experiments. Their sequence of interaction (steps that they go through) and the objects that they've paid attention to (eye fixation and sequences of fixation they go through) are often analyzed to show how they go through the information.

Eye Tracking technology has been used in the field of human-computer interaction to understand human behaviors, enable hands-free interaction, and create new user experiences and humanized user interfaces. Researchers are using eye tracking to understand how the human brain accumulates impressions through human vision. With the ability to observe a user's gaze, it

makes it possible to gain deep insights into the person's attention and understand various driving factors behind human behavior and actions [96].

Eye tracking can also be used to in a hands-busy circumstance to enable user interaction. By using the eyes as an input source, users can point to objects on a computer screen. A computer that is facilitated by eye tracking can greatly help users to use the computer when the user cannot or does not wish to use hands as the input form.

Eye tracking can also be used to innovate and create new user experiences. By combining eye tracking with other input modalities, for example keyboard, touchpad and voice commands, the field of multimodal computing has created different prototypes to allow users to interact with the computer in a more natural way [97] [Eichler [98]. New and innovative interfaces were also created to facilitate consumer devices with more intuitive, natural, engaging and efficient interfaces than conventional user interfaces.

3.4.2 *Mind-Eye Hypothesis*

One of the premises of using eye tracking to understand users' behaviors is based on a hypothesis: what people are looking at and what they are thinking about tend to be the same. This hypothesis is often called mind-eye hypothesis. This means that knowing where people look can tell us something about their behavior. This establishes the ground for researchers to investigate where users' attentions are and how the human brain and behavior works.

The mind-eye hypothesis is very powerful in allowing us to use eye tracking to tell us what users pay attention to on visual objects, including web pages. People often look at the same thing that they are thinking about while they are engaged in consuming the media objects being presented to them. When we look at the data collected by an eye tracker, we often consider that fixations equal attention: people fixate on the visual objects that they concerned about, and the

more they look at something, the more attention they pay to the object, and the more they think about it.

3.4.3 *Key Eye Movement Elements*

Using Eye Tracking technology to understand where people are looking requires that we distinguish foveal vision, which is a small central area with high resolution, and peripheral vision, which covers the vast majority of the visual field with fuzzy resolution. The foveal vision only covers about 2 degrees of the visual field - about the size of a thumbnail at arm's length or one to two words on a computer screen under most viewing conditions [93].

3.4.4 *Fixations and Saccades*

When a person's eye moves across the items of interest, the eye's multiple observations don't happen as one smooth panning movement. Instead, the eye moves in the style of glides and pauses between each movement.

When the eye is pausing on something, it is called a fixation. Fixations usually happen very fast, and last between one-tenth and one-half second. These fast and short fixations are often seen when a user is consuming stimuli that has strong visual changes, such as video game. When a user is reading a text heavy content, such as text on a book or on a website, their fixations tend to be longer.

When the eye moves rapidly from one fixation to the next fixation, the movement is called a saccade. When the eye moves very fast, each saccade lasts only between one-hundredth and one-tenth of a second. During a saccade, because the optical image on the retina is very blurred during these fast movements, the eye is effectively blind when it is not focusing on any

solid object. In short, our eye doesn't see anything when it is moving across, and can only see things when it is holding still in a fixation.

3.4.5 *Heatmaps and Gaze Plots*

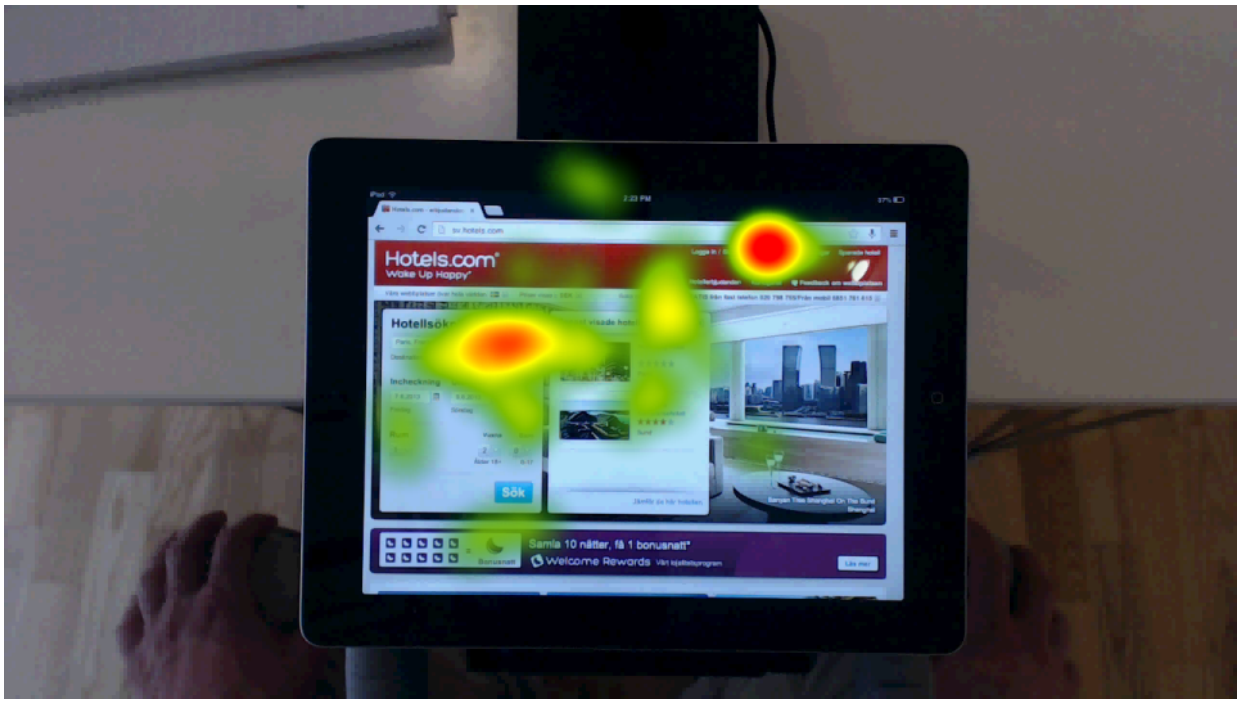


Figure 3.1 An Example of an Eye Tracking Heatmap

Heat maps are the most commonly known visualization format for eye tracking results [99]. In a typical heat map, a screenshot is displayed as a background. Users' fixations (often in aggregation) are displayed as color-coded circles that are an overlay above the background image. The size of the circle often indicates the length of the time that was spent on a particular area. The red areas are the visual objects that attracted most attention, and the yellow areas are the places that attracted less attention. The blue areas indicate the least-viewed areas. When an area is not covered by any colored circle, this means the user has never fixated on that area - meaning that it didn't attract any of user's attention (see the above Figure for an example).

The heatmap can be generated based on the aggregated fixations from one user over time, or the combined fixations of many users on a page. The size of the circle indicates the strength of the attention, which can either represented using the number of fixations or the duration of fixations. Even though these two measures are different, in reality, they are often highly correlated. Longer duration of fixations is composed of a larger number of fixations that cluster around the same area. The most commonly used metric for generating a heatmap is the fixation duration, which can be interpreted as the amount of attention allocated to each part of a visual area.

The heatmap is useful to show aggregated attention across multiple users. It is important to obtain the aggregated view in order to eliminate individual differences. Besides the distribution of attention that different areas of stimuli generate, researchers are also often interested in the sequence of how each user (or multiple users) digest a visual stimulus (e.g. watching a video, reading a book, browsing a webpage, etc.)

The sequence of users' fixations can be visualized using a gaze plot. It is also started with a background image of the visual stimuli. On the image, there are a series of blue dots (order sort in number) indicating each single fixation (see Figure 3.2). Similar to the heatmap, the size of the dots represents the duration of a fixation. The bigger the dot is, the longer is the fixation. The numbers on the dots indicate the sequence of fixations where number one is the first fixation. The object that is beneath the first fixation is the object that the user looked at first when visiting the page.

Figure 3.2 A Gaze Plot on a Food Package

All the fixations on the page are linked with thin lines. These thin lines represent saccades indicating the eye moved from one foveal point to another foveal point. The area that the line is crossing indicates the area where the user's eye glided through without paying any attention - didn't look at the element at all. The gaze plot is useful to show the order of fixations, especially in the first few seconds when the user starts to respond to the visual stimuli.

3.4.6 *Using Eye Tracking to Understand Social Behaviors*

In this work, we are going to investigate how the deprivation of need to belong affects individual ability to process social information and to solve cognitively challenging tasks. Two separate tasks will be administered to observe the effects on these two very different skills. First, we are going to ask participants to consume an experimental social networking page in order to

get familiar with people in that social group. Eye tracking will be administered to track their natural eye scan pattern.

Second, we are going to take web search as an example of information processing tasks that often require applying intensive cogntive skills. Web search is a common cognitive task people do online. When doing a web search, the searcher is trying to accomplish a reading comprehension task in reading the text, parsing the meaning behind the title and snippets, and judging the relevancy of individual results. We chose the web search task because the nature of this task requires that users cognitively process the textual information.

In the study, we will use the following measurements to understand what aspect of web browsing behaviors are affected by the deprivation of need to belong:

- The total fixation duration on the page
- Attention spent on social vs. non-social information
- Attention spend on posts versus replies
- Attention spend on posts made by the main contributor versus other members
- Amount of information retained after completing the task
- Amount of posts remembered
- Amount of people recalled
- Degree of willingness to write about oneself
- Number of results looked at
- Number of fixations on each search result

3.4.7 *Summary of the Section*

The second research methodology that we are going to apply in the following study is eye tracking, which monitors people's eye movements. The eye tracking allows us to observe

people's behavior at a micro level as a matter of seconds. We will administrate the eye tracking technique to collect users' eye movement in 1) browsing and digesting a carefully crafted social message page, and 2) solving search browsing tasks that utilize participants' cognition. The analysis of eye tracking data will help us understand where people are looking, how long they look at certain visual target, and their overall ordered scan path on the whole page.

3.5 RETROSPECTIVE THINK ALOUD PROTOCOL

Thinking aloud (TA) is a usability evaluation method used to gain insight into how people work with a product or interface. In the classic TA approach, subjects verbalize their thoughts and actions as they work. In this work, we will validate the retrospective think aloud method, and collect users' verbal accounts of how they use Social Networking site to make friends and maintain their relationships.

3.5.1 *Think Aloud Protocol*

Following the appearance of Ericsson & Simon's milestone work [100], this method became widely used in cognitive science and human-computer interaction (HCI). In HCI, the concurrent form of thinking aloud (CTA) has been widely used to study various materials from webpages [101] [102] [103] to end-user products [104] [105], and in various settings from the laboratory [106] [107] to the field [108]. As Jakob Nielsen commented, "think aloud may be the single most valuable usability engineering method" [109].

There are different think aloud approaches that are widely used in the field of user experience research. In concurrent think aloud (CTA), users work on typical tasks and at the same time verbalize what they are thinking and doing. However useful the CTA approach is, certain questions have been raised about its validity. First, the act of speaking concurrently may

have a negative effect on users' task performance. Second, the effort that users make to verbalize information while performing tasks might distract subjects' attention and concentration. Third, the effort to fully verbalize the steps in the work might change the ways that users attend to the task components [110] [111] [112, 113].

As opposed to the *concurrent* think aloud approach, the *retrospective* think aloud (RTA) method asks users first to complete the tasks and only afterward to verbalize their process. The use of RTA can avoid possible negative effects that the concurrent think aloud approach has. The retrospective think aloud approach is also sometimes called post-task testing [114], retrospective protocol [115], retrospective report [116], think after [110], etc.

3.5.2 *Study of Retrospective Think Aloud Protocol*

RTA has been widely used, and people believe that it provides valuable data; however, there has been little work done to confirm the validity and reliability of RTA. Most of the research to date on RTA has focused on comparing this method to other methods (e.g., CTA) in specific task domains [117] [110] [116] [118] [115] [114] [119]. These comparisons were based on user testing rather than experimental study, which undermines the validity and generalizability of the conclusions drawn [120].

No research has scientifically studied the validity of RTA based on its most fundamental claim—that in RTA people talk about what they really did in terms of their actual mental processes or performance. Thus the validity of RTA in usability research has needed serious investigation. This work is also needed to support our use of this approach to understand the impact of need to belong on people's social and cognitive behaviors.

In this work, we investigate the validity of retrospective think aloud with the following hypotheses:

Hypothesis 22: People's recounting of what went on in their task performance in a stimulated RTA describes the same sequence of objects in the same order that the subject attended to in the original task performance.

Hypothesis 23: The validity defined in hypothesis 22 is not affected by the task complexity, which is defined in terms of visual information processing complexity.

We also looked at two more exploratory questions:

Question 1: *Besides a record of the items attended to in the order they were considered, what other types of information does stimulated RTA provide and in what format?*

Question 2: *What is NOT in the stimulated RTA?—What features of the task performance are not reported?*

We present an experimental study with three main goals: (1) to assess the validity of RTA (whether people's report of what they did truly follows their original task performance), (2) to evaluate the impact of task complexity on the validity of the RTA, and (3) to characterize what other information the RTA provides beyond the basic record of task performance. This study also provides us with a good understanding of the limits of the method and the right way to interpret and use the user accounts collected via retrospective think aloud.

After we establish the validity of retrospective think aloud, we use this approach to complement our eye tracking study to understand what users were thinking about while they were completing their tasks. Examples of questions that we will ask in the retrospective think aloud phase (after the eye tracking process itself) include:

- Please describe your thought process.
- What are you thinking now?

- Why did you do that?
- Did you notice anything on this page that helped you complete your tasks?

3.5.3 *Summary of the Section*

Researchers have been using retrospective think aloud protocol to collect user accounts of their thought process after they complete the tasks in their hand. The goal is to avoid the impact of think aloud on the actual task performance. Unfortunately, the validity of this approach was undefined. In this body of work, we first conduct a study to establish the validity of this approach. With confidence in the validity of retrospective think aloud data, we then applied this approach to complement the eye tracking study to understand how people process social information after they complete relevant social tasks. Participants' verbal accounts collected via retrospective think aloud will help us understand why they focus on certain social features on the page (which will be revealed in eye tracking data), and how they thought about the social stimulus presented on a social networking page.

3.6 TOOLS TO RESEARCH NEED TO BELONG

3.6.1 *Need to Belong Scale*

After the need to belong was identified as one of the most fundamental human motives, abundant research has been done to identify this motive and understand the mechanisms and consequences resulting from this motive. Every study that investigates the mechanisms and effects of need to belong needs to start with measuring this particular motive.

Leary, et al has established a valid 10-item need to belong (NTB) scale for researchers to use in their studies [121]. The scale is reported to demonstrate adequate reliability, with

Cronbach's alpha being 0.83 in Pickett, Gardner, and Knowles [21], who used the Need to Belong scale in a study of sensitivity to social cues.

Subsequently in 2013, Leary et al. officially published the scale in their work around measuring individual differences in the need to belong. Studies reported in that work officially examined the construct validity of the Need to Belong Scale [122]. The desire for acceptance and belonging were found to be correlated with, but distinct from, extraversion and affiliation motivation that involve a desire for social contact. In addition, need to belong scores were not related to insecure attachment or unfulfilled needs for acceptance.

Positive correlation was found between need to belong and extraversion, agreeableness, and neuroticism (often seen as anxiety, moodiness, worry, frustration, and loneliness). Consistent with what was reported in the literature, need to belong was associated with emotional reactions to rejection, values involving interpersonal relationships, and subclinical manifestations of certain personality disorders.

In a similar effort, Nichols et al studied the use of one single question to measure the need to belong [123]. The goal was to provide researchers with a way to measure the need to belong motive when the research setting may not afford researchers the luxury of including a 10-item questionnaire. Their work examined the psychometric properties of a single-item need to belong scale by examining concurrent and construct validity. The single item need to belong is ''I have a strong need to belong.'' Their studies showed good reliability and validity of the single item need to belong measure for its use and utility in future research.

Since the need to belong motive came to researchers' attention, numerous studies have used this 10 item scale to measure the degree of need to belong. Loveland, et. al. instructed their participants to complete this 10 item need to belong scale to study how participants for whom the

need to belong is an active goal experience a significantly stronger preference for nostalgic products than do participants for whom this is not an active goal [124]. Ho et al. used the same 10 item need to belong scale to study Internet users' motivations to pass along online content and the relationship between 4 identified motivations and the frequency of passing along online content [125].

In this dissertation, we follow the common practice and assess participants' need to belong using the 10-item need to belong scale [121] [122]. The 10 items in the scale assess the degree to which respondents desire to be accepted by other people, seek opportunities to belong to social groups, and react negatively when they are shunned, rejected, or ostracized.

More specifically, the questions were framed around how an individual feels or responds if he or she is accepted or rejected. For example, a rejection question could be "If other people don't seem to accept me, I don't let it bother me," and "My feelings are easily hurt when I feel that others do not accept me." Items can be measured on a 5-point scale [121] [123], a 9-point scale [126], or a 11-point scale [32]. The most commonly used measure is a 5-point scale ranging from 1 (strongly disagree) to 5 (strongly agree), and we chose it for the scale to be used in this study.

Out of ten questions, seven of them are concerned with rejection, such as "My feelings are easily hurt when I feel that others do not accept me." and "I try hard not to do things that will make other people avoid or reject me." The higher the score, the stronger is the need to belong.

Three questions are worded oppositely and express fewer concerns around the need to belong, such as "If other people don't seem to accept me, I don't let it bother me." and "Being apart from my friends for long periods of time does not bother me." The higher the score is to those questions, the weaker is the need to belong. For example, if an individual strongly agrees

with “If other people don’t seem to accept me, I don’t let it bother me,” this individual has a lower need to belong. These three items are reverse scored (e.g. a score of 3 of moderately agree will be reverse scored to 5-3=2).

A total score is derived by adding the responses. A high total score reflects a greater need to belong.

Table 3.1 Need to Belong Scale

Need to Belong Scale

(Leary, Kelly, Cottrell, & Schreindorfer, 2005)

Instructions: For each of the statements below, indicate the degree to which you agree or disagree with the statement by writing a number in the space beside the question using the scale below:

1 = Strongly disagree

2 = Moderately disagree

3 = Neither agree nor disagree

4 = Moderately agree

5 = Strongly agree

_____ 1. If other people don't seem to accept me, I don't let it bother me.

_____ 2. I try hard not to do things that will make other people avoid or reject me.

_____ 3. I seldom worry about whether other people care about me.

_____ 4. I need to feel that there are people I can turn to in times of need.

_____ 5. I want other people to accept me.

_____ 6. I do not like being alone.

_____ 7. Being apart from my friends for long periods of time does not bother me.

_____ 8. I have a strong need to belong.

_____ 9. It bothers me a great deal when I am not included in other people's plans.

____ 10. My feelings are easily hurt when I feel that others do not accept me.

3.6.2 *Need to Belong Manipulation*

In experimental studies, there are various ways to create an illusion and feeling of being rejected or left out. Some studies employ explicit threats to belongingness which in turn trigger users to apply strategies to enhance an individual's sense of social connection. One way is to provide bogus feedback and false impressions to participants that their personality type is likely to lead to social isolation and loneliness [51] [127] [22].

Twenge et al used this approach to manipulate users' sense of belonging and feeling of rejection by giving participants false feedback of a future alone (instead of feedback of future acceptance) [54]. Participants were told that they would end up alone later in life or that other participants had rejected them. When the participants were provoked by receiving this type of negative evaluation from a confederate, rejected participants demonstrated more aggressive behaviors. In their experiments, excluded participants' aggressive behaviors include issuing a more negative job evaluation against someone who had insulted them, or blasting a target with higher levels of aversive noise both when the target had insulted them and when the target was a neutral person and no interaction had occurred. The use of these instruments resulted in findings that indicate need to belong resulted in changes in information processing.

Some studies have participants provide autobiographical accounts of instances in which belongingness is threatened [128].

Another common way to threaten the need to belong is by engaging participants in activities that create a sense of rejection. Participants can be ostracized through engaging in a group-based online game. The common tool that was used to reject or ostracize participants was the Cyberball online game. The Cyberball computer program was created to simulate social rejection in order to inflate the need to belong.

Cyberball is a virtual ball-tossing game involving three other (nonexistent) participants located in different laboratories across campus [129]. In a Cyberball game, participants are randomly assigned to be included by none, one, two, or all three of the other players in the ball-toss game. Taking a four-player game as an example, all participants receive an initial toss from each of the other three players at the beginning of the game. Then they received tosses from the ‘‘other players’’ in accordance with their condition. For a player who is assigned in the ‘‘included by three’’ condition, he or she would receive the ball from all three of the other players. For a player who is assigned in the “excluded by three” condition, he or she will be excluded from all tossing activities and receive no ball throughout the game. In total, there were 30 ball tosses happening throughout the game.

The Cyberball program allows researchers to control the level to which participants are included or excluded by predetermining the percentage of tosses that will be thrown to a participant [28, 130].

The Cyberball game has been used extensively to study social rejection [131] [28]. Ko reported that after being left out of a ball-toss game, participants increased their use of the word *we*, implying that a brief instance of social rejection motivated participants to include the self in part of a larger social whole [131].

Jamieson et al [132] used the Cyberball game to study the role of "need threat" in producing motivation after ostracism (which often threatens fundamental needs to belong, self-esteem, control, and meaningful existence). They found that "ostracized" participants who don't consider a "cognitive ability" performance socially relevant perform worse than "included" participants. When "rejected" participants do think the cognitive-ability performance is socially relevant, they perform better than "included" participants. This study showed that rejected participants could be motivated to elevate their inclusionary status by performing better on socially relevant cognitive ability tasks.

DeWall et al also studied the rejection-aggression link by stimulating social rejection through the Cyberball game [133]. Participants played the game with different numbers of virtual players (0, 1, 2, 3). The study found that the degree of pain from social rejection could vary by simply changing the number of players in the game (the more players in the game, the stronger the pain of social rejection). Aggression and unpleasant emotions triggered by social-rejection pain can be numbed by acceptance from others with decreased impact for each additional acceptor.

To investigate how different levels of need to belong affect people's social behavior, we administered this Cyberball game to our participants. Following the common practice of setting up the Cyberball game, we framed the game as a way for participants to engage mental visualization processes. Participants were instructed to play Cyberball [130] with three "players from other game rooms" (actually the computer) and to visualize playing the ball toss with the other players.

Participants could throw to whomever they wished, and they believed the other "players" could do so as well. Participants who were assigned in the rejection condition received two

throws at the beginning of the game, after which the other "players" who were actually programmed by the computer stopped throwing balls to the participant. In the inclusion condition, participants received the ball for approximately one fourth of the total tosses. After the task was explained, the participant could start the game when he or she was ready. The program terminated after 20 throws. After the game ended, the participants immediately moved on to complete tasks that asked them to consume and digest information posted on social networking pages.

3.7 Site Selection and Participants

The object of study in this body of work is behavior on a social networking site. There are a good number of options that can be chosen to study the social interaction and dynamics of people's participation on social networking sites. In this section, we describe what we chose as our testbed social networking site, and how we recruited participants for each individual study.

3.7.1 *Site Selection*

This work investigates how the need to belong plays a role in a social setting. There are now a variety of forms of online community that provide an online social setting since online communication has become a norm. The online community has evolved from chat room and online bulletin board to social networking sites. The latter have gained wide popularity, attracted diversified user groups, developed many advanced features, and been augmented with rich media. The social networking site has become the place where people come together to share diverse information and form collaborations.

The most common online communities, e.g. Facebook or MySpace, often allow users to register and create profiles about themselves, upload photos, keep in touch with friends, and

make new friends. The most widely known online communities in early days include MyCyberSpace.com, Xanga, LiveJournal, Facebook, and MySpace. The commonality among these communities is to provide users a chance to create a profile that provides information regarding their interests, personality, relationship status, occupation, and much more. Each one offers a slightly different focus. For example, the primary focus of LiveJournal is to support people for blogging. Facebook was originally open to college and high school students with an email address associated with a registered school, before it began to accept registration from the general public. MySpace uses music to associate people together and allow fans, artists, and producers an avenue to find one another.

Among all the social networking sites that currently exist online, Facebook is the leading platform, having obtained more than one billion monthly active users worldwide. Given this diversity, Facebook has surpassed MySpace, Twitter, and other social networking sites to be the most used testbed for various social networking research studies [134] [7] [30, 83].

Researchers often use Facebook to test social psychology theories, as well as to study the usage and adoption of socially enhanced technologies. In the section "Social Networking Site as a New Form of CMC" in Chapter two, we've reviewed studies done on Facebook looking at its usage, user group characteristics, and its social effect. These studies extended our understanding of what role Facebook is playing in people's life, both in formulating social connection and in seeking for useful information.

In this work, we chose to select Facebook as the platform for us to test our hypotheses about the relationships between the need to belong and users' online social behaviors in a social networking setting. This work will help us understand how Facebook users behave differently when they have different levels of the need to belong.

3.7.2 *Participants and Recruiting*

Participants who joined in the studies reported here were recruited through a mix of several recruitment channels. The recruitment channels were chosen based on the nature of the study and the availability of participant pools. All recruiting strategies and instruments were approved by the University of Washington Institutional Review Board (IRB).

The first study reported in this dissertation investigates hypotheses on the overall correlation between participants' level of need to belong and their social activity levels on social networking sites. We approached this question by conducting a survey with participants from the social networking site.

To answer the research question with a decent level of generalizability, the survey requires a substantial number of participants from the bigger population on the social networking site. To approach this population, we recruited participants of Facebook site through various social networking channels, which included posting study announcements on Facebook, through a university mailing list and through professional mailing lists (e.g. chi-web@ mailinglist, etc.), as well as word of mouth. In order to get more responses, participants were then asked to send the survey link to their Facebook friends to maximize the survey participation. This broad sampling strategy allowed us to obtain a large sample size and diversity of the populations from which responses are collected.

The second study evaluates the validity of retrospective think aloud. At the time the study was conducted, we were able to utilize a university research participant pool established by the department. An approved recruitment email was sent to the mailing list of the participant pool. Participants were voluntarily to join the study in exchange for a research credit. During the study, participants were asked to complete an experiment in a lab. The data collected were to

used to evaluate whether the retrospective think aloud protocol provides a valid recounting of what has happened during the experiment.

The last study reported here investigated how the need to belong affects people's micro-level behaviors. The micro-level behaviors were measured through eye tracking as well as a social characteristic evaluation task. We recruited people from the general public for this study by posting advertisements to commonly used websites (e.g. Craigslist). This allowed us to obtain participants with a wide variety of backgrounds, but all had experience in a social networking site. We didn't have a particular preference towards participants' gender, but gender was recorded as a factor to reveal any gender difference in terms of what they attended to online and how they processed information.

3.8 STUDY DESIGN

The high level research question - "How does need to belong relate to people's participation on social networking sites?" - will be answered by the following study design.

The whole study is composed of three sub-studies. These three studies combined together provided us with a holistic view of how the need to belong affects people's behaviors on both micro and macro levels.

We first looked at user behaviors at a macro level by conducting a survey to investigate how users' online experience relates to social belongingness. This helped us understand how people are behaving as a group with a longer period of time. Then, we validated the retrospective think aloud approach, which is needed to study users' micro behaviors in terms of what they do in the moment. With the validity of the method being confirmed, we used it to conduct the third study to reveal how the manipulated need to belong affects what people decide to do in a social situation and how people process information to complete cognitive tasks.

This research uses a mixed methodology to investigate our research questions. The dataset collected in this study will include both quantitative and qualitative data. All studies were official reviewed and approved by University of Washington Human Subjects Division.

3.8.1 *Using a Survey to Understand Macro Behavior at Scale*

As mentioned before, the first study used a survey to explore users' online experience relating to social belongingness. Community participants' social behavior and their social psychological needs were measured. The goal was to reveal the possible connections between what they do and what they feel.

In this study, I conducted a large-scale survey with subjects recruited from both a major research university in the US and the general public. The survey is used to reveal the diversity of users' online group experience as well as cues associated with people's sense of belonging. Two hundred and six participants completed the survey.

The data collected from the survey include online participants' gender, profession, time to join the social networking site, frequency of visits, time to stay on the social networking site, number of friends, major activities, major goals, major information users attended to, frequency of initiating activities, frequency of participating in online activities, and other aspects of their history of participating in online community activities. The demographic information is collected to represent the scale of the community participants' overall online experience.

Participants were also asked to complete a psychological scale of need to belong, which is a set of 10-item psychometric questions designed by Mark Leary [121]. Participants in the study were also asked about the type of the relationships they have with the friends and number of friends that they have on the social networking site. The survey data was analyzed using

descriptive statistics and linear regression. The detailed statistical analysis will be described in depth in Chapter 4.

3.8.2 *Establishing the Validity of Retrospective Think Aloud Protocol*

The second study in this work validated the retrospective think aloud (RTA) approach. This prepares us for using RTA in the subsequent eye tracking study. By establishing the validity of using RTA, we can defend the use of this approach to collect users' post-experiment verbal accounts of what they were thinking while they were trying to complete the activities in the experiment. This supports our choice to conduct an eye tracking study to understand how users' micro-behaviors are subtly affected by the manipulation of need to belong, without possibly compromising users' underlying thoughts in the experiment by having them think aloud simultaneously.

More specifically, in this second study, we describe an experiment with three main goals: (1) to assess the validity of RTA (whether people's report of what they did truly follows their original task performance), (2) to evaluate the impact of task complexity on the validity of the RTA, and (3) to characterize what other information the RTA provides beyond the basic record of task performance. This study also provides us with a good understanding of how to collect and use data gained through RTA. These insights are also very useful to the field of user experience research in large.

The validity experiment was designed and conducted to capture and compare two records of the events that occurred during subjects' task performance: eye movement data and retrospective reports. We used eye movement data as criterion data to indicate what objects people attended to and in what order.

We also designed our tasks as typical problem-solving tasks similar to the types of tasks that other researchers have used in evaluating verbal protocols [100] [113]. We designed the tasks to be experimental tasks instead of "real world" tasks in order to eliminate unwanted confounds and complexities in subjects' task performance, which could lead to difficulties in processing and analyzing subjects' verbalization and eye tracking. Tasks were designed with two different levels of complexity to address the issue of RTA's reliability.

The experiment had four sections: a pre-questionnaire, a task performance session, an RTA session, and a post- questionnaire. The experiment took about 45-60 minutes.

Eye movement data were collected during the experiment. Participants' verbal accounts were collected after the experiment. Eye tracking data provides a highly detailed record of all the locations that a user has looked at. We computationally reduced the highly dense eye tracking data to a low density level that can be compared to the verbal report. The eye movement data for each task was reduced to an ordered sequence of "Areas of Interest" (AOI). The verbal data were qualitatively coded to the similar ordered sequences of AOI. These two sets of sequences of AOI were then compared by applying a sequence alignment algorithm. The more detailed data analysis approach will be described in Chapter 5.

3.8.3 *Experimental Eye Tracking Study on Micro-Behavior*

In addition to understanding the broad landscape of sensing belongingness online, we conducted the third study, a lab study that uses eye tracking technology and RTA, to reveal the users' micro-behaviors when their need to belong level is manipulated. This study, composed of two main parts, aimed to understand how people respond differently to a social stimulus and how they apply their cognitive skills to solve problems when their levels of need to belong were

elevated in both parts. To summarize our basic treatment, we manipulated people's sense of belonging and then exposed them to a stimulus (social information or search task).

The first part of the study looks in detail at how people consume social information. We expected to reveal the changes in people's ability to process social stimuli and impacts in their social processing ability. Specifically, the experimental design and analysis attempted to reveal how people's sense of belonging changes their attention distribution, as well as their understanding of the social information presented on the experimental Facebook page. The activities in the first part of study, focused on changes in consumption of social information, included playing a Cyberball game, viewing a Facebook webpage, completing a social evaluation task through a short survey, and retrospectively thinking aloud.

The participants first played the Cyberball game, set up to include or exclude participants so that some experience the deprivation of need to belong. Then, they were asked to go through an experimental Facebook page that was designed to represent a Facebook conversation among a group of nine people. Different levels of social engagement were presented in the conversation.

The participants were told to examine the experimental Facebook page ahead of a social gathering with people appearing on the page. Their goal is to understand the dynamic of this group and formulate a plan to introduce themselves and find some common topics in order to make some friends at the upcoming social event.

During the time when the participants digested the experimental Facebook page, their eye movements were recorded. These eye tracking data were analyzed to reveal the sequence of how they consumed the social information from the imagined audience group.

After they finished consuming the experimental Facebook page, they were asked to evaluate the social characteristics of the individuals present on the Facebook page and write a

short message to introduce themselves to this imagined group. Both the evaluation and message-writing were administered as a short survey. The survey was formulated to be completed within 2 minutes. We designed the social evaluation and message writing parts to be natural extensions of the social browsing experience. The evaluated social characteristics and the messages they wrote in the survey were analyzed to reveal how many social information points were salient and remembered by participants in different inclusive or exclusive conditions.

After they finished evaluating the individual's social characteristics and writing a brief message, participants were asked to retrospectively think aloud about the way that they processed the experimental Facebook page. We designed the short social followup task (characteristic evaluation and message writing) to be a natural part of the whole social task (digest social information, evaluate social context, and take social actions). The social followup task was designed to be very brief, to ensure that when participants retrospectively recalled how they processed the Facebook page, they were able to reliably remember what they read on the experimental Facebook page.

Their verbal accounts were intended to help us understand what pieces of information they thought most important to pay attention to over others. This concludes the first part of study, which was to reveal the effect of need to belong on ways how people process social information presented on an experimental Facebook page.

The second phase of this study focused on changes in cognitive ability in solving search problems to reveal the impacts on cognitive ability. Participants were asked to go through a set of activities which included playing the Cyberball game again and then performing several search tasks. Specifically, the task design and participants' performance analysis attempted to

understand how people's sense of belonging affects their cognition and to reveal what tasks are most likely to be affected when people feel lonely.

The search tasks were designed to investigate how the level of need to belong affects people's cognitive capability in problem solving. Instead of asking people to work on solving more abstract or analytical problems, we chose to ask people to work on information-seeking problems, because we wanted to investigate whether different levels of need to belong increase or decrease people's ability in finding answers to problems that people often do in their real life. If an effect can be seen in solving search problems, we are more likely able to infer the impact on people's real life cognitive capability.

As in the first phase of this study, participants' eye movements were recorded while they were performing the search tasks. The subsequent analysis of the eye movement data helped us reveal the impact of need to belong on participants' cognitive ability. (No RTA was required to answer our questions in this second phase.)

By exposing people to a manipulative experimental environment, this study attempted to reveal how the sense of belonging affects people's social processing ability in parsing social information as well as their cognitive ability in solving real world problems.

3.9 Summary of the Chapter

Need to belong as one of the fundamental needs and motives has been heavily researched in the field of social psychology. Most studies were concerned about its psychometric mechanism and its relationship with other key social motives. Very limited research has been done to understand the impact of need to belong in the increasingly common online social setting.

In this body of work, we are going to systematically investigate the relationships between need to belong and people's online social behaviors. The goals of the study are to 1) reveal the correlations between online social networking participants' social activity level and their inherent level of need to belong, 2) establish the validity of using the retrospective think aloud (RTA) approach to understand the underlying thought process during the time when people consume social information, and 3) use eye-tracking and RTA to investigate the effect of need to belong on people's ability to consume social information as well as ability to perform cognitive tasks. The details about these three studies will be reported in the next three chapters.

Chapter 4. NEED TO BELONG AND SOCIAL BEHAVIOR AT SCALE

4.1 INTRODUCTION

People are longing for time staying with others, having more companions, and maintaining their relationships. Human beings are inherently socially oriented and often exhibit a strong fundamental need to be socially connected. We all need to feel like we have a place where we belong. We want to be in places where we are viewed as being important. We also like to surround ourselves with people who care about us and value our inputs and opinions. Being social animals, we inherently reject being alone.

For decades, social and personality psychologists have argued that people have an intrinsic motivation to affiliate and bond with others to form a group. The hierarchy of basic human needs constructed by Abraham Maslow in the 50's included the need to belong [135]. The hierarchy starts with getting the most basic psychological needs met, such as those of thirst, hunger and shelter. After the basic needs are met, the next level of needs to be met are safety and security. The next level is the need to belong and be loved and to be affiliated with others and be accepted. Every individual has the need to belong and we all have experienced it and have tried to fulfill this need at some point of our life. According to Maslow, the level of need for love and belongingness is the level where the majority of the population remains. The desire for friendship, efforts to look for a mate and the desire to be part of a family are all reflections of this need.

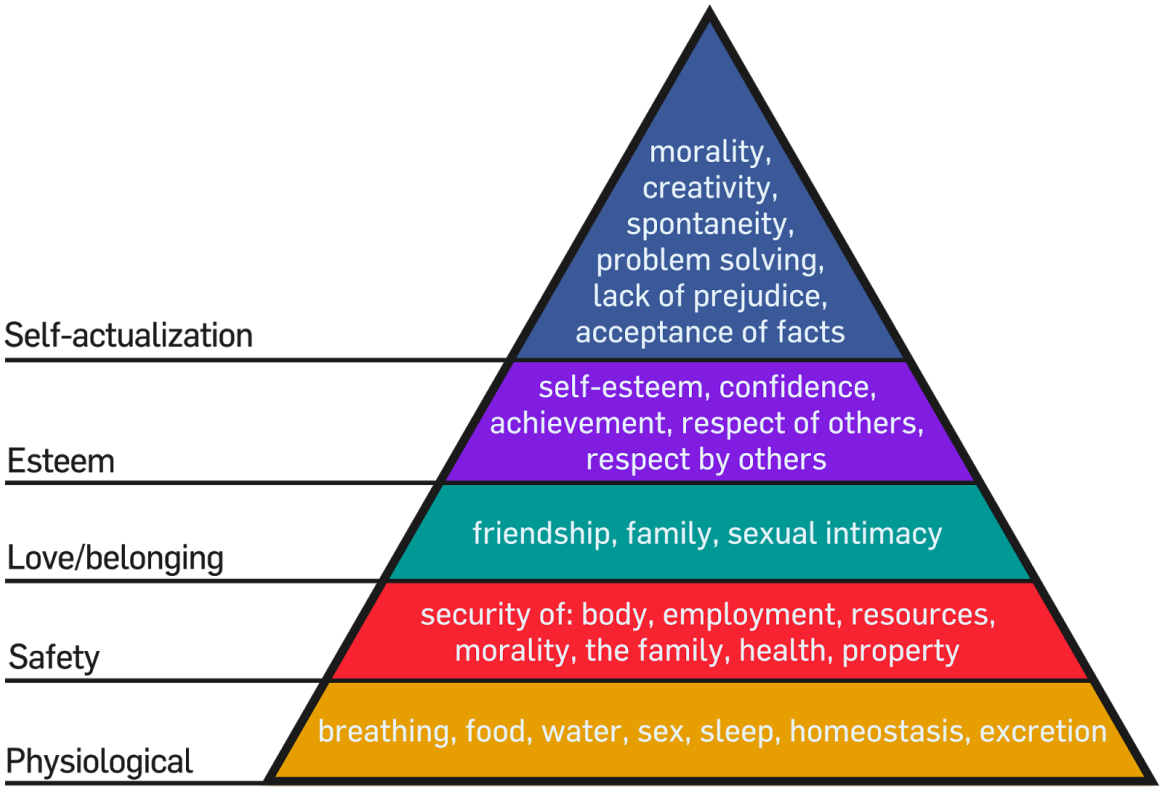


Figure 4.1 Maslow's Hierarchy of Needs

More recently, Baumeister and Leary have re-established the need to belong to be a basic driver of human behavior [11]. Baumeister and Leary have argued that the need to belong lies at the heart of many important social phenomena and closely associates with all kinds of social behaviors, ranging from both infant and adult attachment to adult emotional experience and physical well-being [126].

With a collage of evidence, they defined the need to belong as "a need to form and maintain at least a minimum quantity of interpersonal relationships." The need to belong is expressed as the desire for frequent, positive, and stable interactions with others [27, 126]. They argue that people are motivated to form and maintain strong and stable interpersonal

relationships. When the need to belong is threatened, people exhibit cognitive, emotional, and behavioral reaction. The need to belong is often fulfilled primarily through affiliation with a group and acceptance from others [25]. it is a basic human motivation to be accepted or feel accepted by others.

Abundant research has studied how the need to belong can be fulfilled in the physical world - through friend connections, communities, etc. In addition to offline interaction, the online community has become one of the key platforms for social communication. More and more, social communication and networking are happening online. With the popularity of social networking sites, millions and millions of people are spending time on their preferred social networking site to network, share, and make new friends. Limited research has been done to explore details of the relationship between the need to belong and the online social interactions.

The goal of the research reported here is to understand how the need to belong, as a fundamental human social need, relates to people's online behaviors. Since much of people's time is spent engaging in online environments, both social and non-social, this research will unfold the pattern of interaction people have on social networking sites and how people with different level of need to belong behave differently in this online world.

4.2 LITERATURE REVIEW

Before online interaction became the new norm, past psychological researchers were studying how the need to belong can be fulfilled in real life. Research that is related to the "need to belong" motive in early days have generalized this need as "the basic need for connectedness or acceptance" [126]. Wood discussed how belongingness goals can be fulfilled with healthy social ties with others [136], which in turn become integral components of overall health and

well-being. Research also found that people who do not place the need to belong or need to connect with other people in their top tier of life goals have poorer outcomes.

Leary et al. (2006) have reported that the Need to Belong scale correlates with, but is distinct from, other variables that involve a desire for social contact, such as extroversion, sociability, and need for affiliation [137].

Carvallo et al. (2006) have found that people's level of belonging needs affects how they perceive and attribute discrimination to either a specific person or a group [126]. People who are high in need to belong reported experiencing lower than average levels of personal and high than average levels of group discrimination. This adjusted discrimination attribution also takes place in an experiment that manipulated participants' need to belong. It shows that acknowledging discrimination represents a threat to people's need to belong.

In 2000, Gardner et. al. reported a series of studies that investigated the relationship between the need to belong, people's memory [25], as well as ability to interpret social information. They assigned participants randomly into groups where both experienced exclusion, but for different reasons. One group experienced exclusion (i.e. not being able to join the group) because of a social reason, where no one selected the participant as a partner. The other group experiences exclusion because of a more objective and non-social reason--because of the group was full. It was found that even this type of small difference could lead to differences in memory and subsequent social behaviors. The study found that the deprived sense of belongingness results in better memory about socially related information, such as interpersonal and social events. Subjects also perform better with paying attention to vocal tones in speech, can more accurately identify subtle emotions, and better at sensing what others are thinking and feeling [20, 21].

Steinel, Wolfgang, et al. investigated the role of intragroup dynamics in intergroup conflict and collaboration [138]. The researchers implemented a computer mediated negotiation experiment to research how group norms may shape the negotiation behavior of "prototypicals" depending on their own position within the group and their dispositional need to belong. "Prototypicals" referred to group members who had characteristics typical of what group members have in common and what differentiates the group from other groups. The group norms that were examined in the study are those relevant to negotiation, such as putting a premium on a cooperative vs. a competitive stance. Two positions within the group were studied. One is the central of the group, whose representatives were called Prototypicals. Another is peripheral to the group. People who hold that position were called "Peripherals." The need to belong was defined as whether they have a stable desire to belong with others and to be included in groups.

The research found that prototypicals behaved more cooperatively when the group norm prescribed cooperation rather than competition. By contrast, peripherals only adhered to the group norm when they had a high need to belong. It was found that "when groups and organizations face each other in negotiation, within-group dynamics can have important consequences for the between-group negotiation." A person who is holding a peripheral position in a group and has a high need to belong has an increased motivation to be accepted. This motivates them to show norm-congruent behaviors in order to result in agreement and harmony inside the group.

Mellor and colleagues [32] and Leary et al. (2006) have found that need to belong has a weak, but significant, correlation with loneliness and satisfaction with personal relationships [32]. And, loneliness was strongly associated with the discrepancy between need to belong and satisfaction with personal relationships. The discrepancy represents the unmet need for

belonging. People living alone had lower need to belong and less satisfaction with personal relationships than those living with others. However, the discrepancy between loneliness and life satisfaction doesn't differ among those groups. This means that the need to belong itself doesn't result in someone who feels lonely. Instead, the more dissatisfied one is with personal relationships, the more lonely one will feel. And people who are lonely have an unmet need to belong, no matter if they naturally have a high or a low need to belong. An unmet need to belong could happen to someone who has a high need to belong and is moderately satisfied with personal relationships, or someone who has a moderate need to belong and feels very dissatisfied with personal relationships. While people with many friends and acquaintances may still be lonely, people with few friends and acquaintances may not be lonely. The former has a higher unmet need to belong and the latter may not.

The need to belong has been proved to be associated with human behaviors in various ways. Loveland et. al [124] have researched how the need to belong is associated with consumer behaviors. The research was originated from a story where an interaction on a social networking site led to a strong desire to go out and purchase a childhood favorite that hasn't been thought about, let alone consumed, in years. The researcher examined potential antecedents to a preference for nostalgic products (products that were more common or popular when one was younger) over contemporary products. The research intended to understand whether people are trying to fulfill their need to belong and strengthen ties with the past by consuming a nostalgic product, such as previously popular movies, television programs, foods, or automobiles. They found that participants whose need to belong is active often experience a significantly stronger preference for nostalgic products than participants for whom this is not an active goal. This effect on participant's behavior was observed both when the need to belong is activated through an

ego-threatening manner, such as after being socially ostracized, and when it is activated in a non-ego-threatening manner, such as when the interdependent self is primed. It was also found that the need to belong can only be satiated through the actual consumption of nostalgic products, rather than the exposure to or the mere selection of nostalgic products.

With communication moving to online, social networking sites have become the mainstream social platform. Much research relating to need to belong has been done by looking at people's perception and real world behaviors. However, there isn't much work done on online behavior. A very limited number of researchers have started to study the need to belong in various settings to reveal its connections to different psychological measurements as well as social behaviors.

Among many differences, one distinct variable with the Internet is that although social contact exists, it has its own very particular quality. Information someone receives is primarily static information that is often text or image based. The message someone can get is limited. In addition, because of this limited channel of information, lots of social cues such as gesture, face expression, body language, etc. are lost on the Internet. Therefore, there is a lot of space up for people's own interpretation. Internet users can make various assumptions and deductions about what other people's goals are to suit their own needs. While the Internet has brought people together from all over the world, it is undeniable that there is a tendency of people to accept only selected information and there is a lot of lost information up in the air for individual explanation.

Furthermore, the Internet is a place that lacks of identity where the representation shown on a social networking site could be very different from what is in the real life. It is an informal setting where individuals appear to be of equal status and interact within certain norms of behavior. Though conflicts do exist, people have a strong desire to live in an ordered and

predictable world both online and offline. Having an equal status while participating in the online space could help with group normalization.

Early studies started to investigate the uses of the social networking site Facebook, and the gratifications that people derived from those uses. Seidman published a study that reported that people with different personality traits use social networking sites differently [88]. More specifically, he studied the relationship between the Big Five and the use of Facebook. The Big Five traits are openness, conscientiousness, agreeableness, extraversion, and neuroticism. In this study, 184 undergraduate students were asked to complete a survey which assessed their personality and Facebook behaviors. They examined two "belongingness behaviors" on Facebook: information-seeking behavior (using Facebook to learn about others) and communication (using Facebook to communicate with others). They found neuroticism (characterized by anxiety, moodiness, and emotional instability, often have social difficulties), agreeableness and extraversion was associated with communication. However, neuroticism was the only trait related to information-seeking. This suggests that neurotic individuals may use Facebook as a passive way to learn about others, whereas extroverted and agreeable individuals may use Facebook as a way to actively supplement offline relationships. This could mean that neurotic individuals use Facebook to solve the social difficulties they often encounter in real life. Their deprived sense of belonging could be fulfilled by this new type of online interaction. This research also pointed out that further research is needed to focus on motivations for Facebook use in order to understand the relationship between that use and personality. Our research, which will be reported in a later section of this chapter, is positioned to achieve this goal.

4.3 RESEARCH QUESTIONS AND HYPOTHESES

Since one of the claimed goals for coming to such social networking sites is to join a community and make friends, it is important and interesting to understand whether people with different levels of need to belong have different motives and use the site differently. In this study, we explore the following research questions:

4.3.1 *Research Question #1: Need to Belong and Coming Online*

How does the need to belong affect people's motivation to come online? Do people who have higher or lower need to belong come online more or less?

Social networking sites are often considered as places where people make new friends and connect with their old friends. They are also places where communities are built for members to give updates and organize events. Some social networking sites were reported to make members feel that they belong to the groups. Therefore, it is reasonable for us to ask, to what extent are social networking sites helping people to achieve their social goals and satisfy their belongness needs? To answer this question, we hypothesize that:

Hypothesis 1: People who have a higher need to belong have more connections on a social site than people who have a lower need to belong.

Hypothesis 2: People who have a higher need to belong come to a social site more often than people who have a lower need to belong.

4.3.2 *Research Question #2: Need to Belong and Online Participation*

How does the need to belong affect people's social behavior online? Do people who participate more online have higher or lower need to belong?

This second research question is concerned with the relationship between people's need to belong, on the one hand, and site motives and uses on Facebook, on the other. To answer this question, we hypothesize that:

Hypothesis 3: People who have a higher need to belong post a status update more often than people who have a lower need to belong.

Hypothesis 4: People who have a higher need to belong broadcast messages more often than people who have a lower need to belong.

Hypothesis 5: People who have a higher need to belong respond to other's posts or comments more often than people who have a lower need to belong.

Hypothesis 6: People who have a higher need to belong share or reshare more often than people who have a lower need to belong.

Hypothesis 7: People who have a higher need to belong like posts more often than people who have a lower need to belong.

Hypothesis 8: People who have a higher need to belong stay on a social site longer than people who have a lower need to belong.

Hypothesis 9: People who have a higher need to belong have different motives as people who have a lower need to belong.

Hypothesis 10: People who have a higher need to belong have higher levels of concerns about privacy than people who have a lower need to belong.

In this study, we conducted a survey to collect measurements about people's social involvement in a social networking site, including their active and passive participation on the site with other members of the site. This survey took the format of an online questionnaire to explore aspects of the user's experience. The goal was to understand whether people with

different levels of need to belong have different motives and use the site differently. The survey questions asked participants to reflect on and comment about their past experience in using social networking sites.

4.4 SURVEY DESIGN

A 33-item questionnaire was developed and pretested on a small sample of academic professionals and graduate students to ensure clarity and ease of understanding. The survey questionnaire is separated into four topics: need to belong, basic demographics, and SNS activities and experiences. We also include several socio-psychological motives that are commonly measured to study human behaviors, e.g. self-esteem measure using the collective self-esteem scale created by Rija Luhtanen and Jennifer Crocker [139], loneliness measure using UCLA Loneliness Scale created by Daniel Russell [140].

The first section presented participants with a group of questions that measure their level of need to belong. The second section collected demographic information. The third section asked participants detailed questions about their participations on the social networking site. The last section of questions presented participants with questions about their feelings relating to need to belong. We will describe each topic in details in the subsequent section.

4.4.1 *Measuring Need to Belong*

The first section of the questionnaire measured participants' need to belong. We adopted the commonly used 10-item need to belong (NTB) scale [121], which was used by many other researchers in their studies. The scale is reported to demonstrate adequate reliability, with Cronbach's alpha being 0.83 in Pickett, Gardner, and Knowles (2004), who used the Need to Belong scale in a study of sensitivity to social cues. This scale includes 10 items such as "If other

people don't seem to accept me, I don't let it bother me," "My feelings are easily hurt when I feel that others do not accept me," and “I have a strong need to belong”. Items were measured on a 5-point scale ranging from 1 (strongly disagree) to 5 (strongly agree). Items expressing a low need to belong were reverse scored so that higher scores reflected a greater need to belong.

Out of ten questions, seven of them are concerned with rejection, such as “My feelings are easily hurt when I feel that others do not accept me.” and “I try hard not to do things that will make other people avoid or reject me.” The higher the score, the stronger is the need to belong.

Three questions are worded oppositely and express fewer concerns around the need to belong, such as “If other people don't seem to accept me, I don't let it bother me.” and “Being apart from my friends for long periods of time does not bother me.” The higher the score is to those questions, the weaker is the need to belong. For example, if an individual strongly agrees with “If other people don’t seem to accept me, I don’t let it bother me,” this individual has a lower need to belong. These three items are reverse scored (e.g. a score of 3 being “moderately agree” will be reverse scored to 5-3=2).

A total score is derived by adding the responses. A high total score reflects a greater need to belong.

4.4.2 *Demographic Information*

The demographic information collected in this study consists of age, gender, education, ethnicity, and income range. The marital status and living arrangement were also collected, since past literature suggested that people’s sense of belonging and the actual loneliness they experience can be different depending on whether they have significant ones in their life, and/or whether they live with someone [141]. The following demographic information was collected:

Table 4.1 Demographic Questions

Matric	Question
Age:	What is your current age?
Gender	What is your gender?
Marital status	What is your current marital status?
Race or ethnicity	What's your race or ethnicity?
Education	What is the highest level of education you've completed?
Household income	What's your household income?
Living arrangement	What is your living arrangement?

4.4.3 *Social Networking Site Participation*

The history of SNC participation and day-to-day activities were measured. The questionnaire collected information include the following:

Table 4.2 Social Networking Activity Questions

Matric	Question
History of use	Approximately, when did you first start using Facebook?
Frequency of visiting the site	How often do you visit Facebook?
Time spent on site weekly	How long do you spend on Facebook each week?
Number of friends in physical world	Currently in your life, how many close friends would you say you have?
Number of friends linked on site	Approximately, how many connections do you have in Facebook?
Active social outreaching	How often do you post a status update, broadcast message or question to Facebook?
Reactive social contact	How often do you react to someone else's post via a comment or reply in Facebook?

3rd party content share	How often do you share someone else's post via Reshare, Retweet or other syndication method in Facebook?
Post reaction	How often do you react to someone else's post via a Like or +1 in Facebook/Google?
Attention to profile	How often do you visit other people's online profiles in Facebook?
Attention to photos	How often have you clicked on a photo or photo collection of a friend of a friend or someone you do not know on Facebook/other, to see more photos?
Levels of concerns about privacy	To what degree do you feel you can control how other Facebook users think about you?

4.4.4 *Psychological feelings related to need to belong*

Table 4.3 Psychological Questions

Matric	**Question**
Relationship satisfaction	How satisfied are you with your personal relationships?
Life satisfaction	How satisfied are you with your life as a whole?
Relationship satisfaction on Social Site	How satisfied are you with your relationships with your online social network on Facebook?
Loneliness	How often did you feel very lonely or remote from other people during the past few weeks?
Self-regulation	I am able to accomplish goals I set for myself.
Approach goal vs. avoidance goal	Identify 6 social goals you have when you come to Facebook.

4.5 PARTICIPANTS

Two hundred seventy-four participants were recruited across multiple organizations and multiple geographical locations, who ranged from 18 to 65+ years old. We recruited participants on Facebook through various social networking channels, which included posting study announcements on Facebook, through a university mailing list and through professional mailing

lists [e.g. chi-web@ mailinglist, etc.], as well as word of mouth. In order to get more responses, participants were then asked to send the survey link to their Facebook friends to maximize the survey participation. This broad sampling strategy allowed us to obtain a large sample size and diversity of the populations from which responses are collected.

The sample consists of 50% men and 50% women. The ethnic composition of our sample was 43% White alone, 43% Asian alone, 4% Some other race alone, 3% Two or more races, 3% Black or African American alone, 3% American Indian or Alaskan Native alone, and 2% Hispanic or Latino origin. 10 Participants receive $50 Cash equivalent through a lottery drawing after the data collection was completed.

Table 4.4 Demographic background of survey respondents

Gender	
Female	50%
Male	51%
Age	
18-24	35%
25-34	46%
35-44	12%
45-54	2%
55-64	3%
65 or older	2%
Ethnicity	
White alone	43%
Asian alone	43%
Some other race alone	4%
Two or more rances	3%
Black or African American alone	3%
American Indian or Alaskan Native alone	3%
Hispanic or Latino origin (of any race)	2%
Education	
Associate Degree (or equivalent)	2%
High School.	4%
Some College.	17%
Bachelors Degree (or equivalent)	39%
Masters Degree (or equivalent)	33%
Doctoral Degree (or equivalent)	6%

4.6 RESULTS

4.6.1 *Social Networking Site (SNC) Activity in General*

What do people do on the site?

Active participation: How often do people actively contribute to Facebook? This data shows that a large portion of people are coming to Facebook and post or broadcast information

on a weekly basis. About 43% of respondents came to the site to post or broadcast information once or a few times a week. About one third of users are passive users who either never post or broadcast anything or only do it once or a few times a month. As expected, a small set of power users exist on Facebook who may contribute to the majority of content on the site.

Table 4.5 Frequency of Participation on Facebook

	howOftenPostBroadcast	howOftenReactComment	howOftenShareRes	howOftenLikePlusone	howOftenViewPictureLostTouch	howOftenViewPhotoAcquaintance	howOftenViewPeopleDonotKnow	howOftenViewCelebrity
Never	4%	3%	16%	3%	7%	4%	19%	36%
Once or a few times a month	26%	14%	29%	15%	36%	40%	29%	22%
Once or a few times a week	42%	45%	26%	35%	24%	28%	19%	11%
Once or a few times a year	13%	5%	14%	7%	27%	20%	28%	23%
Once or multiple times a day	15%	32%	14%	41%	5%	8%	5%	7%

Reactive participation: How often do people react to comments? How often do people reshare? As we all know, not everyone actively participates online communities. By active participation, we are referring to the post or broadcast activities that were often initiated without external intervention, and often can generate more follow up communication. There are always some set of users who only participate in the group activity or communication by responding to other people's request. We call these types of participation "reactive participation." In a SNS, reactive participation refers to the content generated by participants via responding to other's posts. Looking at Facebook participation, reactive participation often happens on a weekly basis. 45% of respondents reported reaction.

Minimal participation: How often do people "like" or "plus"? Though a social networking site is often meant for people to seek interaction, people do not always DO things on this type of site. There are always barriers to having an active social interaction online. It is known that people are more comfortable talking face to face. It is much easier to initiate a conversation with someone when you know who they are, what they like, and how they would respond to what you say. On the Internet, the conversation is often felt insecure and more

unpredictable. It is not clear who will respond to your post and what they would say. Because of these reasons, we often hear people say that "I don't really do things on Facebook, I just check it from time to time." We call this type of social networking site users "minimal participants." They exhibit a limited engagement on social networking sites and are often using the site to simply monitor their friends' interactions. For this type of user, their favorite tool and most often used tool is probably the "plus", "like", or "plus 1" widget. This type of widget affords a very limited interaction, yet these types of interactions can easily noticed by the owner of the post. Results from data?

Content consumption: How often do people view pictures and read content? It is widely known that people often lurk on social networking sites, though lurking can be viewed as a negative behavior where the user only consumes the content, but does not contribute to the communication/interaction. However, recently studies on lurking has revealed that people lurk for various reasons. And it is likely that everyone has engaged in this type of interaction at some point. Even the most active social networking site users simply look at other friends' posts and may or may not reply with a word. To avoid viewing this type of behavior as being negative, we chose to call this type of interaction "content consumption." Content consumption refers to coming to a social networking site only to view status, posts, pictures, etc. Results in the data?

4.6.2 *Need to Belong and SNC Friendship*

Does people's need to belong affect their friendship score?

The need to belong speaks to a fundamental need people have to seek connections and form relationships. The social networking site is one type of online community where people come and seek connections. Therefore, the very first question we have is around the connections between people's sense of belonging and the actual social connection they have in their daily life

and the connections they create on the social networking site. We want to understand whether the need to belong is related to how many friends or connections they have online and in their real life [11].

We found that both need to belong and self-esteem were **not associated** with the total number of connections people have in either their real life or on the social networking site (see the regression plot) . The size of people's social circle in real life is associated with how lonely people have felt in the past few months and whether they live alone or with others. The size of people's online social circle is associated only with people's loneliness, which was measured as how lonely they have felt recently.

```
tst.lmer <- lmer(d$numberFriendLife ~
            belong +
            selfesteem +
            selfRegulation +
            howOftenLonglyPastFewMonths +
            livingArrangement +
            (1| timeStamp),
            data=d)
Fixed effects:
                        Estimate Std. Error  t value p.value.LRT
(Intercept)              18.60143    5.98237  3.10940       0.002
belong                   -0.04242    0.12212 -0.34740       0.725
selfesteen                0.06704    0.15488  0.43290       0.661
selfRegulation            0.72268    0.53575  1.34890       0.172
howOftenLonglyPastFewMonths  0.71762    0.26267  2.73200       0.006
livingArrangement         -4.18545    1.82222 -2.29690       0.021


(tst.lmer <- lmer(d$numberConnection ~
                  belong +
                  selfesteen +
                  selfRegulation +
                  howOftenLonglyPastFewMonths +
                  livingArrangement +
                  (1| timeStamp),
                  data=d))
p.values.lmer(tst.lmer)
Fixed effects:
```

	Estimate	Std. Error	t value	p.value.LRT
(Intercept)	56.6534	18.7277	3.0251	0.003
belong	-0.3491	0.3707	-0.9417	0.368
selfesteen	0.6484	0.4958	1.3078	0.187
selfRegulation	-1.1307	1.7010	-0.6647	0.498
howOftenLonglyPastFewMonths	-1.6730	0.8450	-1.9800	0.049
livingArrangement	1.0249	5.8211	0.1761	0.863

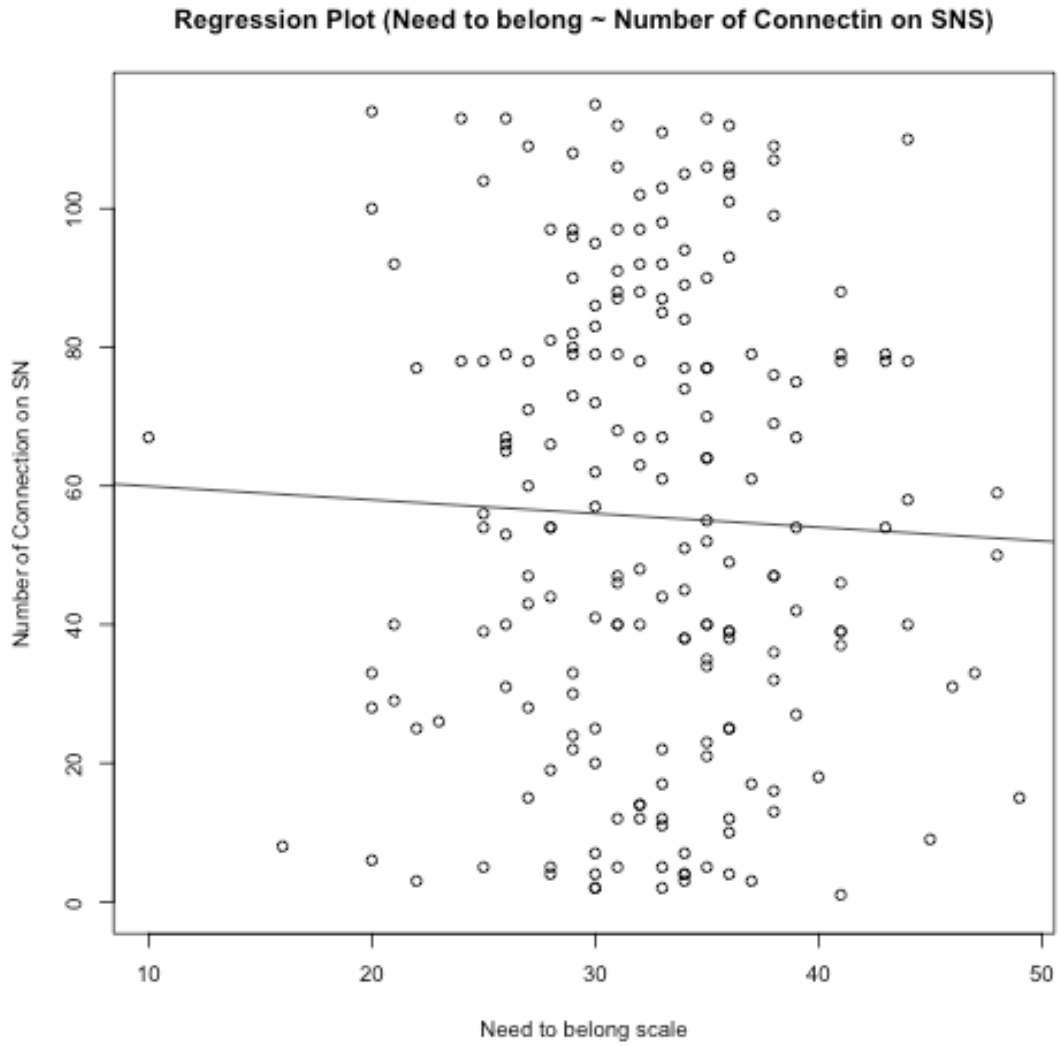


Figure 4.2 Regression Plot (Need to belong ~ Number of Connections on SN

4.6.3 *Need to Belong and SNC Interaction*

Does people's need to belong affect how people interact with others on social networking sites?

Even though the need to belong didn't affect how many connections people have on social networking sites, it **indeed affects how frequently people come to a social site** in general, as well as what they do on the social site.

Respondents' need to belong and measure of self esteem are significantly associated with the frequency of their visits. In other words, people who have higher need to belong come to the site more frequently. The same result holds for the self esteem measure--people who are higher in self esteem would come to the site more often.

This finding confirms our hypothesis about the correlation between people's need to belong and their online social behaviors. For people who have a higher need to belong, they might be more motivated to come to a social networking site to try to make connections. Logging on to the social networking site, after all, is the very first step for them to make an effort to connect with other people.

```
(tst.lmer <- lmer(d$siteVisitFrequency ~
                belong +
                selfesteem +
                        selfRegulation +
                howOftenLonglyPastFewMonths +
                livingArrangement +
                (1| timeStamp),
                data=d))
        p.values.lmer(tst.lmer)

        Fixed effects:
                            Estimate Std. Error  t value p.value.LRT
        (Intercept)              2.41541    0.62018  3.89500       0.000
        belong                   0.03398    0.01235  2.75000       0.006
        selfesteen               0.03238    0.01635  1.98100       0.045
        selfRegulation          -0.08769    0.05619 -1.56100       0.118
        howOftenLonglyPastFewMonths -0.03097    0.02784 -1.11300       0.259
        livingArrangement        0.14657    0.19207  0.76300       0.439
```

Not only does the need to belong affect how often people come to a social networking site, the analysis also shows that **the need to belong is significantly associated with how often people participate in various activities to create connections online**.

The need to belong is significantly associated with the frequency of actively participating in online networking. This includes posting a status update and broadcasting a message or questions to Facebook. In other words, people who have higher need to belong behave slightly more actively than people who have a lower need to belong. This means that people do more outreaching on social networking site. This makes sense considering how easy it is for people to post a status update and broadcasting a message on a social networking site.

```
tst.lmer <- lmer(d$howOftenPostBroadcast ~
                belong +
                selfesteen +
                selfRegulation +
                howOftenLonglyPastFewMonths +
                livingArrangement +
                (1| timeStamp),
                data=d)
        summary(tst.lmer)
        p.values.lmer(tst.lmer)

        Fixed effects:
                              Estimate Std. Error   t value p.value.LRT
        (Intercept)             2.206277   0.620031  3.558000       0.000
        belong                  0.029546   0.012722  2.322000       0.019
        selfesteen             -0.008609   0.015988 -0.538000       0.585
        selfRegulation          0.063898   0.055299  1.156000       0.242
        howOftenLonglyPastFewMonths -0.021511   0.027061 -0.795000       0.421
        livingArrangement       0.057550   0.187807  0.306000       0.755
```

Not surprisingly, the need to belong is also associated with people's reactive behaviors as well. **People who have a higher need to belong react more to other's social interaction**. The frequency of responding to other's posts or comments is also associated with how lonely people have been in the past few months.

```
tst.lmer <- lmer(d$howOftenReactComment ~
                 belong +
                 selfesteen +
                 selfRegulation +
                 howOftenLonglyPastFewMonths +
                 livingArrangement +
                 (1| timeStamp),
                 data=d)
        summary(tst.lmer)
        p.values.lmer(tst.lmer)

        Fixed effects:
                              Estimate Std. Error  t value p.value.LRT
        (Intercept)             1.56703    0.61620  2.54300       0.010
        belong                  0.04227    0.01166  3.62500       0.001
        selfesteen              0.01760    0.01677  1.05000       0.307
        selfRegulation         -0.02072    0.05671 -0.36500       0.686
        howOftenLonglyPastFewMonths -0.05738    0.02876 -1.99500       0.044
        livingArrangement       0.19183    0.19569  0.98000       0.317
```

Similarly, people's need to belong measure is also positively correlated to how often they share or reshare, and how often they like or plus one on the topic of their interests. The frequency of feeling lonely in the past few months was negatively correlated to how often people like or plus something on Facebook. This means that people who feel lonely are less likely to "like" or "plus" things on a social networking site.

It is interesting to see that the frequency of behaving actively on a social networking site (posting, sharing or resharing) is only associated with need to belong, whereas the more passive behaviors (reacting, liking, plussing) is not only associated with need to belong, but also to people's loneliness. Liking or plus-ing something is the minimal interaction people can do on a social networking site. Comparatively, posting or sharing information requires people to initiate a new activity. This might mean that being lonely and having a higher need to belong could motivate a person to passively react to social signals on a social networking site, but only the need to belong can trigger a person to actively seek and initiate new interaction .

```
(tst.lmer <- lmer(d$howOftenShareReshare ~
                  belong +
                  selfesteen +
                  selfRegulation +
                  howOftenLonglyPastFewMonths +
                  livingArrangement +
                  (1| timeStamp),
                  data=d))
        p.values.lmer(tst.lmer)

        Fixed effects:
                                Estimate Std. Error  t value p.value.LRT
        (Intercept)                1.76741    0.73192  2.41480       0.017
        belong                     0.03278    0.01500  2.18530       0.032
        selfesteen                -0.01261    0.01889 -0.66770       0.499
        selfRegulation            -0.06162    0.06535 -0.94290       0.339
        howOftenLonglyPastFewMonths -0.01378    0.03199 -0.43080       0.662
        livingArrangement          0.29347    0.22204  1.32170       0.181
```

```
(tst.lmer <- lmer(d$howOftenLikePlusone ~
                  belong +
                  selfesteen +
                  selfRegulation +
                  howOftenLonglyPastFewMonths +
                  livingArrangement +
                  (1| timeStamp),
                  data=d))
        p.values.lmer(tst.lmer)
        Fixed effects:
                                 Estimate Std. Error   t value p.value.LRT
        (Intercept)                1.922730   0.679057  2.831000       0.004
        belong                     0.045525   0.013520  3.367000       0.001
        selfesteen                 0.009499   0.017905  0.531000       0.599
        selfRegulation            -0.007320   0.061541 -0.119000       0.895
        howOftenLonglyPastFewMonths -0.065080   0.030493 -2.134000       0.031
        livingArrangement          0.156078   0.210378  0.742000       0.458
```

4.6.4 *Need to Belong and SNS History*

Do people's need to belong affect how long they stay on the site in their visits?

The analysis shows that **people's need to belong is not associated with how long people stay on the site**. Instead, the length of site visit is related to how satisfied people are with their online social networking experience. This means that the longer people log on to a social networking site, they become more satisfied with their relationships with the online social network on Facebook.

```
(tst.lmer <- lmer(d$siteFirstStart ~
                  belong +
                  selfesteen +
                  selfRegulation +
                  satisfiedRelationshipOnSite +
                  howOftenLonglyPastFewMonths +
                  livingArrangement +
                  (1| timeStamp),
                  data=d))
      p.values.lmer(tst.lmer)
```

```
      Fixed effects:
                                  Estimate Std. Error  t value p.value.LRT
      (Intercept)                  6.47506    1.32484  4.88700       0.000
      belong                      -0.02604    0.02421 -1.07600       0.312
      selfesteen                   0.03294    0.03134  1.05100       0.287
      selfRegulation              -0.06837    0.10863 -0.62900       0.524
      satisfiedRelationshipOnSite -0.27367    0.07559 -3.62100       0.000
      howOftenLonglyPastFewMonths -0.15426    0.05633 -2.73900       0.006
      livingArrangement           -0.14369    0.36871 -0.39000       0.693
```

4.6.5 *Need to Belong and other SNS Goals*

Do people with a higher need to belong have different goals?

Social networking sites have been used by people to connect with their friends and family. We are interested in how people perceive the site on a very high level. To understand people's overall thoughts about the site, we asked them "What is the first thing that comes to mind when you think about what you enjoy most when using Facebook?". After taking out some

of the commonly used keywords (e.g. friend, people), we generated a wordle to show the trends. It clearly shows that people perceive Facebook as a way to keep in touch with others. More prominently than we expected are the things that come to people's mind such as chatting, photos, events, pictures, etc. It is also obvious that people use Facebook more for getting in touch with "old" friends than making new friends.

Figure 4.3 Word Cloud of Users' Goals

To get a clear sense of what people's goals are for participating on social networking sites, we coded goals stated by 274 people. Each person was asked to state 3 goals they have had when coming to Facebook. If they didn't have 3 goals, they were allowed to input less. We found that out of 274 people, about 207 (75%) of people provided meaningful answers to the question about their social life goals on Facebook.

We then coded these 207 responses with their explicit goals. 12 pronounced goals were identified. If a response represented multiple goals, the corresponding goals were all coded and labeled.

We found that 24 people (12% of all valid responses) stated clearly that they didn't have any goals for using Facebook for their social life. Most people have two to three goals, which are often related. This is expected because the social networking site support users with lots of different social interactions, and these interactions are often related.

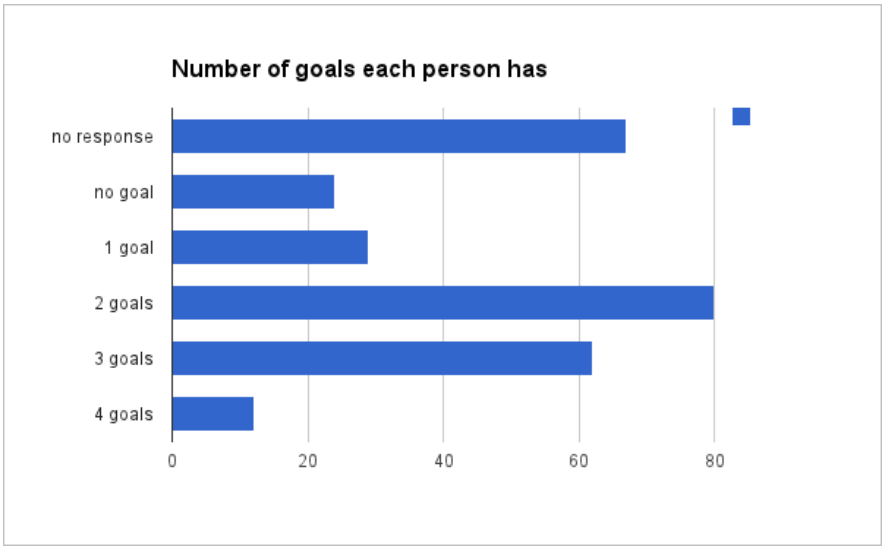


Figure 4.4 Number of goals each person has

We found 12 pronounced goals:

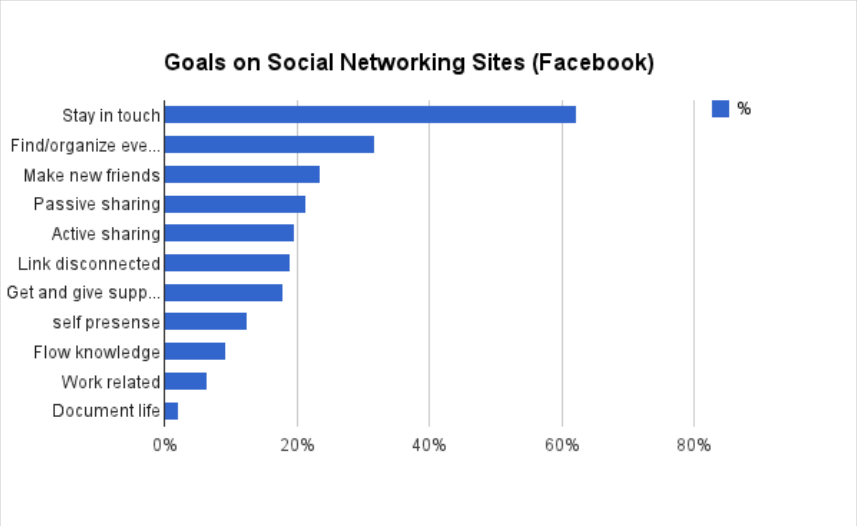


Figure 4.5 Twelve categorized goals

Table 4.6 Percent of goals on Facebook

Goal on Facebook	Percent
Stay in touch	62%
Find or organize events	32%
Make new friends	23%
Passively sharing	21%
Actively sharing	20%
Link disconnected	19%
Get and give support	18%
Presentation of self	13%
Flow knowledge	9%
Work related	7%
Document life	2%
Make money	2%

The most common goal Facebook users cited is “Stay in touch”. About two thirds of Facebook users consider Facebook as a way to keep their existing social connections active in the online world.

We also found that there are a variety of other goals that people have, including organizing events, making new friends, reconnecting with those they’ve lost touch with, sharing things by broadcasting to a big group, managing self-image and maintaining a desired self-presentation, etc.

There are a set of other goals that are often not mentioned in the literature. These goals are non-social and relate to other goals in people life, such as learning knowledge, maintaining work

relationships, documenting his or her life for the poster's own record, and using Facebook as an advertisement platform to make money.

The following table gives examples for each goal we coded in this study.

Table 4.7 Example of goals

Goal on Facebook	Examples
Stay in touch	- Keep in touch with people I enjoy who I might otherwise lose track of - Stay in touch with friends - Strong communication with people from my major. - To be connected with society. - Play Facebook games (words with friends) to keep in touch with my mom and a few other friends, since it's a way to interact asynchronously, even when we're busy and on different schedules.
Find or organize events	- Figuring out what other people are doing so I can join them - Attend their events - I'd like to go out more often on weekends. - Look for upcoming events with clubs
Make new friends	- Meet new people - To make new friends. - Get to know more people exclusively on Facebook - I want to interact with others who are in the same business or profession - Finding out about people in my new community - Meet new people in my area or figure out who I know that lives here
Passively	- Look at pictures of friends.

sharing	- See what is going on in my town - Respond to friends' updates - Know when something good or bad is happening in people's lives so I can help.
Actively sharing	- Keep people looped into what's happening - Keep family, friends, and colleagues enough up to date that we don't miss opportunities (e.g. catching up when in the same town, discovering and acting on common interests) - Network for an organization I'm starting 2) - Connect with others in my life and update them on how I feel/how I am
Link disconnected	- I want to keep in contact with people I care about or were close to at one point in time or another - Find old friends - Keep in touch with family living overseas. - Let my friends know that I still care about them (especially those that I don't see often).
Get and give support	- Helping other people - Teaching good thing to others - Learn how to take care of others in need. - Know when something good or bad is happening in people's lives so I can help. - Support others when they need things or are just not having a great day
Presentation of self	- Present myself as a fun person - I do not want people to forget about my existence. - To appear to be successful and playful - I try to post professionally relevant things to portray a positive professional image of myself to my professional network.

	Be a sample to others
Flow knowledge	- I want to know what other people find interesting to read. - Share things I find interesting, both situationally and re: media. - Learn new things. - Find out about interesting new media that my friends are consuming.
Work related	- Find job offers. - I got some job opportunities on Facebook - For my prospects for doing internet marketing. - I try to post professionally-relevant things to portray a positive professional image of myself to my professional network. - Being a successful manager - Job searching - Have good job
Document life	- make new memories this summer with all my friends - remember good times with friends
Make money	- To earn good income. - Be rich - Earn money and save for tomorrow's life

4.6.6 *Need to Belong and Privacy*

Do people with a high need to belong have more or less concerns about privacy?

When looking at how often people provide personal information online, most people provide some, but not all, information we asked about. Only 2 participants didn't provide any information, and only 12 participants provided all the information including pictures, birthday, phone number, home address, city of residence, email, gender, relationship status, and their interests and hobbies. Most users were in the middle where some real information was provided. The table below lists the percentage of users who provide their personal information at different levels of transparency. The percentages that are high were colored as Green, and the percentage that are low were colored as Red.

The table shows that the **least sensitive information that most people provide is "Picture" and "Gender,"** where 66% of users provided their gender information and 61% of users provided pictures. Unsurprisingly, **"Home address", "Phone number", and "Birthday" were probably viewed as the most private information.** Respectively 69%, 51%, and 51% users refused to provide these items of information, even if they could simply provide fake information or provide information but make it hidden.

It is also interesting to see that **people usually do not provide fake information**. Across the different information that people could provide, only 4% of users chose to provide fake information, on average. And, there is no significant difference between different types of data that users could provide.

Table 4.8 Percent of users who provide personal information

	Do not provide	Provide fake info	Provide but hidden	Do provide
providePicture	10%	4%	25%	61%
provideBirthday	51%	4%	32%	13%
providePhoneNumber	51%	4%	32%	13%

provideHomeAddress	69%	4%	15%	11%
provideResidence	12%	6%	33%	48%
provideEmail	21%	2%	47%	29%
provideGender	7%	3%	24%	66%
provideRelationshipStatus	25%	4%	26%	45%
provideInterests	18%	4%	36%	42%

We weighted the ways that respondents provided their information to investigate whether there is any association between respondents' need to belong score and data tranparency. We use the table below to assign scores to the information people provided.

Table 4.9 Transparency score

Options	Transparency score
Do not provide	1
Provide fake information	2
Provide information, but is hidden	3
Provide information, and is public	4

We calculate each respondent's transparency score by adding all the scores they received for each item of information. The lowest score is 9, which is for the case where respondents didn't provide any information (2 respondents fall within that category). The highest score is 36, where respondents provide all the information and all the information is public and open (12 respondents fall within that category).

We also found that people's **need to belong measure is statistically correlated with how transparently they provide their personal information**. People with a higher need to belong score tend to be more open to providing more information publicly, as shown in the table

below. We suspect if it is because people who have a higher need to belong might be willing to socialize more, therefore, making more information public.

```
table(d$provideAll)

 9 10 12 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36
 2  1  1  6  2  4  6  7  6 11 11 11 20 12  8 20 11  8 14  4  7 10  6  2 12

summary(m1 <- glm(provideAll ~ belong, family = "poisson", data = d))
            Estimate Std. Error z value Pr(>|z|)
(Intercept) 3.101250   0.075039  41.328   <2e-16 ***
belong      0.004450   0.002261   1.968    0.049 *
```

Not only people who have a higher need to belong expose themselves more, we found that **they also feel that they have a better control** on how other people think about them online.

```
(tst.lmer <- lmer(d$degreeControlHowUsersThink ~
                belong +
                selfesteen +
                selfRegulation +
                howOftenLonglyPastFewMonths +
                livingArrangement +
                (1| timeStamp),
                data=d))
p.values.lmer(tst.lmer)
Fixed effects:
                            Estimate Std. Error   t value p.value.LRT
(Intercept)                 2.309886   0.629668  3.668000       0.000
belong                      0.026461   0.012910  2.050000       0.039
selfesteen                  0.002458   0.016246  0.151000       0.878
selfRegulation              0.017727   0.056201  0.315000       0.749
howOftenLonglyPastFewMonths -0.023559   0.027510 -0.856000       0.385
livingArrangement           -0.046826   0.190924 -0.245000       0.803
```

4.6.7 *SNC Goals and Age Effect*

In order to analyze whether younger people has different goals as old people, we grouped participants into 3 categories based on possible stage of their life:

Table 4.10 Three groups of participants

Age range	Note
18-24	Likely they are seeking for a relationship
25-34	Likely they are seeking for a stable relationshp
35 or up	Likely they are already in a stable relationship

We found that people with different ages differ in term of whether they have goals on Facebook. There is a statistically significant difference among young, working, and middle age respondents in terms of whether they would have any goal or not when they are using Facebook. Respondents who are more than 35 years old are most likely to have no goal when using the social networking site (40% of them explicitly stated that they don't have any goal). Comparatively, respondents who are between 25 to 34 years old are most likely to have some goals (14% of them explicitly stated their goals). People who are young (age between 18-24) are most likely to have social goals (92% of them have clearly state their goals in coming to a social networking site).

```
table(d1$noGoalf, d1$ageBin)

    18-24 25-34  35 or older
 0    79    89         15
 1     6    12          6
> chisq.test(d1$noGoalf, d1$ageBin)

   Pearson's Chi-squared test

data:  d1$noGoalf and d1$ageBin
X-squared = 7.6191, df = 2, p-value = 0.02216
```

We found that people of **different ages have different goals in making new friends** (marginally statistically significant on Making New Friend). People who are younger (age between 18 to 24) are more likely to have the goal of looking for new friends or making new

connections. 40% of young respondents expressed a goal of making new friends when they were asked to list 3 goals. A social networking site is a perfect online channel for them to connect with their friends' friends. Comparatively, only 20% of respondents who are between 25 to 34 are seeking for new friends. This percentage is even less for people who is more than 35 years old (only 10%).

```
table(d1$MakeNewf, d1$ageBin)

   18-24 25-34  35 or older
0    61    84          19
1    24    17           2
> chisq.test(d1$MakeNewf, d1$ageBin)

  Pearson's Chi-squared test

data:  d1$MakeNewf and d1$ageBin
X-squared = 5.444, df = 2, p-value = 0.06574
```

We didn't find any difference in other type of goals ("Event", "Stay in touch", "Passive Sharing", "Active Sharing", "Connect Disconnected") between these three age groups.

4.7 SUMMARY OF THE CHAPTER

Social networking site are often considered a place for people to socialize online. The research reported in the chapter investigates what roles the need to belong, one of the most fundamental social needs, plays in driving people to come online for social interactions.

We conducted an online survey with 274 Facebook users to understand how the need to belong is related to their motivation to come online and how this same need affects their social behaviors online. The respondents who answered the survey have a variety of backgrounds and were recruited via broad recruiting channels (e.g. university student mailings, professional networks, Facebook outreaching, etc.).

The study shows that majority of people come to Facebook and post or broadcast information on a weekly basis. The need to belong is not associated with the total number of connections people have in their real life or on the social networking site. But the size of people's online social circle is significantly associated with people's loneliness (the bigger the size of social circle, the lower the loneliness).

The study confirmed our hypothesis that the need to belong plays a significant role in how frequently people come to a social networking site. People who have a higher need to belong are more motivated to come to a social networking site more frequently. In addition, analyses showed that the need to belong significantly correlates with how often people participate in social activities to create connections online.

People with a higher need to belong were found to come on to Facebook more frequently to post a status update, broadcasting message or questions. They also react more to other's social interaction (e.g. posts or comments).

Chapter 5. THE VALIDITY OF THE STIMULATED RETROSPECTIVE THINK-ALOUD METHOD AS MEASURED BY EYE TRACKING

5.1 INTRODUCTION

Think aloud (TA) is a usability evaluation method used to gain insight into how people work with a product or interface. In the most commonly used approach, Concurrent Think aloud (CTA), users work on typical tasks while at the same time verbalizing what they are thinking and doing. Following the appearance of Ericsson & Simon's milestone work [100], this method became widely used in cognitive science and human-computer interaction (HCI). In HCI, CTA has been widely used to study various materials from webpages [101] [102] [103] to end-user products [104] [105], and in various settings from the laboratory [106] [107] to the field [108]. As Jakob Nielsen commented, "think aloud may be the single most valuable usability engineering method" [109].

However, certain questions have been raised about CTA. First, the act of speaking concurrently may have a negative effect on users' task performance. Second, the effort that users make to verbalize information while performing tasks might distract subjects' attention and concentration. Third, the effort to fully verbalize the steps in the work might change the ways that users attend to the task components [110] [111] [112, 113].

To avoid these possible negative effects, some usability researchers have proposed to use Retrospective Think Aloud (RTA), a method that asks users first to complete the tasks and only afterward to verbalize their process. This method is also called post-task testing [114], retrospective protocol [115], retrospective report [116], think after [110], etc.

RTA has been widely used, and people believe that it provides valuable data; however, there has been little work done to confirm the validity and reliability of RTA. Most of the research to date on RTA has focused on comparing this method to other methods (e.g., CTA) in specific task domains [117] [110] [116] [118] [115] [114] [119]. These comparisons were based on user testing rather than experimental study, which undermines the validity and generalizability of the conclusions drawn [120].

No research has scientifically studied the validity of RTA based on its most fundamental claim—that in RTA people talk about what they really did in terms of their actual mental processes or performance. Thus the validity of RTA in usability research is still in need of serious investigation.

In this chapter, we present an experimental study with three main goals: (1) to assess the validity of RTA (whether people's report of what they did truly follows their original task performance), (2) to evaluate the impact of task complexity on the validity of the RTA, and (3) to characterize what other information the RTA provides beyond the basic record of task performance.

First, we present our hypotheses and the details of our experiment. Next, we describe our data processing and findings. Then, we discuss our results and their implications for usability evaluation. Finally, we make some concluding remarks and discuss future work.

The results reported here have been published in the *ACM CHI* Conference on Human Factors in Computing Systems in 2006 [142].

5.2 HYPOTHESES AND QUESTIONS

The focus of our study is the validity of RTA—whether subjects' verbal accounts accurately reflect what occurred during the task performance. The subjects' RTA is considered valid if it describes the same sequence of objects in the same order as the subject attended to in the original task performance. We also studied the reliability of RTA across two levels of task complexity. We worked with what appears to be the most commonly used form of RTA, "stimulated" RTA, in which the retrospection is prompted by visual reminders of the tasks [117] [116] [143].

To refresh our memory, here are the key hypotheses we defined in Chapter 3.2:

Hypothesis 22: *People's recounting of what went on in their task performance in a stimulated RTA describes the same sequence of objects in the same order that the subject attended to in the original task performance.*

Hypothesis 23: *The validity defined in hypothesis 22 is not affected by the task complexity, which is defined in terms of visual information processing complexity.*

We also looked at two more exploratory questions:

Question 1: *Besides a record of the items attended to in the order they were considered, what other types of information does stimulated RTA provide and in what format?*

Question 2: *What is NOT in the stimulated RTA? What features of the task performance are not reported?*

5.3 DECOMPOSITION OF VERBAL REPORT

To address the four concerns listed above, we decomposed the verbal reports into two aspects. Aspect one is the simple record of the objects that subjects report attending to during the task performance and the order in which they did so. This part of the verbal report can be empirically measured and compared with other independent validation data, e.g. eye fixations. Hypotheses 1 and 2 deal with this part of the verbal report. We evaluate this aspect of the verbal report along two dimensions:

1) Degree of valid account: to what degree does subjects' retrospective verbalization truly report what they attended to, in order, in the task performance?

2) Degree of fabrication (error of commission): to what degree is the retrospective verbalization based on subjects' fabrication of events that in fact did not occur?

The measures of valid account and fabrication indicate the validity of stimulated RTA, as stated in hypothesis 22. Whether these two measures are affected by task complexity indicates the reliability of RTA, as stated in hypothesis 23.

The second aspect of the retrospection is *how* subjects talked about the objects that they attended to. Question 1 addresses this aspect of the verbal report. RTA can be most informatively studied by categorizing (1) the types of verbalizations that occur and (2) the way they are related to steps in the task performance sequence.

In addition to what is in people's retrospective verbalization, it is equally important to see what's *not* there, which in studies about TA [100, 113] is sometimes called forgetting or the error of omission. But not including certain information in the verbal report doesn't necessarily mean

that people forgot what they did. They may simply choose to report information in a different way or in less detail. Hence, we can only interpret instances in which objects were missing in subjects' verbal reports as instances of *omission*, analysis of which answers question 2.

The results about the validity and reliability of stimulated RTA can be generally applied to any field that uses RTA to collect user's performance information. The results about the types of verbalization and missing information in stimulated RTA are more useful in the specific context of usability evaluation.

5.4 EXPERIMENT

We designed and conducted an experiment to capture and compare two records of the events that occurred during subjects' task performance: eye movement data and retrospective reports.

5.4.1 *Use of Eye Movement Data as Validation Data*

Eye movement data has been considered one of the measures or indicators of user attention [144] and has been compared with a record of people's concurrent think aloud [145]. It directly shows the locations that people have looked at and in what order. In our study, we used eye movement data as criterion data to indicate what objects people attended to and in what order. The logic of using eye movement data as criterion data is based on a generally accepted assumption called "eye-mind hypothesis" [146] [102] that where people look indicates what they are paying attention to, or thinking about.

5.4.2 *Task Design*

We designed our tasks as typical problem-solving tasks similar to the types of tasks that other researchers have used in evaluating verbal protocols [100] [113]. We designed the tasks to be experimental tasks instead of "real world" tasks in order to eliminate unwanted confounds and complexities in subjects' task performance, which could lead to difficulties in processing and analyzing subjects' verbalization and eye tracking.

We also designed the tasks with two different levels of complexity to address the issue of RTA's reliability. We designed four tasks, two in a "simple" group and two in a "complex" group. In each group there was one graphical task and one numerical task. Subjects worked on all four tasks. The answer key was randomized to multiple-choice options (A, B, C, etc.) in order to prevent bias due to subjects' knowledge of the solutions from previously-tested subjects. The tasks were:

Simple tasks: 1) number pattern (numerical): evaluate the sequence to identify the last number in that sequence; 2) matching puzzle piece (graphical): choose the correct puzzle piece that matches the target piece in the picture.

Complex tasks: 1) classroom data table (numerical): evaluate the maximum capacity and number of students to determine which term period shows the greatest overload; 2) bottle or airplane graph (graphical): analyze graphs to determine which graph best represents the height and volume of water poured into a container or to evaluate whether statements about the airplanes are true or false.

Task complexity relates to the cognitive load required in completing a task. For our task design we borrowed classic concepts from Campbell [147] and Wood [136] to develop a combined definition of task complexity in problem-solving tasks: (1) information load: amount of information the subject has to retain; (2) information diversity: dimensions of information that need to be accounted for; (3) information transformation: amount of recoding of information for meaning; (4) number of dimensions in a solution, and (5) number of task steps.

Hence, matching a puzzle piece is a simple task because it requires less information load, diversity, transformation, and so on. The subject needs to remember the shape and/or color of the target piece and mentally rotate a puzzle piece to the same orientation as the target piece. The number pattern is also a simple task because it requires only a linear or constant mathematical calculation.

The complex tasks required greater cognitive processing in all five measurements. For example, the classroom data table required that subjects calculate the difference between room capacity and number of students to determine maximum overload across three classrooms. The airplane graph required that subjects use and retain information about two airplanes from three separate graphs. The bottle graph asked that subjects mentally envision how water flows into a container (flask, funnel, bucket, etc.) and translate that into a graphical representation.

Although we designed the tasks to be experimental tasks, the problem-solving strategies that they call upon are similar to those used for tasks in the real world and for tasks designed for usability testing: deriving answers from data presentations, identifying items based on shape, etc. Thus, the design of these tasks enables us not only to scientifically control the study, but also to ensure that the results could apply to usability testing using real world tasks.

5.4.3 *Procedure*

The experiment had four sections: a pre-questionnaire, a task performance session, an RTA session, and a post- questionnaire. The experiment took about 45-60 minutes.

The pre-questionnaire asked about subjects' background and experience in eye tracking and in using the think aloud method. After administering the pre-questionnaire, we tested subjects to determine whether their eyes could be accurately calibrated (if not, we ended the study).

If the eye calibration succeeded, subjects were asked to complete four tasks, two from the simple group and two from the complex group, with their eye movement captured. Subjects were also randomly assigned into one of two conditions (a Latin squared task order of simple-complex or complex-simple). The computer screen and subject's mouse interactions were recorded using a screen capturing software.

Following the task session, we briefly explained to subjects the basic concepts of think aloud (TA) and asked them to apply these concepts in a TA practice, in which they were asked to verbalize while taking staples out of a stapler.

After the training session, the video of screen captures was played on the computer. The video showed subjects the task screens they had seen in the task session, the cursor positions and movements, and any selections they made. The video did not show the captured eye movement. Subjects were asked to report what they did and what they thought when they were doing the tasks. The use of a videotape as a stimulus for the RTA is documented in the previous literature [117] [100, 115, 143] [119]. Subjects' verbalizations were recorded by using video recorders.

After they completed the verbalization, subjects were asked to fill out a post-questionnaire about their perceptions of task complexity and their experience in doing RTA.

5.4.4 *Subjects*

Forty-three student volunteers were recruited from an undergraduate engineering class for this study. They received class credit for their participation.

Among these students, one student was dismissed because his eye movement couldn't be calibrated. Fifteen students' eye movement data needed substantial adjustments and were thus excluded from the analysis reported in this chapter.

Another two students were eliminated because of difficulties with their verbalization. The exclusion criteria were (1) subjects rated their language ability as "speaking English is very difficult and I can only partially express what I really want to say", and (2) the evaluation of the verbal reports showed that their verbalizations were unintelligible. Another student's data was randomly excluded to achieve two groups of equal size.

In total, 24 subjects, two females and twenty-two males between 19 to 33 years old, were included in the data analysis reported in this chapter. None of them had experience doing RTA, although one subject had once done a concurrent think aloud.

5.4.5 *Apparatus*

The experiment was conducted using a Dell computer running under Windows XP. The computer is equipped with an eye tracking system from Eye Response Technologies which includes an eye tracking camera, an ERICA system for eye calibration, and a GazeTracker for

data collection. Subjects' task performance was recorded using Camtasia software. Their verbalizations were recorded onto Sony digital video tape using a video recording suite.

5.5 DATA PROCESSING

5.5.1 *Coding of Sequences in Verbalization and Eye Movement*

Eye movement data provides a highly detailed record of all the locations that a user has looked at. Reducing this data to a density level that can be compared to verbal report presents a challenge [145]. Our approach involved computationally reducing the eye movement data for each task to an ordered sequence of "Areas of Interest" (AOI), qualitatively coding the verbal data to ordered sequences of AOI, and then applying a sequence alignment algorithm to compare the AOIs in eye movement and verbal sequences.

5.5.2 *"Areas Of Interest" as Indications of User's Attention*

Coarse-level and fine-level rectangular AOIs were defined for each task screen, based on the "chunks" that might be looked at or talked about separately. Coarse-level AOIs were defined as major screen regions (e.g., instruction, task problem, answer choice, task submission button). When a coarse-level AOI includes meaningfully distinguishable objects, it was further decomposed into fine-level AOIs. For example, in the bottle graph task shown in Fig.1, the screen is decomposed into 5 coarse-level AOIs: an instruction area (A), additional textual labels (B), a problem area (C), a solutions area (D), and a task submission button area (E). The problem and solution areas (C & D) contain graphics that a person can meaningfully speak about or point to separately while describing the task. Thus, these areas were further decomposed into fine-level AOIs (f through m). Table 1 lists the number of coarse and fine level AOIs for each task.

Table 5.1. Number of AOIs in the coding schema for each task

Number of AOIs	Coarse level	Fine level
Puzzle	5	9
Number pattern	8	18
Classroom table	5	12
Bottle graph	5	8
Airplane graph	9	25

5.5.3 *Coding of AOI Sequence from Eye Movement Data*

Reducing the eye movement data to visual areas of interest involved the following steps: reducing the eye gaze stream to a sequence of eye fixations, determining which objects the users had fixated upon, and reducing the eye fixation data to AOI sequences. Once calibrated, our eye tracker is able to sample the (X, Y) screen location of an eye gaze 30 times per second.

Because we are specifically interested in the users' loci of attention, the eye gaze data first was transformed into a sequence of eye fixations (an eye movement that stabilizes an image directly on the retina for at least the minimum period of time required for processing the information).

The GazeTracker software was used to calculate fixations, requiring a cluster of at least 3 gaze points within a 40-pixel diameter (slightly more than 1 degree of visual angle) for a minimum of 100ms for graphical and numerical data or 200ms for textual sentences (e.g., instructions). Assuming the eye-mind hypothesis [146] [148], the sequences of fixations represent the sequence of objects on the screen that the users cognitively attended to.

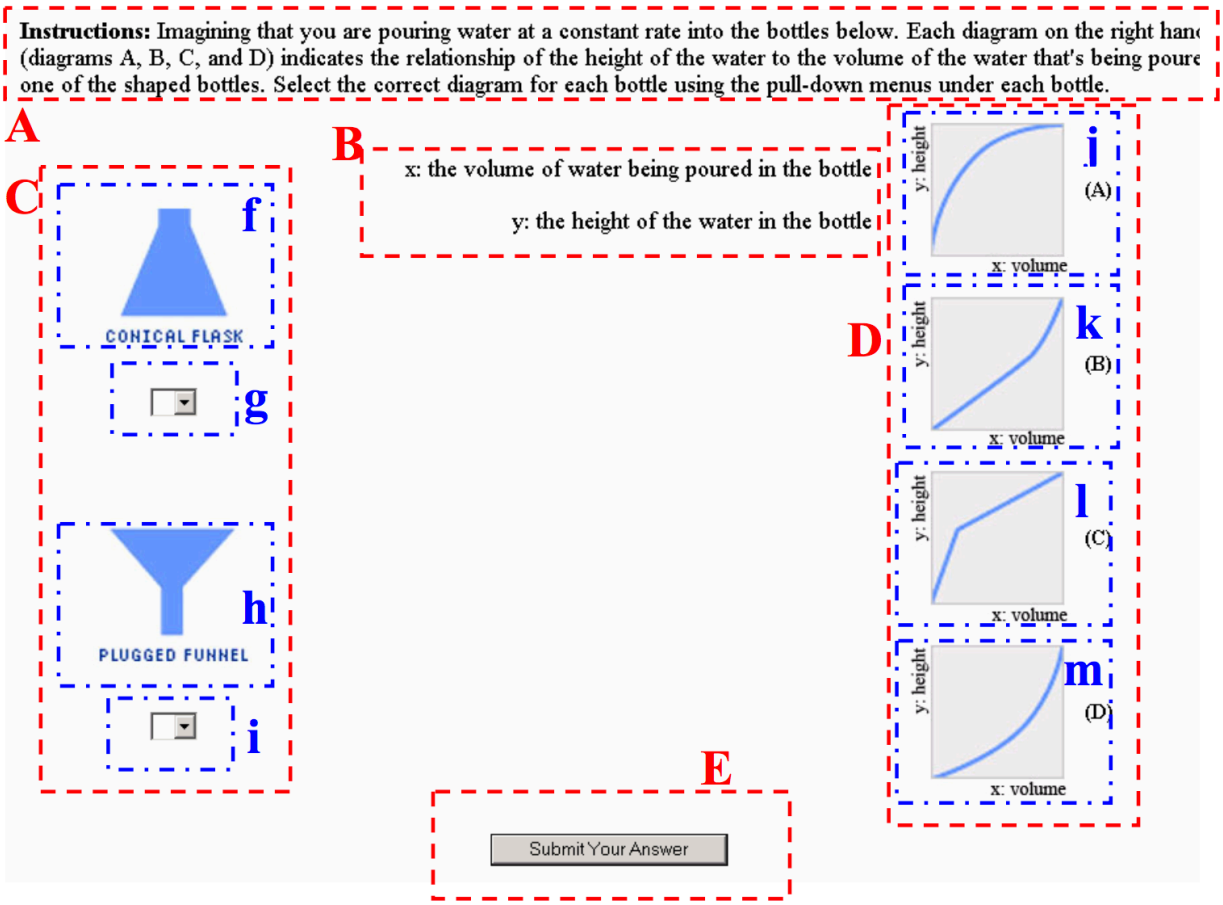


Figure 5.1. The coding schema for the bottle task.

Because multiple fixations can occur in immediate sequence within one AOI (e.g., reading the instructions induces word-by-word fixations), any sequence of two or more fixations within the same AOI was collapsed into a single "fixation cluster." The generated sequences of eye fixations (clusters) were matched with the task screen AOIs to determine when fixations occurred within an AOI. This resulted in two eye movement sequences: a lower- resolution coarse-level sequence of AOIs and higher- resolution sequence that contained both coarse and fine- level AOIs (using fine-level whenever possible, but not all AOI regions decomposed at the fine level).

5.5.4 *Coding of AOI Sequence from Verbalization*

The subjects' retrospective verbalizations were first transcribed into text files. During the qualitative coding process, coders identified utterance segments by categorical type and, when stated, the object AOIs that the segment referenced. The categorical coding of segments was based on a pre-defined set of verbalization categories which will be discussed later. When a subject verbally referenced an object in a task screen, such as "the conical flask" (see Fig. 1), the segment was coded at the fine level (AOI = "f") in addition to the coarse level (AOI = "C"). When a subject mentioned the region without indicating a specific object (e.g., "the bottle") or referred to the region as a whole (e.g., "the bottles on the left"), the segment was coded at only the coarse level (AOI = "C"). These coded segments were used to form the final AOI sequence for the verbalization.

Interrater reliability was calculated as the percentage of agreements out of the total number of codings per a verbalization session. It was performed on 16% of the data and yielded 87% reliability on the coarse level coding and 77% reliability on the fine level coding.

5.5.5 *Calculating Validity Using Sequence Alignment*

To measure whether subjects' verbalizations corresponded to the objects attended to in the order of occurrence, we compared the eye movement and verbal AOI sequences by calculating the edit distances and the alignment between two sequences using the Levenshtein algorithm and one of its extensions, the Needleman-Wunch algorithm. Levenshtein edit distance is a well-known algorithm for finding the minimum number of "edits" (i.e., deletions, insertions, or substitutions) required to transform one string into another [149]. The alignment of two sequences is a qualitative measure of the sequence similarity, which exhibits where the two

sequences are similar and where they differ. In the HCI domain, Levenshtein distance has been used to measure error rates between the presented and transcribed texts in text entry [150], and to find out the missing or incorrect letters in cognitive modeling based on ACT-R model [151].

In this study, Levenshtein distance was used to compare eye movement and verbal AOI sequences on the coarse level. Given that the fine-level AOI verbal sequences could include both coarse or fine grain AOIs depending on the resolution that subjects used when referencing objects, Needleman-Wunch was used to allow for approximate matches. The sequence alignment algorithms calculated the number of "edits" to transform one sequence into the other, based on which maximal alignment of the verbal and eye movement AOI sequences was generated.

Once aligned, the AOIs from the verbal sequence that match up with AOIs in the corresponding eye movement sequence indicate valid accounts (the subject's verbal report corresponds to subject's performance.) The AOIs found in the verbal report but not in the eye movement data indicate verbal fabrication of information. Likewise, the number of AOIs found in the eye movement data but not in the verbal report indicates verbal omissions of information.

Table 5.2. Measurement of Verbal Report and Eye Movement

		Eye movement	
		Yes	No
Verbal report	Yes	Valid (approximate) account	Fabrication or misstatement
	No	Omission	N/A

We also found another feature of subjects' retrospection: misstatement. In this case, the subject mentions an object in-between two other objects reported in the eye movement data, but

the subject misidentifies the middle object. Although the notion of misstatement doesn't appear in earlier literature, this case is different from fabrication and we make this distinction in our analysis. Table 2 summarizes the ways in which the alignments between the verbal report and eye movement data were compared. The results were normalized into percentages based on the total length of the verbal and eye movement sequences.

The following provides an example of alignment, which shows how we calculate the degree of valid account, fabrication, misstatement, and omission. Given the verbal AOI sequence: `BDBCGCF` and the eye movement AOI sequence: `ABCBACCEH`, the resulting alignment is:

```
Verbal report:    -BDB-CGCF-
                    |$|  |  |!
Eye movement:     ABCBAC-CEH
```

This sequence alignment shows that the verbal sequence consists of 4 valid accounts ("|"), 1 approximate account ("!"), 1 fabrication ("−" on eye movement sequence), and 1 misstatement ("$"). The total number of verbal AOIs is 7:

Degree of valid account = 4/7 = 57%

Degree of approximate account = 1/7 =14.3%

Degree of fabrication = 1/7 = 14.3%

Degree of misstatement = 1/7 = 14.3%

The total number of eye movement AOIs is 9. Five of them correspond with verbal AOIs. Omission accounts for the rest of them ("−" on verbal sequence.) Thus,

Degree of Omission = 4/9 = 44%

5.5.6 *Categorization of Verbalization*

As stated earlier, subjects' verbalizations about the objects that they attended to were coded to form the AOI sequence. In addition, subjects' verbalizations were coded based on what *kind* of statements they provided.

Earlier, Russo coded concurrent verbal statements into five categories: perceptual, low level inferences, high level inferences, strategy, and all others [113]. After a preliminary analysis indicated the presence of a broader range of categories, we coded our verbal reports into eight categories separated into four types, as shown in Table 5.3.

Table 5.3. Categories of verbal statements

Type	Category
Behavior Statements	Procedural Behavior (PB)
	Negative Behavior (NB)
Inferential/explanatory Statements	Logic Inference (LI)
	Perception Explanation (PE)
	Strategy Explanation (SE)
Reflective comments	Forensics/Diagnostics (FD)
Others	Meta-Comment (MC)
	Others (OT)

Behavior statements are specific statements about what subjects did during their task performance, such as "I read the instructions at the top" (A23). Negative behavior was coded for statements provided in a negative way, such as "I also don't think I read the name of the flask" (A23).

The inferential statements include "logic inference" directly inferred from or generated based on information that users attended to, such as "I see that the top and bottom of this highlighted piece protrudes out" (B01); "perception explanation", such as "the picture is pretty bright" (A01); and strategy explanation about how subjects completed the task, such as "and this one I just started doing the subtractions...addition" (B09).

Reflective comments contain self-diagnostics about what subjects did or should have done, such as "for this one I was actually a little confused about what they were asking at first" (A10). The last category is "meta-comments", such as "this one (number table task) kind of took me by surprise" (A18), and unidentifiable verbalizations. The coding of the categories of verbalization has 77% interrater reliability (percentage of agreements) on 16% of the data.

5.6 RESULTS

We analyzed the following data using descriptive statistics, repeated measure variance analysis, and chi-square:

1) Sequence comparison measures between verbal AOI sequences and ET AOI sequences

2) Percentage of categorical verbal statements

3) Subject's rating of task complexity and RTA experience

5.6.1 *Validity of RTAP: Valid Account vs. Fabrication*

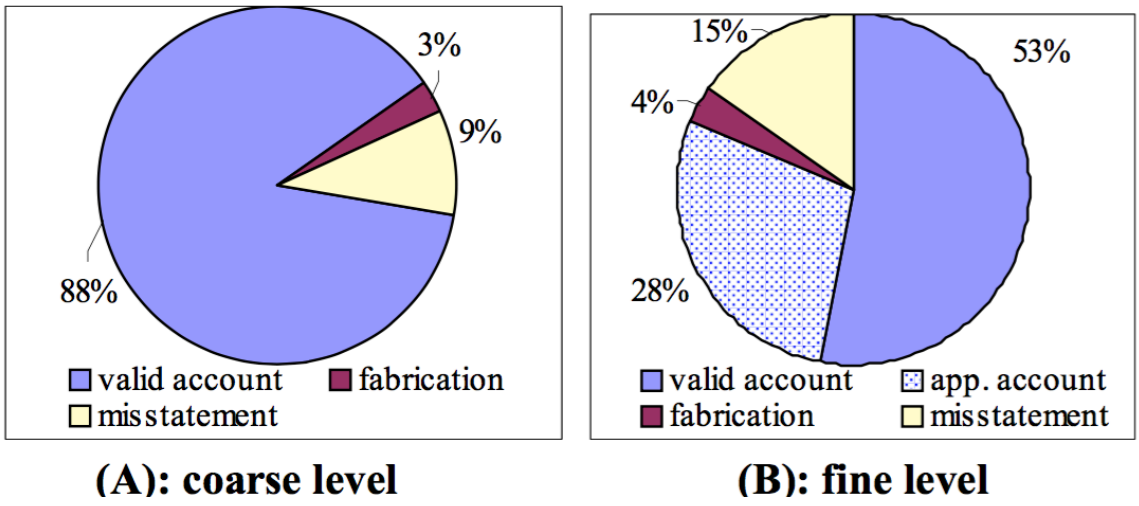


Figure 5.2.The validity of stimulated RTA

Fig. 5.2 shows the validity of stimulated RTA on the coarse and fine level. Sequence comparison of verbal and eye movement data on the coarse level indicates the validity of RTA report on subjects' general problem-solving processes (Fig. 2-A). We found 88% valid accounts (verbal AOIs matched eye movement AOIs and occurred in the same order). 9% of misstatements points to subjects' awareness of having attended to AOI regions but inability to identify the exact target objects. And 3% fabrication in which verbal AOIs did not correspond with eye movement AOIs.

We also determined RTA validity at the fine level (Fig. 2- B). We found 53% valid accounts of low-level AOIs that matched up in the verbal and ET data; 28% of approximate matches in which verbal and eye data matched up sequentially on the coarse level but varied somewhat on the fine AOI levels (for example, a subject's verbalization may indicate the left side of a diagram, but the eye data the right side); 4% fabrication on the fine level; and 15%

misstatement, indicating that people experienced some difficulties in identifying exact low-level AOIs even though they appear to remember attending to those regions.

We acknowledge that the design of the experimental tasks may lead to underestimates of fabrication because subjects are constrained to look at a defined set of items in a display. Any future study needs to look at the extent of subjects' fabrication in a real world task environment.

5.6.2 *Reliability of Verbal Reports with Task Complexity*

Our task design incorporated two levels of task complexity: simple and complex. To verify our measurements of task complexity, we relied on subjects' post-test ratings of task complexity on the four tasks that they worked on.

Subjects' ratings confirmed our measurements of task complexity. The repeated measure variance analysis shows significant difference between the two simple and two complex tasks ($F(3,69)=13.948$, $p<.05$.) A post-hoc Tukey analysis shows no significant difference between tasks in the simple group (the two puzzle tasks vs. the number pattern task, $p=.572$) and between tasks in the complex group (the classroom table vs. the bottle or the airplane task, $p=.973$). But there are significant differences between simple and complex tasks ($p=.00$, .00, .012, .003 for all four pair-wise comparisons). The results of subjects' rating show that tasks in the complex group are perceived as significantly more complex than tasks in the simple group.

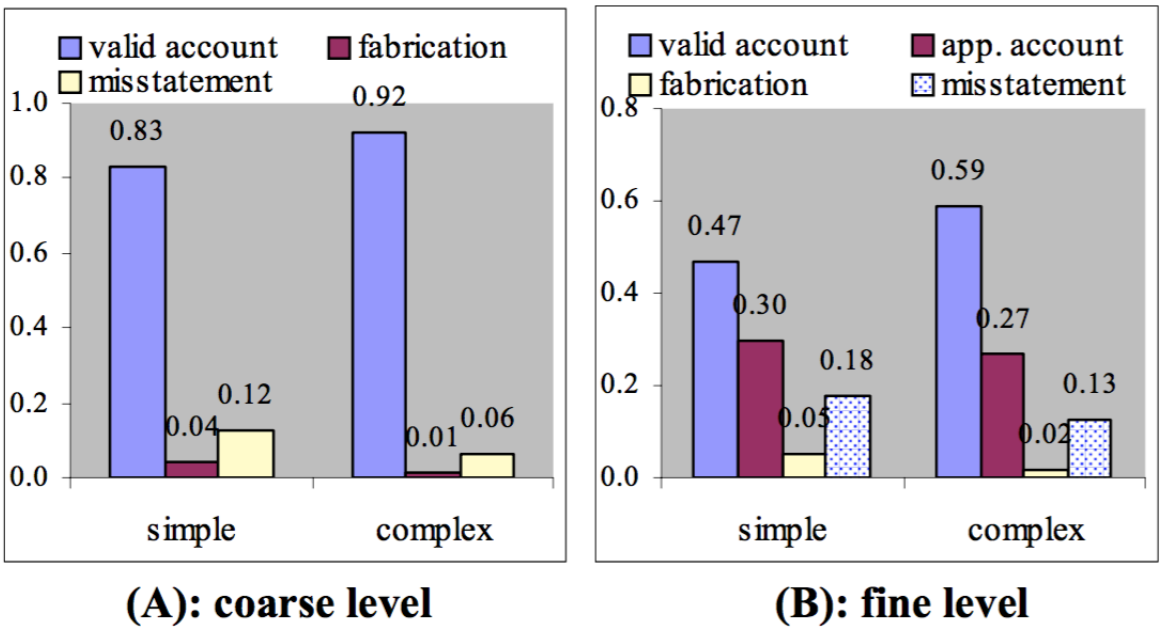


Figure 5.3. The reliability of stimulated RTA over task complexity

To determine whether task complexity has any significant impact on the validity of RTA, we conducted a chi-square analysis of subjects' valid account, misstatement, and fabrication. We found that on the coarse level (Fig. 5.3-A) there is no significant effect of task complexity on the validity of RTA ($\chi 2 = 4.26$, $p = .12$). Subjects' valid account is 83% for simple tasks and 92% for complex tasks; fabrication dropped from 4% for simple tasks to 1% for complex tasks; and misstatement dropped from 12% for simple tasks to 6% for complex tasks.

Although there is no significant difference between simple and complex tasks on the validity of RTA, we did find an interesting trend: subjects tended to produce more valid accounts and commit fewer fabrications in the complex tasks than in the simple tasks. Could this suggests that subjects put more thought in complex problem-solving and can therefore verbalize in more detail? On the fine level (Fig. 3-B), we found no significant difference between simple and complex tasks ($\chi 3 = 3.6$, $p=.31$) on valid account, approximate account, fabrication, and

misstatement. The same trend that subjects produced more valid accounts and fewer fabrications on complex than simple tasks at the fine level is consistent with our findings at the coarse level.

5.6.3 *Verbal Reports: Procedural, Inferential, and Explanatory*

RTA also provides descriptive information about how subjects attended to the objects in their task performance.

We categorized the types of verbalization subjects provided and the way these verbalizations are related to the steps in the task performance sequence. We discuss the results on omission after presenting the results for verbal categorization, because we think there is a very close relationship between the two. Understanding the former could provide more insight into how omissions occur.

Fig. 4 shows the distribution of the categorized verbalizations. 36% were statements about subjects' procedural behavior, 29% logical inference, 25% strategy explanation, 3% perception explanation, 3% forensics/ diagnostics, 1% meta-comments, and 2% for other. The low percentage of meta-comments and other statements indicates that subjects were focused on verbalizing what they recalled about their performance and that there was little intervention between the experimenter and subject.

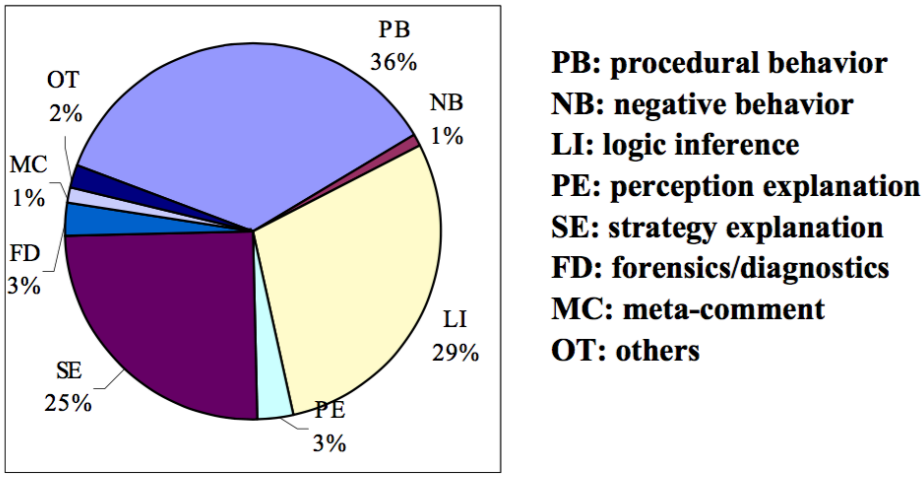


Figure 5.4. Categories of retrospective verbalization

A chi-square analysis of the verbal categories shows no significant effect of task complexity on the type of statements that people made ($\chi 7 = 3.69$, p=.81). Fig. 5 shows that in both simple and complex tasks one-third of subjects' statements involved procedural behavior; 34% of logical inference for simple tasks and 24% for complex tasks.; 22% of strategy explanations for simple tasks and 28% for complex tasks; and 1% of other comments for simple tasks and 3% for complex tasks.

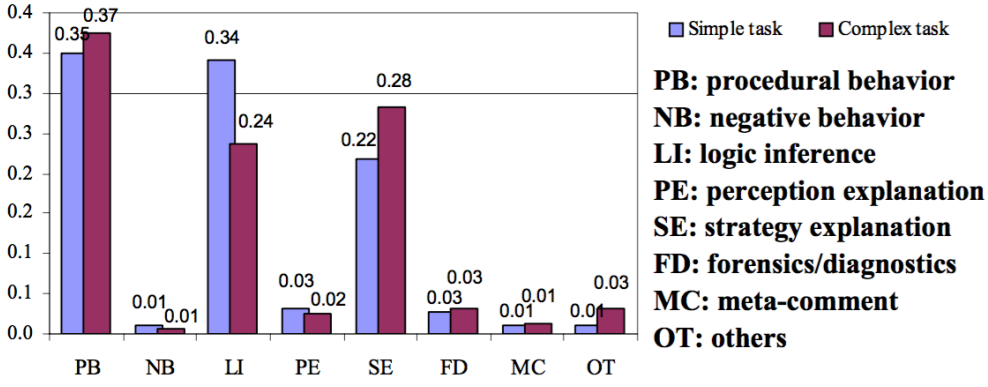


Figure 5.5. The percentages of categorized RTA statements

The results indicate that when subjects verbalized on complex tasks, they tended to make more higher-level inferences (strategy explanations) than intermediate-level inferences (logical inferences).

In terms of the relationship between the type of verbalization and reports of the objects that subjects were attending to, 41% of verbal AOIs came from procedural statements and 31% from statements of logical inference. Among the other verbal categories, 23% of verbal AOIs were drawn from explanatory statements, 2% from perception explanation, and 2% from forensics/diagnostics.

5.6.4 *Degree of Omission*

We were also interested in finding out what is *not* there, the degree of omission as revealed by the sequence alignment. We found that 47% of eye movement AOIs did not correspond with verbal AOIs. An analysis of the effect of task complexity on omission indicates significant difference between simple and complex tasks ($F(1, 23)=20.6$, $p<0.05$): 38% of eye movement AOIs were missing for simple tasks and 56% for complex tasks. There is no significant difference between tasks in the same task-complexity level.

Further analysis of typical omissions between AOI sequences in verbalization and eye movement suggests at least two possible reasons: One, differences in data density and abstraction level for verbal and eye data result in omission in general; and two, omissions more likely occur when subjects have difficulty working out a problem, which may explain why there are more omissions for complex tasks. We discuss omission further in the discussion section.

5.6.5 *Subjects' Evaluation of RTA Experience*

Subjects' rating of factors that facilitated their verbalizations (5: very helpful; 1: not helpful at all) shows that they relied on their memory the most (4.17), followed by the video replay (3.83). Video replay of their mouse movements (2.33) and the think-aloud training (2.13) were rated as not helpful. Rating of experimenter's prompts fell between being helpful and not helpful (2.61).

5.7 DISCUSSION

Hypothesis 22: *Our findings support our first hypothesis that people's recounting of what went on in their task performance in a stimulated retrospective think aloud describes the same sequence of objects in the same order as what they attended to during the original task performance.*

More than 80% of subjects' verbalizations of what they were attending to corresponded with the eye movement data. We reject the notion of subjects' fabrication since only less than 3% of their verbalization failed to match up with objects identified by their eye movement.

This finding indicates that usability researchers can trust the information they get from a stimulated RTA. This finding is especially useful for those whose products cannot easily be tested using concurrent think-aloud (for instance, games). Also, by using RTA researchers can collect other usability measures during task performance, such as time on task, error rate, etc., without concerns about the effects of verbalizing on that data. The combination of performance measures and verbalization can provide usability evaluators more accurate and comprehensive

usability measures on the materials they tested. These gains are achieved at the cost of the additional time required for the retrospection.

Hypothesis 23: *Our findings support our second hypothesis that retrospective think aloud is reliable in that it is unaffected by task complexity.*

Subjects' verbalization on complex tasks, defined by a heavy and diverse information load, had the same percentage of valid accounts as their verbalization on simple tasks. In addition, the small incident rate of fabrication for complex tasks was similar to that of simple tasks. These results suggest the general reliability of stimulated RTA in usability testing, in which it is common to use tasks with different levels of complexity to investigate usability issues.

5.7.1 *What Other Information does RTA Provide?*

Subjects' retrospective verbalization provided a wealth of explanatory information about what they were attending to, how they processed information, and how they arrived at a solution, and it did so while at the same time closely following the contours of the actual task performance.

Ericsson & Simon [100] considered explanatory statements as unreliable because they could distort the report of what subjects actually did and in what order. However, our study of what subjects attended to and in what order found that fully 23% of all verbal sequences used to correlate with AOIs in subjects' eye movement came from explanatory statements. Overall, only one-third of subjects' verbalizations were simply procedural and more than half were inferential (logical or strategic). While subjects' inferential and explanatory statements were not as specific

as their procedural statements, they nonetheless provided important information about how subjects were mentally processing information to work out a solution.

5.7.2 *What are People Omitting from RTA?*

Our study found gaps in the verbal AOI sequences when compared to the eye movement AOI sequences, suggesting that subjects' were omitting information from their verbalization. To account for these omissions, we looked at what subjects were neglecting to say in their verbalization and arrived at two plausible explanations:

Case #1: Different data densities and levels of abstraction

Omissions occurred in part because verbal and eye movement data differ in data density and abstraction levels. Whereas eye tracking provides high density, low abstract- level sequence data, verbal reports tend to provide low density, high abstract level, aggregated sequence information. We anticipated this problem and tried to remedy it by using coarse and fine level AOI coding

schemas. However, we found that the gap between RTA and ET could not be completely bridged in these instances.

To illustrate our point about data density and abstraction levels, we pick one representative case from our data, Subject B15 who had a total of 49 omissions (with .62 degree of omission), considered average across all subjects. In the verbal report on the second complex task (Fig. 1), which involves identifying the correct graph for the ink bottle, Subject B15 mainly talked about the ink bottle and the A, B, and D answer choices, and described his behavior: "...and I was pretty much looking from left to right the entire time; I glanced up at the

instructions a few times...” We coded this part of the verbalization (HHKDJMIA), following the coding schema shown in Fig. 1. The coarse level AOIs are labeled in capital letter (A-E), and fine level AOIs are labeled with lower case letters (f-m)

In contrast with the verbal AOI sequence, the eye movement AOI sequence was longer and richer in detail (HKHKJMJHMKJBJAMJMHMHMLJKLIMIHM). The codes H, J, K, and M appear multiple times in the sequence, which indicate that the subject’s eye movement was constantly switching between the ink bottle and graphs A, B, and D.

Although in the alignment of the verbal and eye movement sequences 22 omissions were recorded, we could not simply dismiss them as a failure of the subject to report what s/he did. Subject B15 clearly stated looking left and right the entire time. Rather than repeating each instance of recursive behavior, the subject apparently chose to summarize his/her actions. Hence, this is one instance in which the eye tracking recorded the subject’s recurrent eye movement between multiple information points but in which the verbal report reduced the ocular behavior to a single observation.

This difference in data densities and abstract levels could result from several facts, including prior training in RTA, auto-processing, etc. In the training session, subjects were told to verbalize everything that they were doing and thinking about. However, the subjects may be unsure of how much detail to provide. They tended to report on things that directly related to the task, such as selecting a choice, but were less likely to report the auto-processing steps, such as recognizing that the letter for the first choice is A.

Although different data densities and abstraction levels between verbalization and eye movement increase the number of omissions, we do not believe that this particular type of omission undermines the validity of RTA.

It is worth pointing out that when usability evaluators analyze RTA, they not only study what users are attending to but their behavior patterns. Given that the eye tracking gives credence to users' verbal report of their behavior, usability professionals can perhaps correlate specific behavior patterns with specific design problems (such as users tend to look at the interface objects back and forth several times if the interface layout is ambiguous or vague).

Case #2: Encountering difficulties in task performance

We also found that the degree of omission was affected by subjects' interaction with the tasks. When subjects said that they had difficulty finding a solution or were confused by the task instruction, their verbalizations remained at a very abstract level. This finding is consistent with Branch's, who observed that the number of "dead ends" encountered by the users affects the amount of data generated during the think-after [110].

Here we pick another case, Subject A11, who verbalized at a very abstract level because s/he was apparently having difficulties solving the problem. Subject A11 had a 71% total omission rate in his/her verbal AOI sequence.

According to the verbal report, the subject was working on question 4 of the airplane task and was looking at the first and the third graph from left to right: "so I was confused which one was (the right graph)...which I was trying to take...I was really very, very hesitant on this one...." This verbalization was assigned the following AOI sequence code: `6CE66E8` (`6` is the code for

the fourth question; 8 for one of the answer choices; C for the first AOI graph on cost; and E for the third AOI graph on capacity).

In contrast, the subject's eye movement AOI sequence showed the following: 6RQRQS6RQR6KS676SRSQKSM 86Q6SKSROPN6R86RS876S789786RLKSMQRMLSR7. We found that for question 4, the subject was constantly looking at the AOI fine levels, namely the first and third graphs. K,M, and L represent three fine level AOIs in the first graph; S,R, and Q are three fine AOIs in the third graph; 6,7,8,9 are four fine AOIs for the questions and answer choices. Although the subject mentioned that s/he was looking at the first and the third graphs, his/her verbalizations remained general and did not mention the fine level AOIs that he/she looked at. The alignment of verbal and eye movement AOI sequences resulted in 56 omissions, which accounted for 50% of the subject's total omissions. It should be noted that a large number of omissions also occurred for question 3 on the same airplane task and for the same reason, that the subject found the task to be confusing and thus scanned the materials repeatedly.

This case appears to exemplify what occurs when subjects are struggling to work out a solution without too much success; subjects tend to heavily revisit information sites that show up in the ET data coding as one long AOI sequence. However, the brevity of the subjects' retrospective verbalizations belies what their eye movement is telling us and may explain our finding of the significant effect of task complexity on omission. It appears that when participants work on a complex task that they have difficulty solving, they tend to experience equal difficulty in formulating and articulating how they went about solving the problem. When that happens, their retrospective verbalizations tend to be abstract and unclear, and any details about what they were attending to are missing.

We see a similar problem in concurrent think aloud when subjects fall silent at the points where the cognitive load is heaviest. It appears at this preliminary stage that stimulated RTA may not help us address this problem. This result, combining with the valid account given from complex tasks, indicates that the retrospective think-aloud could be a useful method for finding usability problems (based on valid account), but maybe not be a useful method for revealing all of the detailed steps in task performance (because of omissions). This issue calls for more research.

The concept of task complexity in this study is a function of information load, information diversity, information transformation, task-solution dimensions, and task steps. All these factors are constitutive of the tasks that we designed. But the combination of factors makes it difficult to isolate the one factor or factors that make the task harder to complete and harder to articulate. We should emphasize, though, that task complexity does not necessarily result in a poorer task or verbal performance, which also depends on a person's prior knowledge and work experience. Further investigation on how task complexity and prior knowledge may affect a person's verbalization needs to be done. It does not, however, fall within the scope of this work.

5.8 SUMMARY OF THE CHAPTER

In this study, we empirically investigated the validity and reliability of stimulated retrospective think aloud (RTA). Our study supported the validity of stimulated RTA in that people's recounting of what went on in their task performance describes the same sequence of objects in the same order as what they attended to during the original task performance. Our study also shows that the validity of the RTA doesn't vary with different levels of task

complexity. These findings are useful in any field that uses RTA to collect user's performance information.

This study also shows that the logic inference and strategy explanation information in people's verbalization also provide valid information about users' task performance. This inferential and explanatory information can indicate how information was processed and clarify what specific strategies people used to complete tasks in a usability study. Usability evaluators can use this information to assess whether a product or interface is successful in supporting users in doing the tasks it is designed for and to identify what parts of the design negatively affect user's behavior.

Two case analyses about omissions in the verbal report show that, in general, in instances when users were struggling to complete tasks, the verbal reports provide low density and high abstract level information. Such patterns could be used as a valid indication of problems in a usability study.

The results and findings presented in the chapter are preliminary work to establish the fundamental validity of stimulated RTA. Future works can be done following two trends. One is to design an advanced algorithm to extract high level information from ET, so that it could be used to compare with high level verbalization. Second is to study how a specific dimension of task complexity affects the degree of omission found in people's retrospective verbalization.

Chapter 6. NEED TO BELONG RELATED TO SOCIAL INFORMATION PROCESSING AND SEARCH

6.1 MOTIVATION

Need to belong is considered one of the fundamental needs people have in their life. The development of social media has greatly expanded the ways that this need can be facilitated and fostered through various online activities. Millions of users are joining online communities to share personal information and make new friends. Countless new social sites have been created to attract people to form online communities and expand friend circles. The hope has been that by coming to these types of sites people can form social connections with others through online communication, which in turn increases their life quality overall.

Since the first popular social site came to people's attention, there has been an increasing number of research studies looking at how social communication affects people's psychological states. However, there has not been a body of knowledge about how participating in an online community affects the fundamental need people have for formulating social relationships: the need to belong. Even though there have been also lots of claims about how a site increased participants' sense of membership and made them to be a part of the community, it is still not clear how exactly the effect has happened, what are the contributing factors, etc.

This study is to understand how people respond differently to social stimuli when they have different levels of need to belong. In the Chapter four, we reported how the need to belong is associated with what people do online on a day-to-day basis. In this chapter, we will report our investigation of the way that people's social and cognitive behavior changes when the individual's sense of belonging has been manipulated before the person is exposed to social stimuli. By looking at how people consume social information, we can understand how they

respond to social stimuli differently. The experimental design and analysis can reveal how people's sense of belonging alters their attention distribution as well as their understanding of the social information presented in the experiment.

In addition to running an experiment with psychological manipulation, this study also intends to understand how people mentally process social information by retrospectively interviewing them about how they processed the information on the experimental page. This can reveal how the sense of belonging directs users' attention while they are digesting information presented on a social site. We hypothesize that the manipulated need to belong drives people to pay different levels of attention to socially sensitive information. By interviewing people about how they processed the social postings, we'd like to reveal the breadth and depth of mechanisms in which the sense of belonging interacts with people's social life.

In summary, this study uses both qualitative and quantitative approaches to understand both psychological and behavioral effects. By exposing people to a manipulated experimental environment, we can understand how the sense of belonging affects people's attention distribution as well as the cognitive processing of social information. By interviewing people about how they processed the social postings on a social page, we are able to comprehend what social experiences affected people's perception of a sense of belonging, and what makes them feel more connected or more distanced.

6.2 METHODOLOGY

In this study, we asked participants to go through two phases. All participants were separated into two groups: a control group and an experimental group.

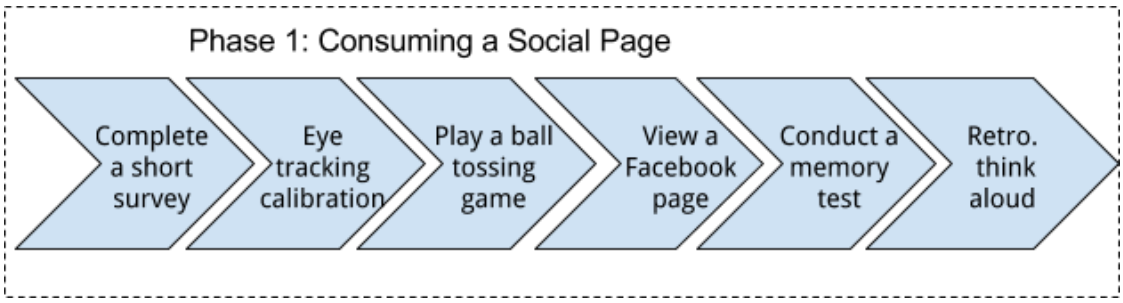


Figure 6.1. Phase 1 Consuming a Social Page

In the first phase (Figure 6.1), all participants were asked to go through a set of tasks to consume social information. First, to collect their demographic information, the participants were asked to answer a short survey. After completing the survey, participants were asked to conduct a short eye tracking calibration so their eye movements can be tracked accurately by the Tobii eye tracker.

Then, participants were asked to play an ostracizing ball-tossing game. The participants who were in the experimental group was given the game that was designed to create a sense of social exclusion and rejection. This is designed to lower participants' initial sense of belonging, elevating the need to fulfill the need to belong for participants who were in the experiment group. The participants who were in the control group were asked to play the same game, but the setting dictated a fair game schema in which everyone has the same chance to get the ball from other players.

After the game playing, participants were asked to view an experimental Facebook page. The Facebook page was designed to contain a variety of Facebook modules, from highly personal conversations to irrelevant impersonal ads. The goal was to understand how participants pick and choose the modules and what they eventually remember after reading the whole page. The design of the Facebook page will be explained in a later section of this chapter. Participants

were asked to spend as much time as they wanted on the designed Facebook page and inform the researcher when they were done with the page.

After participants completed processing the Facebook page, they were asked to answer a very short survey on what they remembered about the contents (e.g. users, post topics, etc.) on the page. To gain a better understanding of how participants processed the designed Facebook page, we then asked participants to retrospectively verbalize how they scanned, selected, and parsed the elements on the page.

The second phase of the study was to investigate how the need to belong affects people's ability to solve cognitive tasks (Figure 6.2). First, participants were asked to calibrate their eye movement with the eye tracker. Then, participants were asked to play the same ball-tossing game. The goal was to reinforce the effect of social exclusion and rejection. Participants who were assigned in the experiment group were once again rejected in the game and participants who were assigned in the control group were treated fairly and had the same chance of getting the ball as other players in the game.

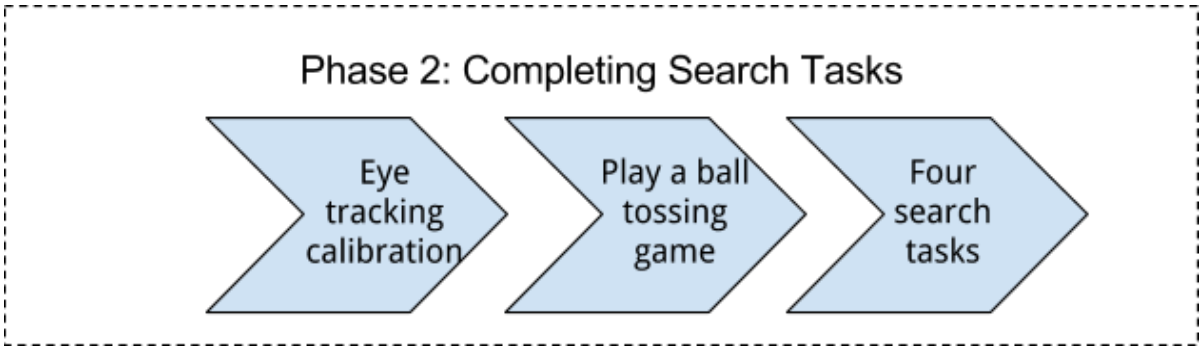


Figure 6.2. : Phase 2 Completing Search Tasks

Then, participants were given four search tasks. Participants were asked to complete those tasks as quickly and accurately as possible. The search tasks varied in difficulty. The first two search tasks were easy enough so that the topics would be familiar to the users and it would

be easy to find the right answer. The last 2 search tasks were more difficult, requiring users to visit several search result pages in order to find the right answer.

The study took one hour to complete. We audiotaped participants' verbal account during parts of the study and tracked their eye movements using an eye tracker.

6.2.1 *Need to belong manipulation*

As we discussed in Chapter 3, there are several ways to manipulate people's sense of belonging. The approach that was mostly commonly used in the prior research was to engage participants in activities that create a sense of rejection. Among others, the Cyberball program allows researchers to control the level to which participants are included or excluded by predetermining the percentage of tosses that will be thrown to a participant [28] [130]. The Cyberball game has been used extensively to study social rejection and social exclusion [28] [130] [131] [132] [27] [133]. In this study, we used this game to create a sense of exclusion and rejection.

In this study, we set up the Cyberball game on a laptop computer for participants to play. They were instructed to play Cyberball with three "players from other game rooms" and to visualize the scene of playing the ball toss with the other players [130].

Participants could throw to whomever they wished, and they believed the other "players" could do so as well. Participants who were assigned in the rejection (experiment) condition received two throws at the beginning of the game, after which the other "players" (who were actually programmed by the computer) stopped throwing balls to the participant. In the inclusion (control) condition, participants received the ball for approximately one fourth of the total tosses. After the task was explained, the participant could start the game when he or she was ready. The

program terminated after 20 throws. After the game ended, the participants immediately moved on to complete tasks that ask them to consume and digest information posted on social networking pages.

6.2.2 *Experiment page design*

In this study, we'd like to understand how people consume social information when they have an elevated need to belong. Instead of asking participants to view their own Facebook pages, we designed an experimental Facebook page with carefully selected content. This helped us control the content stimulus on the Facebook page and allowed us to observe the true effect of varied need to belong.

The experimental Facebook page was designed to represent Facebook conversations among a group of nine people. We separated the conversations into four different styles along two dimensions:

- Active vs. Passive: A Facebook participant can be classified as an individual who tends to active posting on the site, or someone who tends to passive replying to other threads.
- Personal vs. non-personal: Facebook content can generally be classified into personal information (such as names, personal activities, etc.) and non-personal content (e.g. web articles, web videos, facts, etc.)

With the above two dimensions, we classified the FB contents into the following four types:

I: Active and Personal Content

Posts that are personal, intimate, beneficial, positive, open, and revealing. These posts are usually long, containing an intimate or emotional tone in the post (Figure 3). Active and personal posts also include posts about personal events, family activities, with images from personal events, calls for events, language related to their emotional state (happy), etc.

Figure 6.3. An Example of Active and Personal FB Content

II: Active but Non-Personal Content

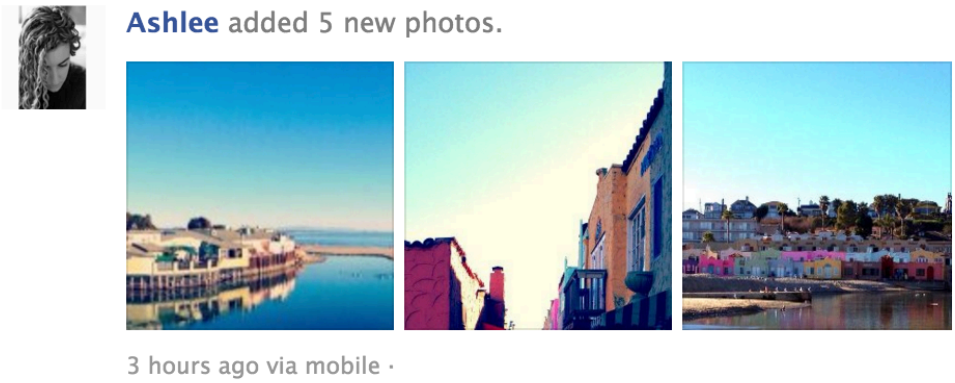


Figure 6.4. An Example of Active but Non-Personal FB Content

This type of content often can be related to connections to other people, but not with reference to the posters themselves. Instead, this content often posts things about talking to other people or speaking from a group perspective (for example, a post about forming a bicycle group

to go to a winery, or an invitation to join my softball team, inviting friends to have lunch, hang out, etc.). Similarly, this type of active but non-personal content could be posts about information that is not about "me", such as retweeting news, posting natural pictures, etc (Figure 4).

III: Passive but Personal Content

This type of content is often passive, supportive, genuine, and open. This could be a short update on personal status, short replies to other's posts, etc. When it is a reply, this reply is typically personal and uses the first person, e.g. "we have …. too", "I hope you will get better..", etc.

In the following example (Figure 5), the replies from Max and Tia are passive (simply replying to Dan's post about his weekend activity), and personal (both use the first person and draw on personal wishes).

Figure 6.5. An Example of Passive, but Personal FB Content

IV: Passive, and Non- Personal Content

This type of content is often a reply someone posted to an active post. They are often short, non emotional, un-engaged with personal content, and offering activity content (e.g. Nice, Great, Congrats, etc. see Figure 6.6).

Figure 6.6. An Example of Passive and Non-Personal FB Content

On the whole FB experiment page, different levels of social engagement were presented in the conversation. For example, Dan is a very active individual who often starts conversations and willingly opens himself to others by using his own portrait as his profile image. Tia often passively participates in the conversation. She often replies to others' posts with short phrases. The phrases she uses are often non-personal and non-emotional. Overall, she often appears to be distanced from the group and doesn't engage with personal content. To fit with what was observed in a real online community, this group of nine people represented a small social circle that features one very active social leader and group contributor, five medium group contributors and three passive group observers. See the full FB page that participants saw in the study below (Figure 6.7).

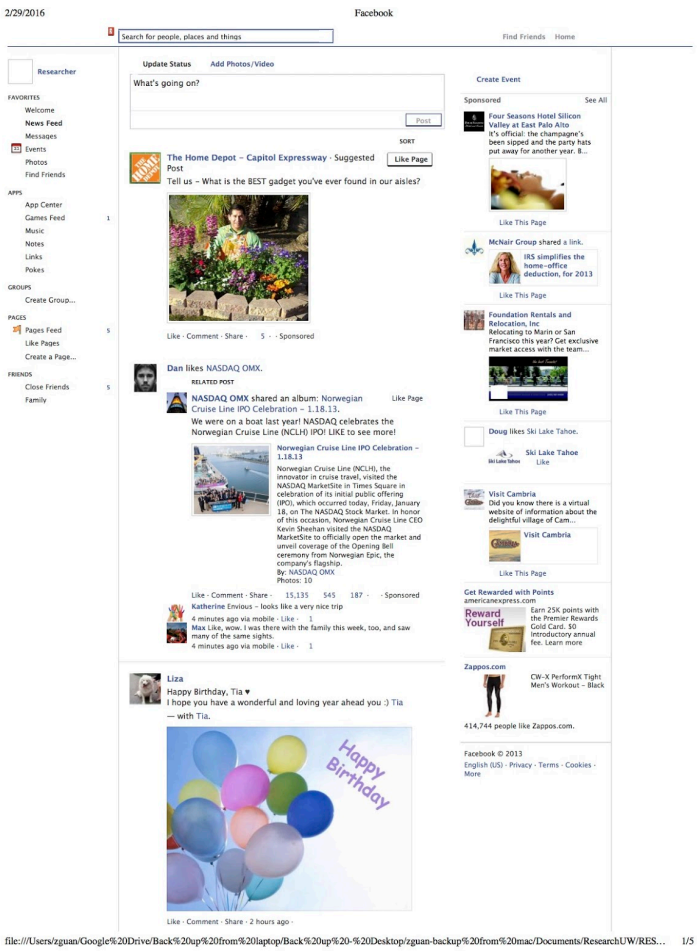


Figure 6.7. The First page of the FB Experiment Page

6.2.3 *Search task design*

It is also the interest of this research to investigate how the social state of need to belong affects people's cognitive capability in problem-solving. Instead of asking people to work on solving mathematical problems, we chose to ask people to work on an information-seeking problem. The hypothesis was to understand whether the different levels of need to belong increase or decrease people's ability to find answers to problems that people often deal with in their real life. If an effect can be seen in solving search problems, we are more likely able to infer the impact on people's real-life cognitive capability.

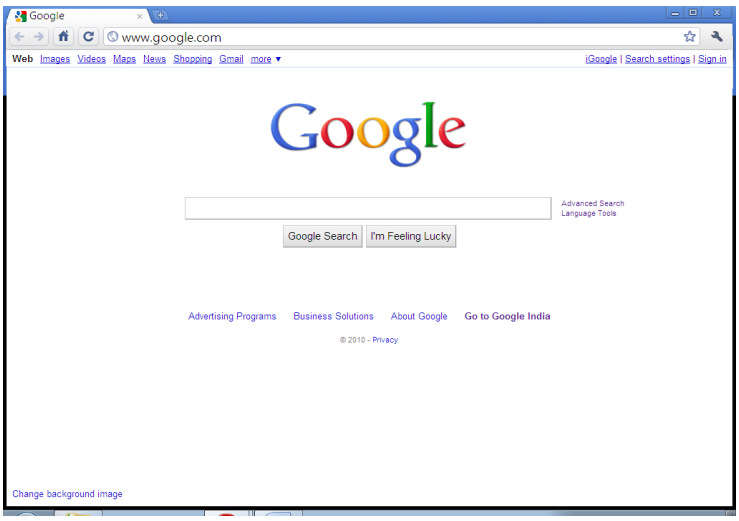


Figure 6.8. The Search Homepage Where Participants Started a Search Task

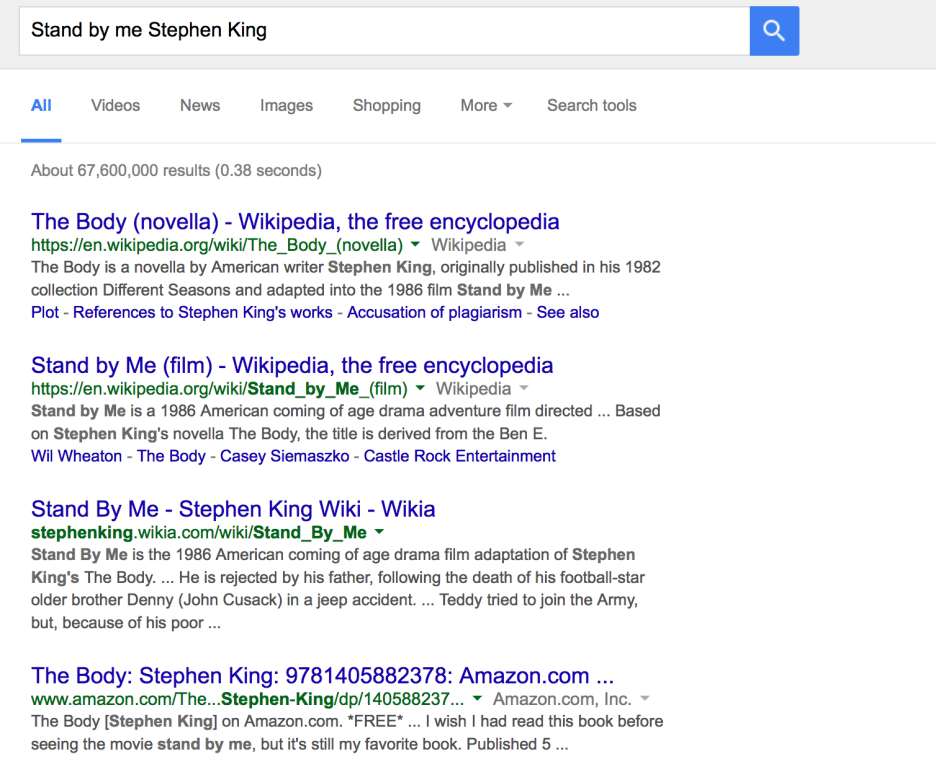


Figure 6.9. A Sample Search Result Page

Four tasks were included in this study. These four tasks varied in their difficulty levels. Two tasks were simple search tasks for which the goal was to find factual information. The other two tasks were harder, where the user needed to go through multiple steps of associating information from different sources in order to find the right information. The table below listed

the tasks we used in this study. All participants were asked to complete these tasks. Tasks were shown in a random order.

Each task is composed of a task description and a given search query which is hyperlinked to a search result page using that search term (Table 1 and 2). A predefined search query and the hyperlinked result page were given to minimize the variation in query formulation. With a given linked search result page, all a participant needed to do was to click on the link, then the search result page (Figure 8 and 9) is shown. Every participant started on the same page, and the steps they took to find the answer were recorded. Participants were told to write down the answer on the answer sheet once they found the answer, and then they could continue onto the next task. A bookmark was provided to the participants so that they could easily get back to the task instruction page.

Table 6.1. Simple Search Task

Task	**Given search query**
I was watching the movie "Stand by Me" the other day. I know it is based on a Stephen King story with a different name. What is the name of the story?	Stand by me Stephen King
I remember an episode of Friends where Chandler was stuck in an ATM vestibule. He was stuck in there with a model, but I can't remember who it was. What was the model's name?	Chandler ATM model name

Table 6.2. Difficult Search Task

Task	**Given search query**
I have heard that diet soda is bad for you because it causes cancer. My friend told me that a large study by the National Cancer Institute found that there was no correlation between cancer and Aspartame consumption. How many people were in this study?	Study cancer aspartame consumption
Your nephew needs to write a report for school about one of the space shuttles that flew in 2008. You want to help him find a map drawing of the	Space Shuttle map 2008 flight path

flight path of the shuttle to include in the report.	

6.3 PARTICIPANTS

Thirty participants were recruited through craigslist posts and email posts to a university and corporation in the California Bay area. We chose to recruit through different channels to diversify participants' background. All the sessions were completed in a local usability laboratory that is equipped with eye tracking software.

After the sessions were completed, the quality of the eye tracking recordings was examined. Four participants were excluded because the replay of the recordings showed a big offset of the eye tracking from the real visual targets. Twenty six participants were included in the analyses presented below.

Participants were randomly assigned to either a control or an experiment group. Thirteen participants were eventually included in each group. Their profiles are listed below (Table 3).

Table 6.3. Participant Profile

Group	Control	Experiment
Number of participant	13	13
Age range	18 to 39	18 to 49
Gender	8 male, 5 female	8 male, 5 female
Need to belong score	28.50 (sd=6.31)	28.08 (sd=4.44)
Need to belong range	20-41	22-37

6.4 RESEARCH QUESTIONS AND HYPOTHESES

As we discussed in detail in Chapter 2.2, past research has shown that people's need to belong could affect their cognitive skills in solving problems as well as their ability to attend to social information. Besides socializing offline, people have been using new social networking platforms to build and maintain their social interaction.

In this study, we use Facebook as the platform to understand how Facebook users behave differently when they have different levels of the need to belong. This study is targeting to answer the 3rd and 4th research questions discussed in Chapter 3.2 - effect of need to belong on people's social and cognitive behaviors.

Based on what we've seen in the literature [discussed in Chapter 2.5] about Facebook regarding motives for using it and the ways people use it, I hypothesize that users with different levels of need to belong will behave differently.

To refresh our memory, here are the research question and hypotheses we defined in Chapter 3.2:

RQ3: How does the need to belong affect people's social information processing, when the need is threatened?

Hypothesis 11: People who were primed with need to belong are more likely to scan the designed Facebook page (with shorter fixations) than to read the content carefully (with longer fixations).

Hypothesis 12: People who were primed with need to belong pay different attention to social information (e.g., people's posts) and objective content (e.g., company's posts or ads) than people who were not primed.

Hypothesis 13: People who were primed with need to belong pay different attention to the content itself (e.g., the core social posts) and the social interaction (e.g., the replies) than people who were not primed.

Hypothesis 14: People who were primed with need to belong pay different attention to the posts made by the main contributor and the posts made by others than people who were not primed.

Hypothesis 15: People who were primed with need to belong pay different attention on visual posts and textual posts than people who were not primed.

Hypothesis 16: People who were primed with need to belong remember more content from the designed Facebook page than people who were not primed.

Hypothesis 17: People who were primed with need to belong remember more people from the designed Facebook page than people who were not primed.

Hypothesis 18: People who were primed with need to belong are more likely to talk about themselves in a future encounter than people who were not primed.

Besides looking at how participants look through the Facebook page using eye tracking, we also asked participants to retrospectively verbalize how they scanned, selected, and parsed the elements on Facebook page. There isn't any hypothesis here since we are analyzing qualitative data. Instead of testing against hypotheses through statistical analysis, we will analyze participants' verbal accounts and look for patterns that reveal how participants scan the paper differently.

Participants' retrospective verbalization provided a wealth of explanatory information about what they were attending to and how they processed information, and it did so while at the same time closely following the contours of the actual task performance.

RQ4: How does the need to belong, when it is threatened, affect people's cognitive skills in conducting online searches?

- **Hypothesis 19:** People who were primed with need to belong read more search results to find the right answers than people who were not primed.
- **Hypothesis 20:** People who were primed with need to belong spend more fixation time finding answers for search tasks than people who were not primed.
- **Hypothesis 21:** People who were primed with need to belong apply different scanning strategy to find answers for search tasks than people who were not primed.

6.5 Data Analysis and Findings

6.5.1 *Demographic Comparison of Control and Experiment Groups*

During the study, participants whose eye movements can be reliably tracked were included in the study and were randomly put in the control or the experiment group. Of the twenty six participants, 13 participants were assigned to the control group, and 13 participants to the experiment group. We examine these two groups on their gender, age, and the need-to-belong score.

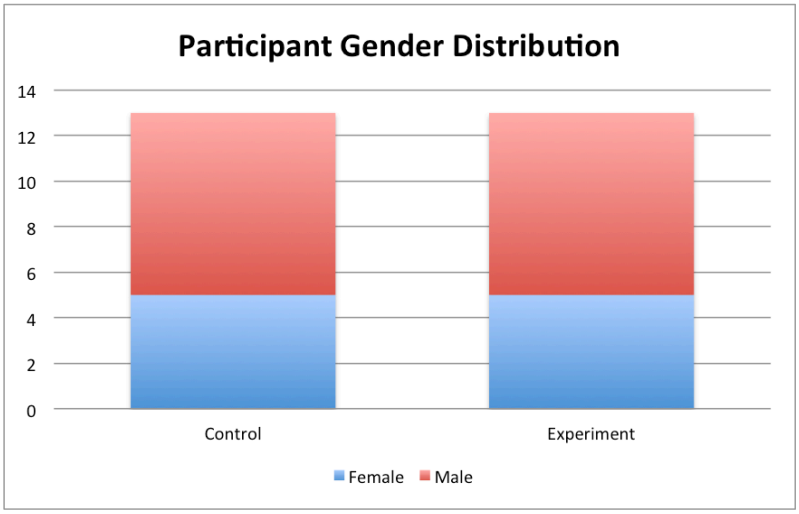


Figure 6.10. Participant Gender Distribution

The control group and experiment group are identical in their gender split (Figure 10). In each group, there are slightly more males than females (60% of males, and 40% of females).

Participants' belonging scores (Figure 6.11) in the experiment group and the control group are also comparable (exp group: mean=29.6, sd=1.7, control group: mean=28.1, sd=1.2). The t-test analysis showed that the difference is not statistically significant (t=0.73, p=0.4729)

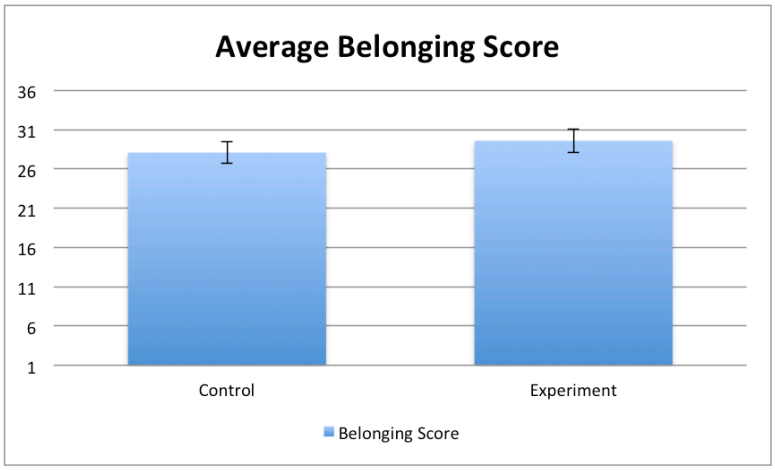


Figure 6.11. Participants' Average Belonging Score

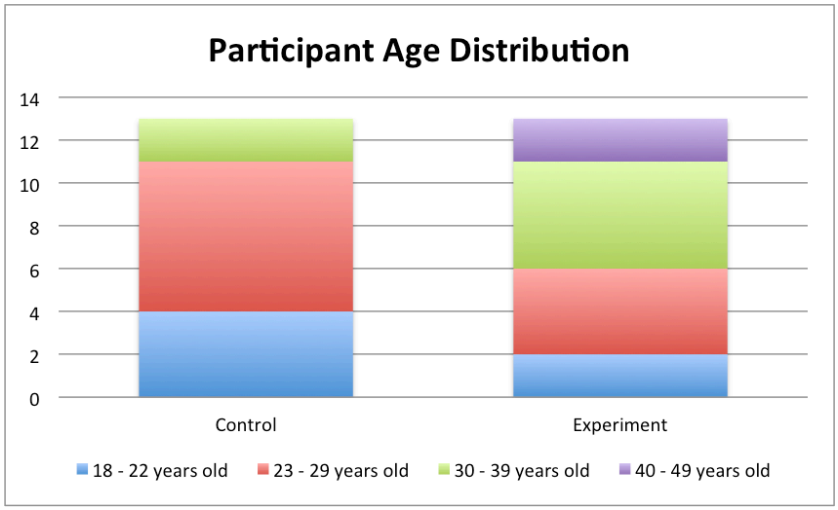


Figure 6.12. Participants' Age Distribution

There is a slight difference on the age split (Figure 6.12). The control group has a slightly younger set of participants (aged 18-29) than the experiment group. The experiment group has more older participants (aged 30-49) than the control group. However, the difference is not statistically significant (p=0.19).

6.5.2 *RQ #1: Need to Belong and Facebook Page Consumption*

If the claims that using a social networking site can increase people's sense of belonging is true, one could expect that people consume information on the site useful to fostering their sense of belonging. To understand if this is true, we investigate participants' eye fixation pattern between those who were ostracized with the ball-tossing game and those who were given a more inclusive game.

We used the following metrics to evaluate information consumption on the page:

- **Fixation Duration**: The length of the fixation duration in millisecond within an Area of Interest (AOI).
- **Fixation count**: the number of fixations within an AOI.
- **Observation length**: The total time in seconds for every time a person has looked within an AOI, starting with a fixation within the AOI and ending with a fixation outside the AOI. It is measured in milliseconds.
- **Number of AOIs**: The total number of AOIs that received participants' attention.

We separated the page content to different AOIs:

- **Social information vs. nonsocial information:** We included two nonsocial posts on the instrument page (Home Depot ads as the first post on the page, a design firm post at the bottom of the page). We expect very little attention would be given to the nonsocial

posts. The question here is to see if different levels of belonging need leads to intentionally skipping the nonsocial post.

- **Posts vs. replies:** The nature of the content written in the posts themselves and content in the replies is different. The posts often deliver a message that the posters want others to know. The messages in the posts are often coherent and concrete. Comparatively, the replies are often short and conversational.
- **Posts from the main contributor vs. others:** On a social networking site, there is a small group of people that contributes the majority of the content on the site. In our group, Dan is such a user. He contributed 5 out of 13 posts (40% of the content), whereas the other 9 members contributed only 8 posts, and none of them contributed more than 2 posts.
- **Posts that are visual as opposed to textual:** The posts on social networking sites are not always textual. People often post images and videos and more visually heavy media. Since the images and videos often attracts more attention in other contexts, we also expect to see different attention distribution along this dimension.

6.5.2.1 Total User Attention on the Page

We first looked at how many Areas of Interest (AOIs) participants have looked at. The analysis of the total number of AOIs scanned by each participant showed that both groups scanned for a similar number of visual areas shown on the page (Figure 13). On average, each participant looked at AOIs 23 times in total (Fig. 6.13).

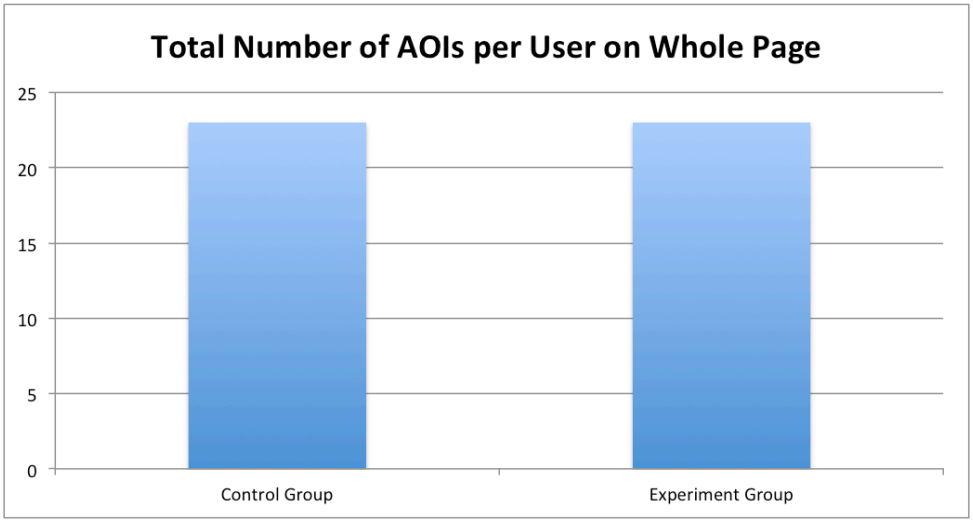


Figure 6.13. Total Number of Areas of Interest (AOIs) per User on Whole Page

The analysis of the averaged fixation length on the page showed that there is no significant difference in the amount of attention being paid to the page between participants in the experiment and in the control group (Figure 6.14).

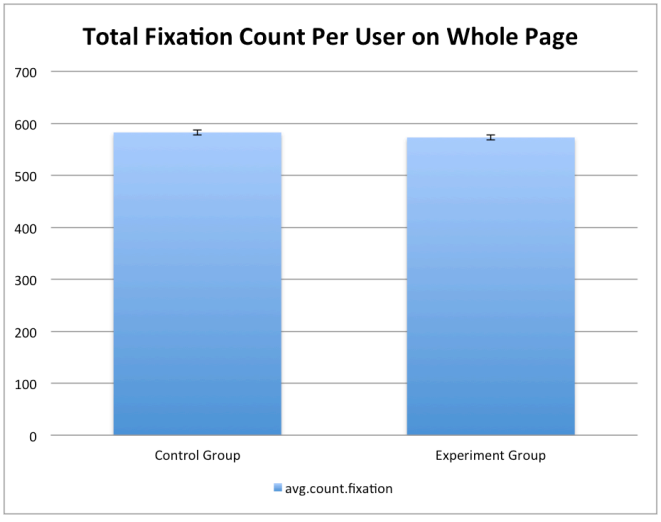


Figure 6.14. Total Fixation Counts per User on Whole Page

As shown below (Figure 6.15), the total number of fixations on the page is about the same for the control and experimental group (mean = 553). The average duration of fixations is also very similar between the control group and the experimental group. This means that people spent similar amounts of attention on the content on the page.

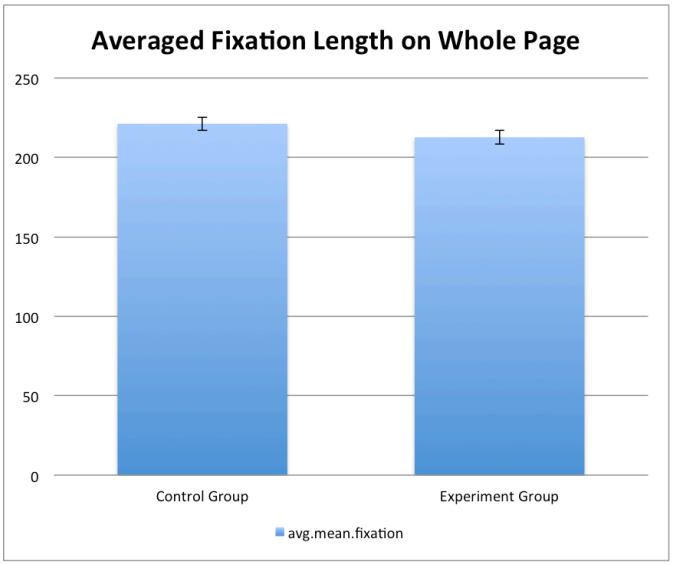


Figure 6.15. Averaged Fixation Length on Whole Page

6.5.2.2 User Attention to Social vs. Non-Social Posts

The analysis of the fixations between social content versus nonsocial content revealed a big difference in attention to the different types of information displayed on the page, even though both the control and the experimental group exhibited the same preference. People spent a lot more attention on the social posts - the main content on the page (also called main post in the following sections).

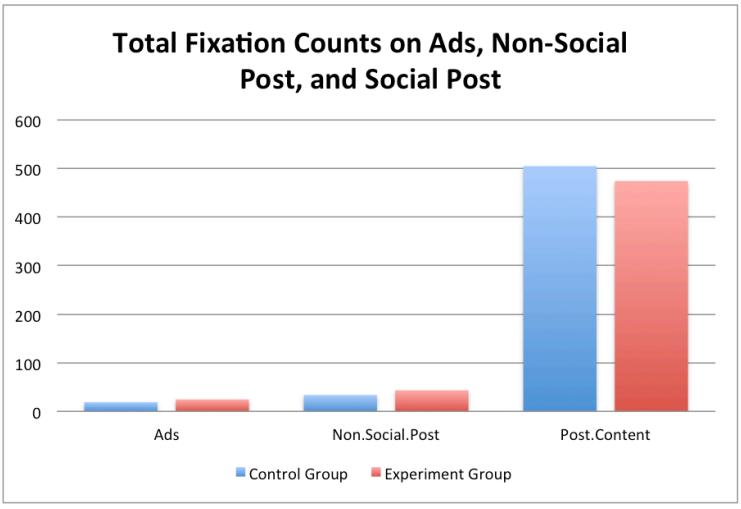


Figure 6.16. Total Fixation Counts on Ads, Non-Social Post and Social Post

Not surprisingly, we found that the ads were often ignored; they received only about 15 fixations - 3% of the fixations gained by the posts (see Figure 6.16). This could be the result of two causes: 1) the ads content is shown at the side of the page, which is not on the main scanning path, or 2) ads are often irrelevant to what people do on the page, therefore consuming the ads is not helpful to understanding the conversation or to getting familiar with the owners of the posts.

We found the total fixation counts on social posts are slightly higher for the control group, though not statistically significant (505 fixations with the control group, 474 fixations with the experiment group).

As shown in Figure 6.17, we also found that even though Ads received *fewer* fixations (less attention from participants), the average fixation *duration* on Ads content is the same as the average fixation duration on other content. This means that participants viewed Ads in the same way as other content, except that they often skip viewing the Ads. When they *did* look at the Ads, they looked at them just as they looked at other content.

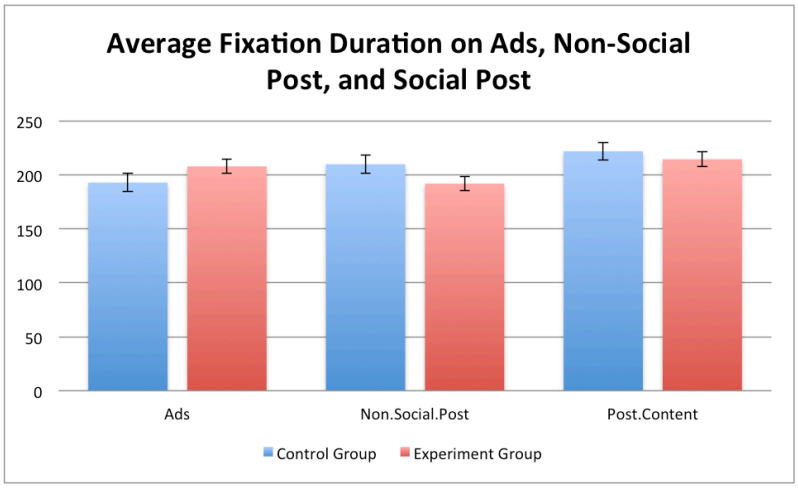


Figure 6.17. Average Fixation Duration on Ads, Non-Social Post, and Social Post

6.5.2.3 *Attention to Posts vs. Replies*

Similarly, it seems that people also view the main posts and the replies differently (see Figure 6.18). First, we looked at the total number of AOIs on the page that were fixated on. Both the control group and the experiment group looked at more posts then replies: 12 main posts, or 92% of the total 13 main posts, versus 7.5 social replies, or 82% of a total of 9 social replies.

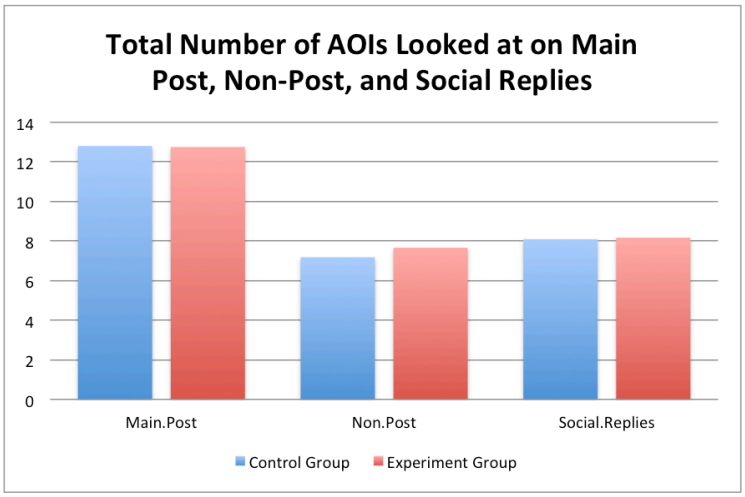


Figure 6.18. Total Number of AOIs on Main Post, Non-Post, and Social Replies

This means that when people encounter new and unfamiliar content on a social networking page, the key information people focus on to get familiar with page participants is still the "meaning" content people post on the site, even if the users often also participate in the social networking activities through replying to others' posts, instead of actively posting on the site.

Since our study was conducted such that that participants were encountering a new and unfamiliar group, this finding can also apply to situations when social networking users have just connected with a new friend. He or she may encounter this new friend's social networking circle to understand who this new friend is and the people in his/her friend circle.

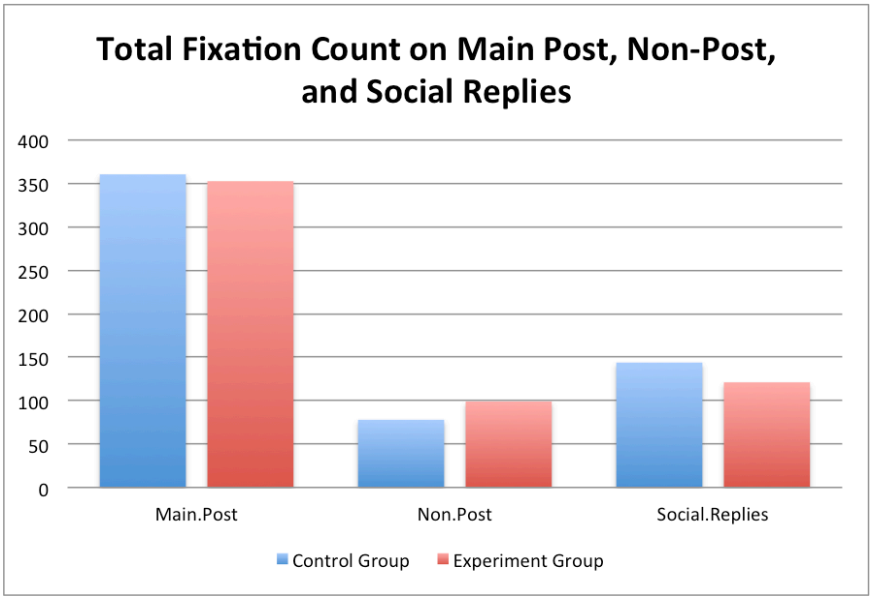


Figure 6.19. Total Fixation Count on Main Post, Non-Post, and Social Replies

The analysis of the total number of fixations (see Figure 6.19) on the social vs. non-social content revealed another pattern. Though we knew that participants visited more main-post AOIs than the AOIs that were from replies (60% more main.post AOIs), the total number of fixations more than doubled on the main posts. The averaged total number of fixations on main posts was 357 (353 for the control group, and 361 for the experimental group). The averaged total number of fixations on social replies was 132 (144 for the control group and 121 for the experimental group). The difference is statistically significant ($F(2, 63)=31$, $p<0.05$). This means that participants not only looked at relatively more main-post AOIs, but they also focused more fixations on the main-post AOIs.

This behavior can be reasonably explained by the different content in the main posts and the social replies. On the main posts, the content is often heavy in writing. The narrative is often coherent and engaging, and delivers the message or story that the owner of the post wants his/her friends to know. Therefore, participants may have utilized a reading mode for the main posts, which resulted in more fixations. On the other hand, the social replies are often short, and

originate from different people. The replies are often diverse and more conversational. Participants may have simply skimmed the replies instead of actually reading them.

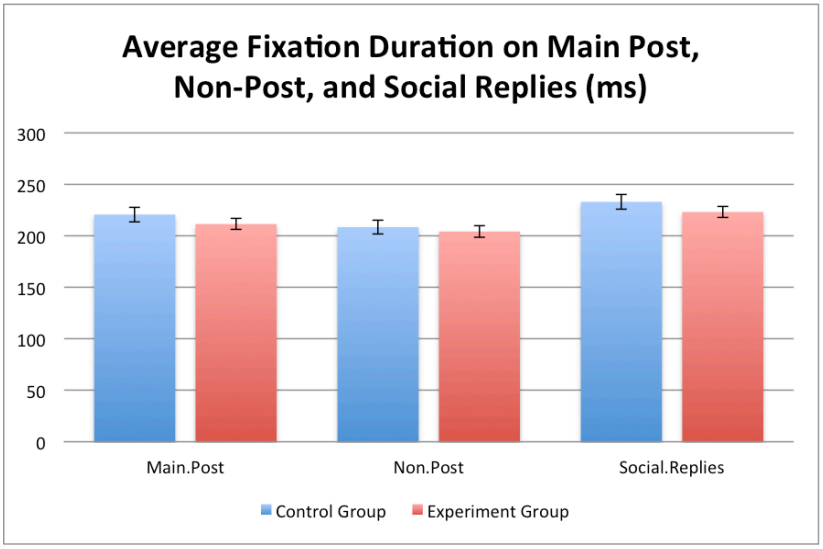


Figure 6.20. Average Fixation Duration on Main Post, Non-Post, and Social Replies

When looking at the fixation *duration*, there is only a small difference between the total amount of attention people paid to different types of posts (Main.Post, Non.Post, and Social.Replies) between the control and the experiment group. The difference between the control group and the experiment group is not statistically significant. We were very surprised by the nearly identical values from these two groups. It seems that the intervention didn't alter the way people spent attention on the different types of content on the page.

6.5.2.4 Attention on Posts from Main Contributors vs. Other Members

Since the main contributor (Dan) made a lot more posts than other members, it is expected that the absolute number of areas of interest that participants focused on was largely from this main contributor. Since the posts from the main contributor are longer than other posts, we see a higher total fixation count per each fixated AOI (see Figure 6.21).

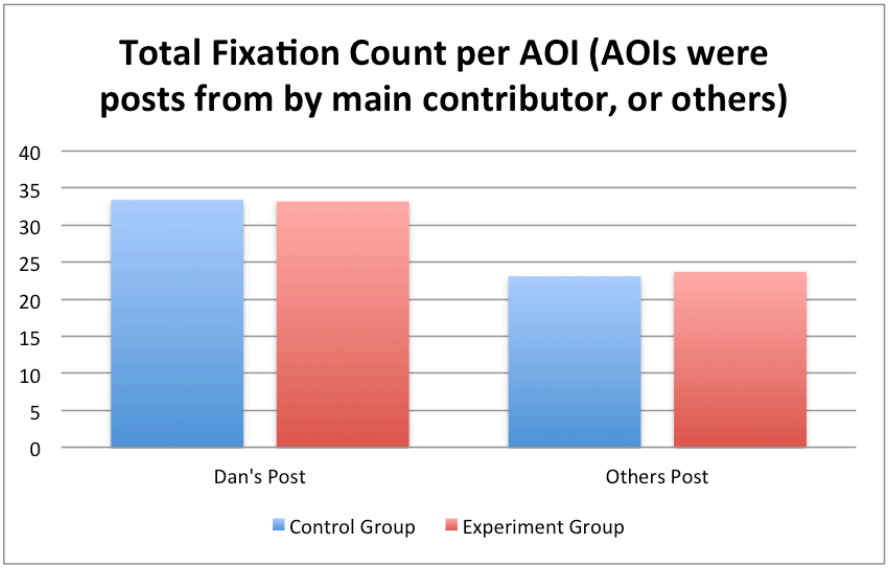


Figure 6.21. Total Fixation Count per AOIs

The analysis on the percentage of AOIs being fixated on shows that there is no statistical significance between the posts made by the main content contributor and post made by others (see Figure 6.22).

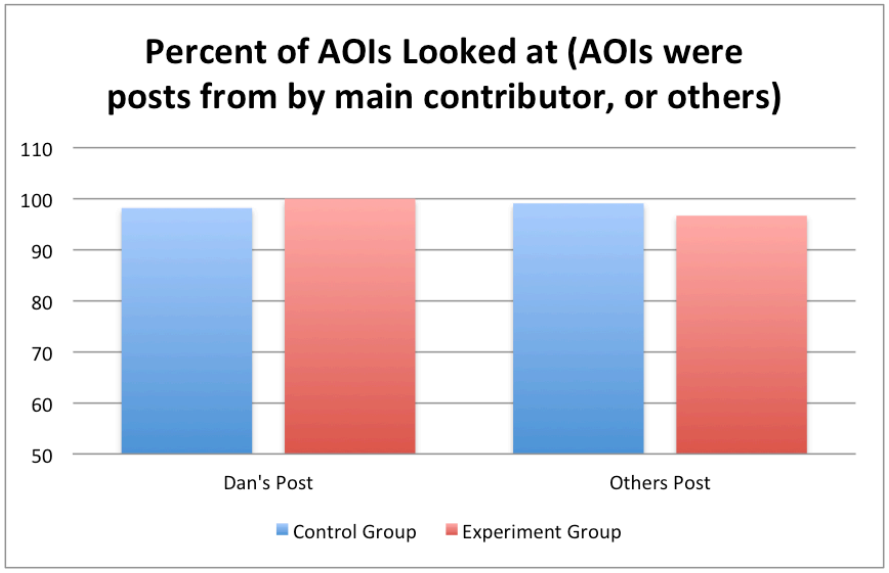


Figure 6.22. Percent of Areas of Interest Looked at (Main Contributor vs. Others)

The difference lies between the posts and the surrounding elements (e.g. ads, frame, etc.). Though the experiment group appears to focus more on Dan's posts compared to the posts of

others on the percentage of AOIs being looked at, we didn't find the difference to be statistically significant. This means that participants didn't treat the main contributor's posts differently from the posts made by others. Since the fact that Dan is the main contributor may come to them only after they've digested the content, they may have consumed all the content in the same way. The effect of the perception about the main contributor may only come after they've read and consumed the content on the page, which we will discuss later.

6.5.2.5 Attention to Visual vs. Textual Posts

On certain social networking sites (e.g. Facebook), visual posts are very common. People sometimes post pictures and videos to the site, instead of writing lengthy textual posts. We could expect that people would pay more attention on the visual posts than the textual posts.

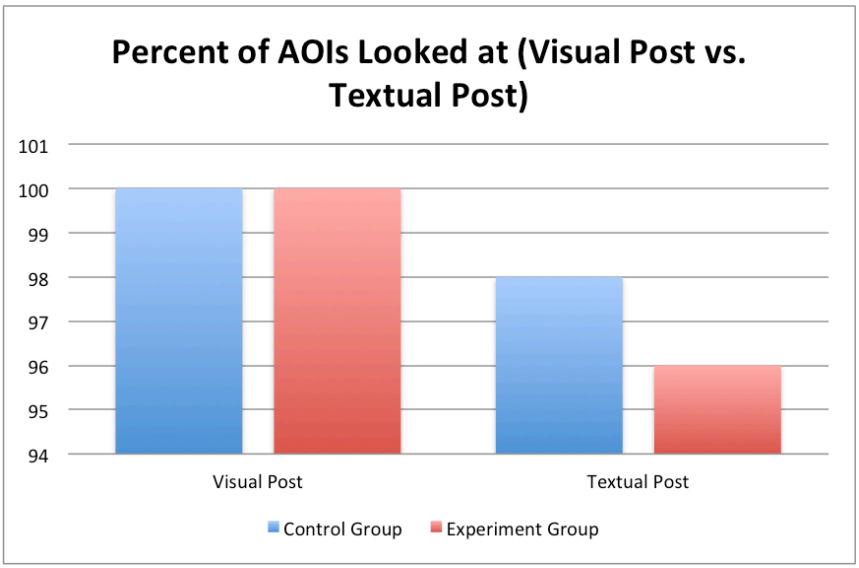


Figure 6.23. Percent of AOIs looked at (Visual Post vs. Textual Post)

In our study, we include 5 posts that are very visual: a big birthday balloon picture for Liza, 3 photos taken by Ashlee, a video posted by Dan about an underwater creature, and a picture posted by Ashlee. We found that participants looked at more visual posts than textual

posts (see Figure 23), and also paid more attention (see Figure 6.24) to each visual post than textual post, though the difference is not significant.

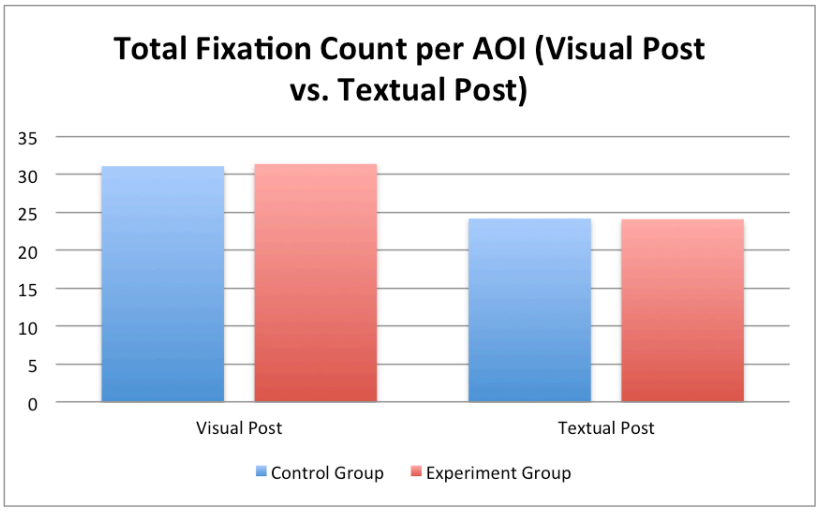


Figure 6.24. Total Fixation Count per AOI (Visual Post vs. Textual Post)

6.5.2.6 Mouse Events on Page

Besides the eye fixations, we also examined the mouse events that happened on the Facebook instrument page. A mouse event was recorded if the participants clicked on elements on the page, using either the left or the right button. More mouse events on a page may mean that participants are interacting more with the content on the page.

We found that there are slightly more mouse click events used by participants in the experiment group than in the control group, and the difference is borderline significant (see Figure 6.25).

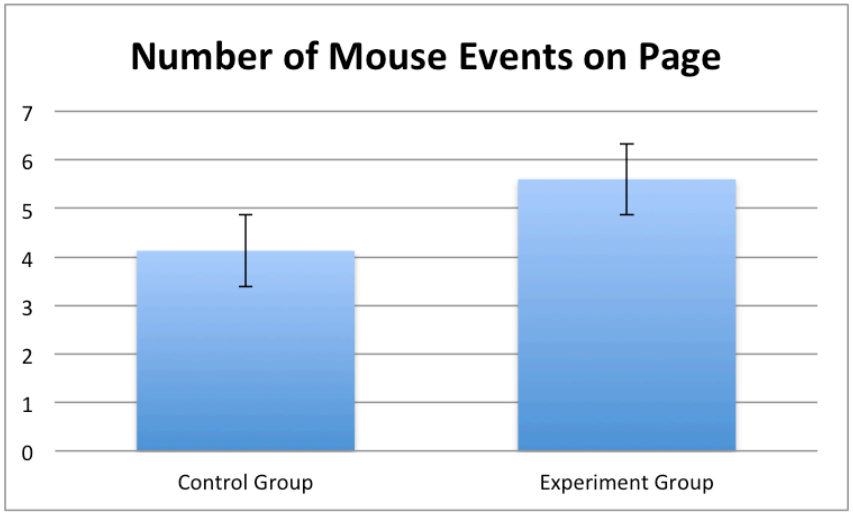


Figure 6.25. Number of Mouse Events on Page

6.5.3 *RQ #2: Effect of Need to Belong on Information Retention*

In the previous section, we examined the immediate effect of need to belong on how people process social information, and we found that participants who were ostracized by the cyberball game processed social information in the same way as participants who didn't receive the experimental treatment. The main difference in how people process social information lies between the social and non-social information (e.g. Ads, Non.Social.Post; see Figure 6.17). While the information was processed in a similar way, the next question is whether people retained information in a similar way.

A psychological treatment can have both an immediate and a prolonged effect on people's behaviors. One way to look at these possible effects is to look at how the information obtained in the previous session was retained in people's minds.

In this study, we also collected information about how much information participants remembered about what was shown on the social networking page. We measure participants' information retention along the following dimensions:

- **Number of posts recalled**

The multi-user environment of a social networking site often results in lots of different topics. Another way to measure how much social information was retained by the participants is to see how many topics participants remember. Therefore, in the post-survey, we asked participants to write down the details they remembered about each site participant. The question was framed as *"What about them do you know? Please describe in details what you remember about each person. Try to write down as many details as possible."* Their responses were then coded based on how many topics they recalled in their answer. The posts were also separated into **social posts** and **non-social posts**. An example of a social post could be "Dan celebrated his b'day recently, saw a ton of elephant seals.". Social posts often feature a person and some of his social properties - such as his friends, his social interaction, as well as social characteristics of himself. An example of non-social post could be "Nasdaq OMX was featured, with an ad for Norwegian cruise line". This type of post is often information and objective. It is not about a person, and may be only about factual information. Since the context of a social networking site is intentionally social, we wanted to investigate if people remember social information and non-social information differently.

- **Content vs. Social Recall**

In people's recall of information, the way they phrased the content could represent the way the content was perceived. Different people often have different takes on the same message. A simple message "Dan's friends celebrated his birthday at the Ano Neuvo Bay and they saw a lot of seals" could be interpreted as either "Dan saw a lot of seals", or "Dan had a great time with his friends". The former focused only on the factual information - Dan saw a lot of seals--whereas the latter extracted the more social aspect of the message - Dan is cared by his friends and they had fun.

- **Number of Individuals on the Page**

The number one goal for users on a social networking site is to get familiar with the virtual social environment. Having a sense of how many people are online and who are those people can help people learn the social context, and provide basis for the users to make necessary social interaction if desired. To investigate, we asked "**Please estimate how many people were in the conversations on the page you saw?** ". In addition to asking participants how many people they remembered, we also coded the names that appeared in their recall of the page content.

- **"Introduce yourself"**

When the need to belong is deprived, we hypothesized that it would affect how people behave in a social environment. Because of the lab experiment setting and the nature of the artificially created social page, it is hard to observe what people would actually do in such environment. Instead, we decided to ask the participants to elaborate on what they might say about themselves if they were to introduce themselves to the group. The question was phrased as "**If you were to tell them about you, what would you say?"**

In this table shown below (see Table 6.4), we tested six variables to gain insights on how participants retain information. We found four out of six variables resulted in statistically significant differences between the control and the experiment group. We will explain each of them in the following sections.

Table 6.4. Statistical Analysis Outcome Overview

measure	*Ctrl*	*Exp*	*Sig.*
num.post.recall	*4.9*	*3.7*	*t = 2.2, df = 24, p-value = 0.**03924***
non.social.post.recall	*0*	*0.31*	*t = -2.3, df = 12, p-value = 0.**03952***
name.recall	*2.8*	*1.8*	*t = 1.8, df = 24, p-value = 0.07966*
char.what.to.say.self	*177*	*91*	*t = 3.1, df = 17, p-value = 0.**005931***

char.what.to.do.join	*217*	*147*	*t = 1.5, df = 24, p-value = 0.1505*
number.ppl.on.page	*7.8*	*5.3*	*t = 2.6, df = 19, p-value = 0.**01591***

** It uses the Welch t-test by default.*

6.5.3.1 Experiment Group Recalls Fewer Posts Than Control Group

We found that participants in the experiment group recalled significantly fewer posts (see Figure 26) from the social page they just viewed than participants in the control group (t=2.18, p<0.05). On average, the control group remembered 4.9 posts (std.error=0.4). The experiment group remembered 3.7 posts (std.error=0.4). Among 15 posts shown on the page, the control group recalled 8% more posts than the experiment group.

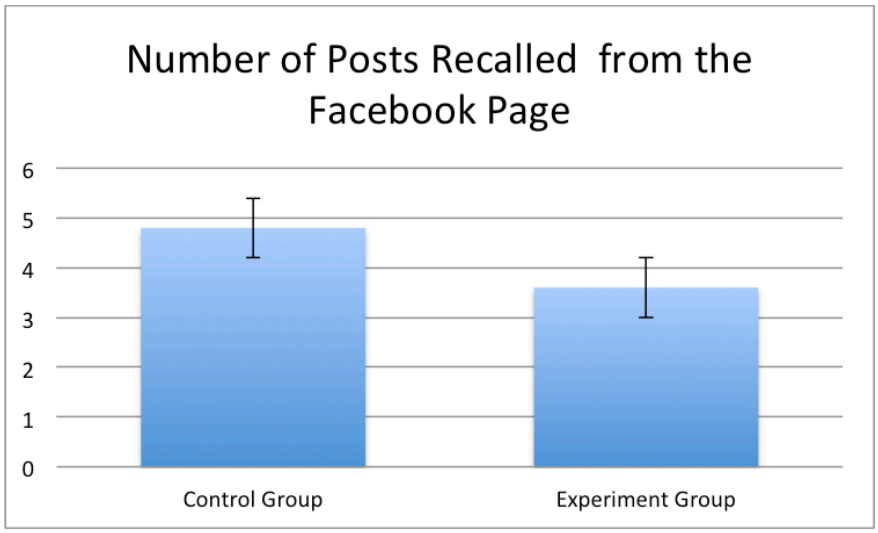


Figure 6.26. Number of Posts Recalled from the Facebook page

A further analysis also showed that the difference lies between social posts vs. non-social posts (e.g. ads, frame, etc.). We found that while the experiment group recalled significantly fewer posts than the control group, the number of non-social posts recalled by the experiment group is significantly higher than what was recalled by the control group (t = -2.31, p-value < 0.05). On average, the experiment group recalled 0.31 non-social posts, and the control group didn't include any non-social posts in their recall of the content on the page.

6.5.3.2 Experiment Group Recalled Fewer People Than Control Group

After participants viewed the social page, they were asked to write down the number of people they saw on the page. We found that the experiment group remembered statistically significantly fewer people (see Figure 27) on the page than the control group (t = 2.6, p-value = 0.01591). The control group thought the size of the small community presented on the instrument page included 7.7 people, while the experiment group thought the size of the community was much smaller - only including 5.3 people.

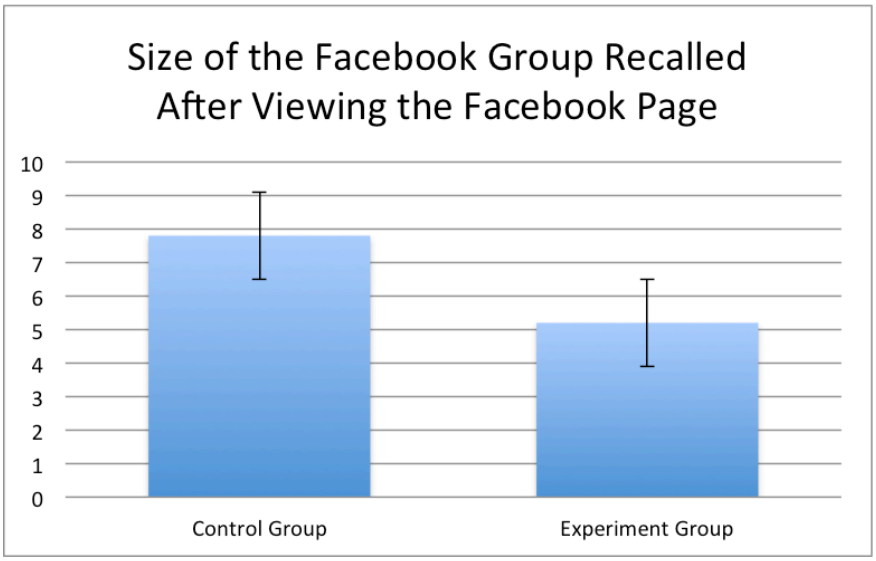


Figure 6.27. Size of the Facebook Group Recalled after Viewing the Facebook Page

Their recall of the actual names in their description of the "**What about them do you know?"** revealed a similar pattern - the experiment group recalled fewer details than the control group (see Figure 28). The difference is marginally significant (t= 1.8304, p-value = 0.07966). On average, the participants in the control group were able to recall 2.8 names in their narratives, and the participants in the experiment group were able to recall only 1.7 names in their narratives.

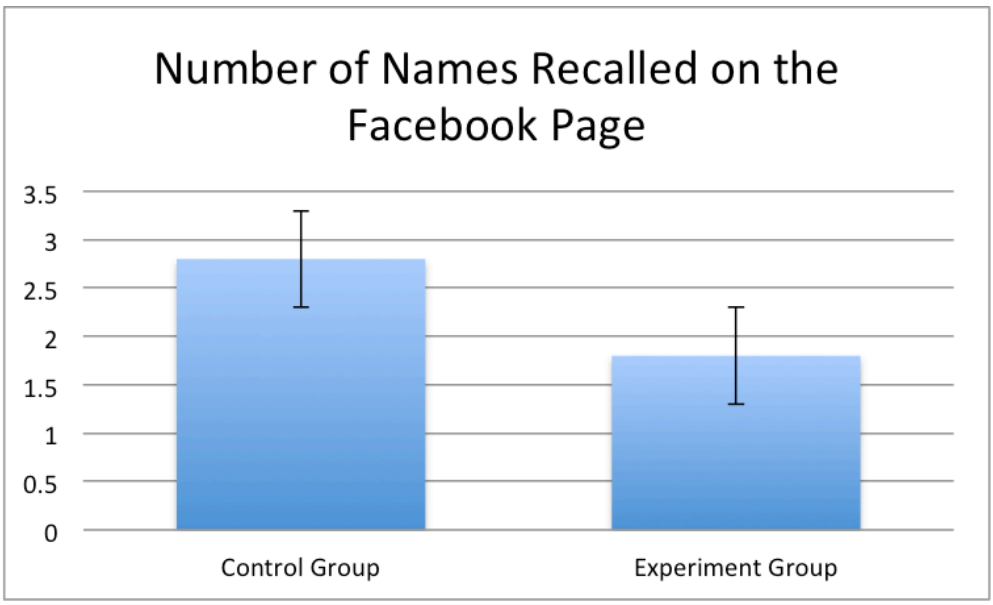


Figure 6.28. Number of Names Recalled After Viewing the Facebook Page

6.5.3.3 Experiment group Less Willing to Reveal Self Than Control Group

We examined how participants would write about themselves: "**If you were to tell them about you, what would you say?** ". We found that the participants in the experiment group said significantly less about themselves than participants in the control group ($t = 3.1476$, p-value = 0.005931) (see Figure 29). On average, the participants in the control group wrote 177 characters (st.error = 25) about themselves (e.g. "I would introduce myself as I normally do. I would say I'm a young software engineer who interested in machine learning and math. I also like basketball and entrepreneurship".). The participants in the experiment group only wrote 91 characters (st.error = 11) about themselves (e.g. I am looking to go on a vacation, could you recommend some good vacation spots).

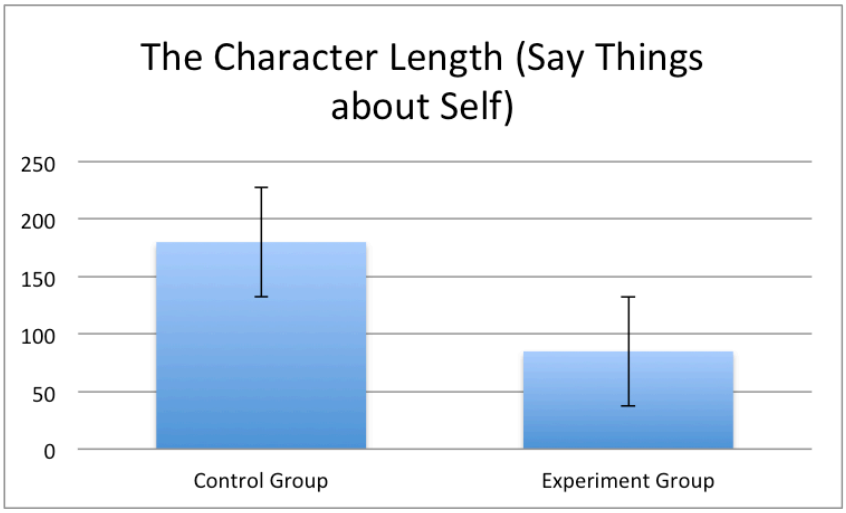


Figure 6.29. The Number of Characters Used

In the experiment group, there were three participants that showed very little interest in talking about themselves at all (e.g. I would not tell people about me, as I don't feel comfortable disclosing my information to strangers). None of the participants in the control group showed a similar refusal attitude. The tone seen in the responses from the control group was very positive and welcoming in that they used affective words (e.g. I would love to learn more about their interests as I love animals, they seem like really interesting people, they seem like the type of people I'd want to be associated with when I'm that age), and they make more associations between themselves and people seen on the page (e.g. also love cats, I liked Norwegian Cruise Lines).

6.5.4 *RQ #3: RTA on Facebook Page Scanning*

After participants answered the short survey, we asked participants to retrospectively verbalize how they scanned the page, processed the posts and replies, as well as how they digested the page overall. Participants went back to the Facebook page and used it as a reference in their verbalization.

Participants' retrospective verbalization can help reveal the possible different patterns people use in scanning a Facebook page and making sense of the social dynamics on the Facebook page in general, as well as between the control and the experiment groups.

6.5.4.1 Content Reader: Focusing on the content

We found that, for some participants, scanning the Facebook page means reading through every post on the page sequentially. We called participants who practiced this type of scanning "content readers." For content readers, their typical scanning started from the top of the page, then, gradually moved towards the bottom of the page. Their goal was to have a comprehensive view of what people said and what topics were covered on the page. As a result, we found participants who used this approach to scan the page often talked more about the content, whether the topic is interesting or the picture is fun to look at, than about the person who made the post or the reason why the person made the post.

> *"I want to see what people say about them, so I was just reading what is out here … I'm wondering where that [a few city scene pictures] is. Is that Venice? " - P4*
>
> *"I was reading this first [the first social post], then the next one. He got a lot of replies, that is nice… Wow, she really tried hard on finding the right dog food. " - P10*
>
> *this [the cruise post], thought this is interesting, seems that he really enjoyed going there [the destination] - P14*
>
> *"I saw this [the cruise post], thought this is interesting. Lots of people like going on Norwegian Cruise." - P24*

While the participants paid a lot of attention to the posts and really tried to engage with the content, we found that the way they described how they scanned the page didn't talk a lot about the individuals who made the posts.

6.5.4.2 Social Reader: Focusing on the social dynamic

As opposed to content readers, "social readers" are people who paid a lot more attention to who was making the post. They engaged with the posted content as well as the replies. They paid attention to names and mentioned people's avatar. They gained a broad sense of who was in the group, who was making more posts, as well as who was friends with whom. In the social readers' think-aloud accounts, they did mention the content that was posted on the Facebook page. However, unlike the content readers, social readers' verbal accounts and interests seem to go beyond what was posted, and were more attracted to the person and the reason behind posts.

> *"[after reading the Norwegian cruise post] Looks like Dan really likes travelling, might be a fun person to talk to… and he is a Canadian." - P3*
>
> *"The dog [Liza's avatar] is so cute! " - P5*
>
> *"Oh, it is Dan again. It seems that he writes and posts a lot. He seems to like travelling [looking at the swim video posted by Dan].- P7*

We saw both content readers and social readers in the control and experiment groups. It is reasonable to hypothesize that these two types of readers naturally exist in the broad social networking community. There were slightly more participants in the experiment group who demonstrated the content-reader pattern and paid more attention to content, though the difference is not statistically significant.

6.5.5 *RQ #4: Effect of Need to Belong on Problem Solving*

Research question 4 looks at how the need to belong affects people's problem-solving ability in looking for information via search tasks. In the following section, I will first explain how we are going to study hypothesis 9 - 11.

We studied hypothesis #9 (People who were primed with need to belong read more search results to find the answers) by looking at the metric of number of AOI viewed (num.AOI) (the total number of Areas of Interest that each participant has viewed or looked at). This metric shows how many search results each participant has looked to find the information in order to complete the task.

For hypothesis #10 (People who were primed with need to belong spend more time on finding answers for the search tasks), we looked at two metrics: Number of fixations (count.fixation), and Summed duration of fixations (sum.fixation). The total number of fixations that have been landed on the page by each participant shows how many times that each participant has looked at the page in order to solve the problem. The total length of the fixations that have been landed on the page evaluates the total time spent on the page to solve the problem. It is equivalent to task completion time except that it counts only the time that the participant was actually looking and processing the page.

For hypothesis #11 (People who were primed with need to belong process the search results pages differently from people who weren't primed), we are studying this by looking at two metrics: Number of fixations per AOI (num.fixation.per.aoi), and Averaged fixation duration (mean.fixation). For the averaged number of fixations that each participant devoted to each Area-of-Interest (search result), a higher value means that the participant looked at the result multiple

times, and a shorter value means that the participant looked at the result briefly in the length of fixation.

The metric "averaged fixation duration per participant" is the signal for the strength of cognitive load. Typically, a longer fixation means that the person is paying more attention to the information. A shorter fixation often indicates a single glimpse at the information.

6.5.5.1 More Effort Spent on Solving Difficult Tasks

The data analysis showed that the experiment group looked at more results and spent more time looking during more difficult tasks (see Figure 30).

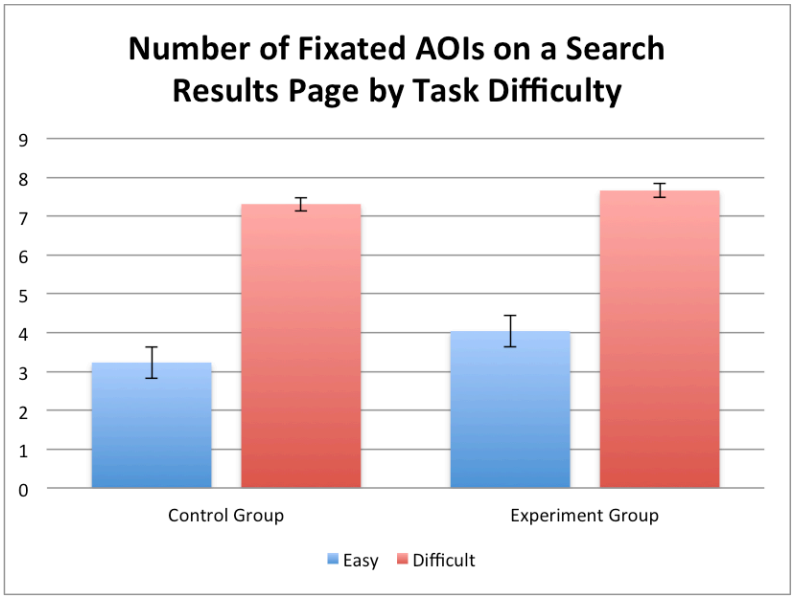


Figure 6.30. Number of Fixated AOIs on a Search Results Page by Task Difficulty

The task difficulty has a statistically significant effect on the total number of search results (num.AOI) participants looked at ($F(1, 151)=16.9$, $p<0.01$); see the chart below. It is our expectation that participants need to spend more effort and read through more results in order to solve harder problems. On average, participants looked at 7.25 search results (st.error = 0.73) before solving difficult tasks. For easy tasks, participants only looked at 3.6 search results on average (st.error=0.45)

6.5.5.2 More Attention Spent on Solving Difficult Tasks

Similarly, we saw the same effect of task difficulty on the total number of fixations (count.fixation) on the page; see the Figure 31. Participants had statistically significantly more fixations on the search result page for more difficult tasks than for the easier tasks ($F(1, 35567)=12.4$, $p<0.01$). In addition, the search result page for harder tasks received statistically significantly longer fixation in length on the page in total ($F(1, 1.271e+09)=12.3$, $p<0.01$). In terms of the type of fixations received, we didn't find statistically significant differences on the mean fixation length (mean.fixation) ($F(1, 1817)=0.93$, $p=0.34$).

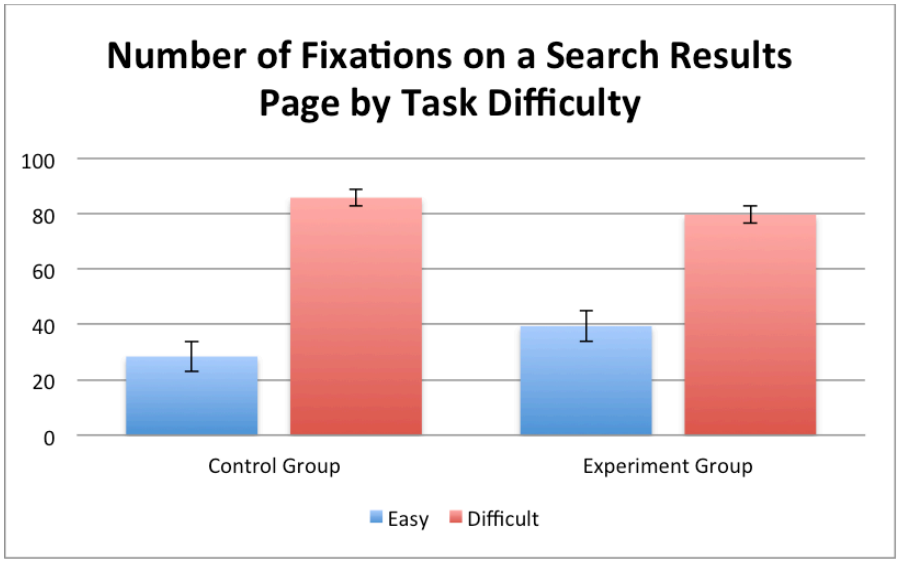


Figure 6.31. Number of Fixations on Search Results Page by Task Difficulty

We didn't find that the effect of task difficulty on the number of fixations on each AOI (each search result is one AOI) **(num.fixation.per.aoi)** to be significant ($F(1, 112)=3.2$, $p=0.08$).

This means that participants applied the same number of fixations on each search result when they browsed the search results to solve the problem for easy and difficult tasks. Task difficulty also didn't have statistically significant effect on the averaged number of fixation lengths on the page (**mean.fixation)** ($F(1, 1817)=0.94$, $p>0.05$).

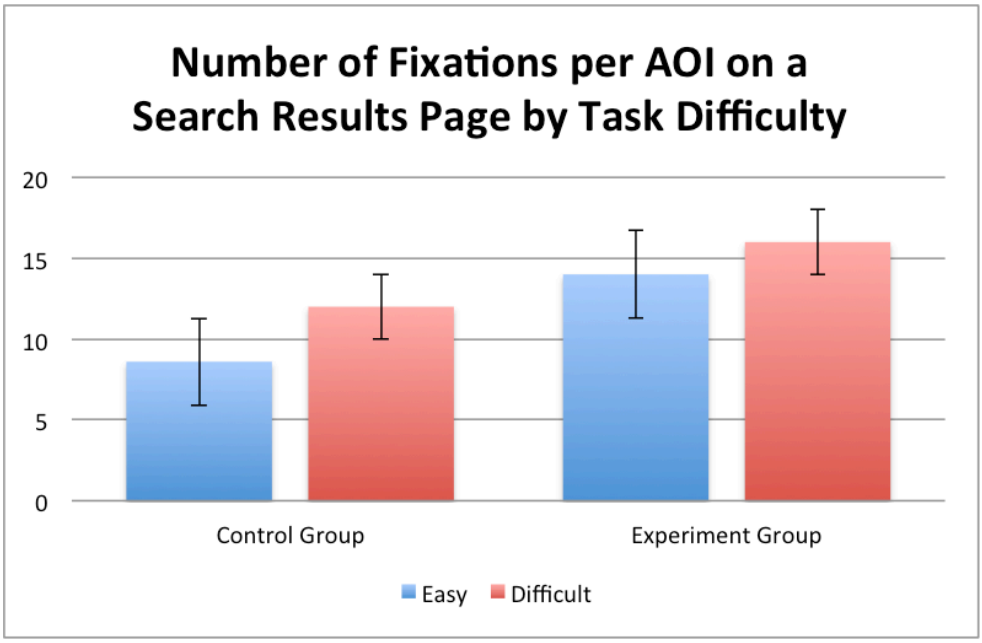


Figure 6.32. Number of Fixations per AOI on a Search Results Page by Task Difficulty

In sum, participants looked at more search results for difficult tasks. On the page for more difficult tasks, there were more fixations used to interpret results, which alone resulted in longer time fixating on the page. The averaged fixation length didn't appear to be different between the easy tasks and difficult tasks. The longer total fixation length fallen on the search result pages were simply caused by examining more results on the page.

6.5.5.3 Experiment Group is Less Efficient in Processing Each Result

The data analysis showed that participants in the experiment group were less efficient in processing the search page - more fixations on each result (see Figure 33). Among the dependent variables we investigated, the only effect that was statistically significant between the control and the experiment group was the effect on averaged fixation duration on the page **(mean.fixation).** We found an interaction effect of task difficulty and group.

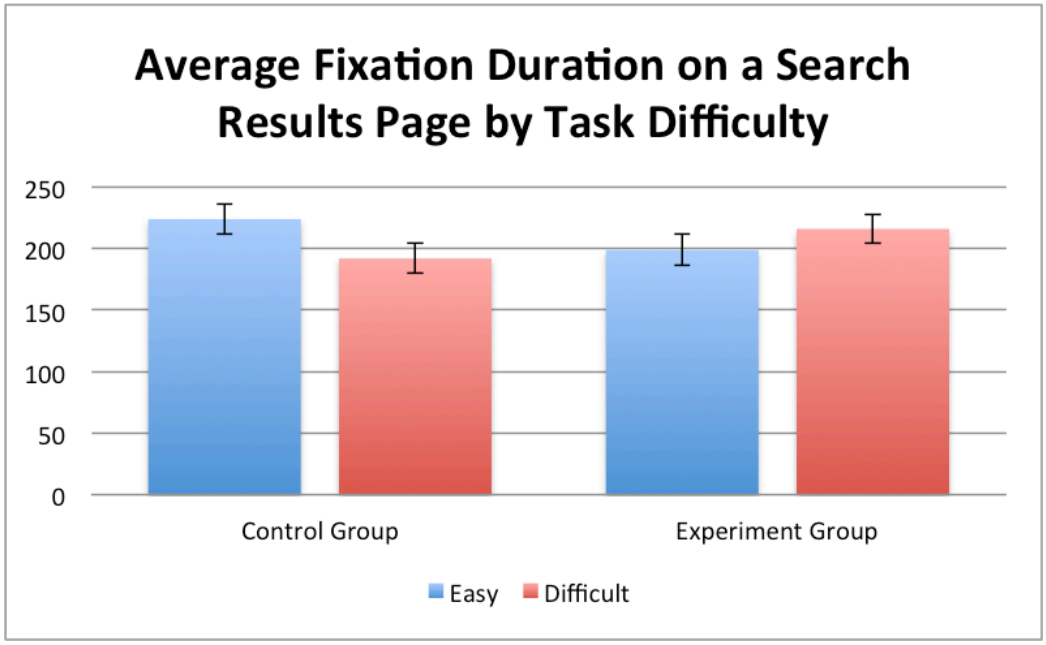


Figure 6.33. Average Fixation Duration on a Search Results Page by Task Difficulty

The averaged duration of fixations on a page is slightly higher for easy tasks in the control group, but the trend is opposite for the experiment group - which applied longer fixations on difficult tasks than on easy tasks.

6.6 DISCUSSION

In this study, we empirically investigated how the manipulation of need to belong affects how people consume social stimuli, how they respond and remember the social signals about the group, and how they utilize cognition to complete problem solving tasks.

Our study shows that reading social information on an experimental social networking page doesn't vary by the amount of need to belong manipulation applied in this study. The need to belong manipulation (carried out by ostracizing someone during a digital ball tossing game) didn't have a statistically significant effect on how people read through a page of social updates. We found that participants who were ostracized in the ball tossing game processed social

information in the same way as participants who didn't receive the experimental treatment. The experiment group spent a similar amount of time reading the page, looked at all the posts that had visual stimuli, paid a lot more attention to the posts than to the social replies, and ignored the ads on the page.

While the experiment group scanned the page in a similar way as the control group, we found the need to belong manipulation did have a profound effect on how people retained information as well as how they responded to social information.

We found that the experiment group remembered significantly fewer people than the control group. Participant in the experiment group didn't seem to have obtained a good sense of who is in the groups, comparing to the control group. Failing to know who is in the "social room" could create a barrier for them to navigate through people and choose members to introduce themselves to. Their social competency could be paralyzed by the fact that they don't have a clear sense of what are the parts of this social group.

In addition to lacking a good sense of "who is in the room", the participants in the experiment group were less efficient in retaining and engaging the social information; they recalled significantly fewer posts from the social page they just viewed than participants in the control group. This finding can have immediate impact on how much the experiment group is able to obtain socially relevant information from the social networking page that is needed for them to "introduce themselves to the group later on". On top of remembering fewer people and fewer posts, we also found that what they remembered was mostly posts that contain less social information (e.g. news about a cruise line, etc.), which is consistent with the literature that reported that people who have a higher need to belong is less capable of detecting social

information. On the other hand, the control group which was not ostracized during the ball tossing game remembered a lot more socially rich posts (e.g. birthday wishes, personal pet story, etc.). Similarly, the experiment group recalled fewer details about individuals they remember than the control group. These findings show that the simple belongingness manipulation could greatly deteriorate users' ability to respond to social signals. In a social environment, remembering fewer people and less social conversation and socially important details could put a person at a disadvantage when he or she is trying to make a social connection.

Belongness-manipulated participants were thus impeded with weakened social sensitivity. They also were handicapped in active social activities; the participants in the experiment group said significantly less about themselves than participants in the control group.

The belongingness manipulation we instrumented in our study impacts how the experiment group solves difficult tasks. Averaged fixation duration for different tasks becomes shorter for the control group. This is consistent with what was reported in the literature, where decreased fixation duration often happens while subjects perform heavy cognitive load tasks (e.g. auditory and driving tasks [ref, Hooge and Erkelens found in 1996]). These oculomotor behavioral changes are the human reaction the consequences of focusing and solving cognitively challenging tasks. This effect was seen in the participants in the control group, and surprisingly not participants in the experiment group.

The fixation duration is significantly longer when the experiment group performs more difficult search tasks. We unfortunately don't have a detailed understanding of the underlying mechanisms that makes user less efficient in their natural reaction towards difficult and heavy cognitive load tasks. But, the statistically significant difference in the average fixation duration provides evidence showing that the manipulation of need to belong could possibly have changed

how participants utilize human natural instincts in responding to external events or tasks and made them less efficient in dealing with tasks with heavy cognitive load.

6.7 SUMMARY OF THE CHAPTER

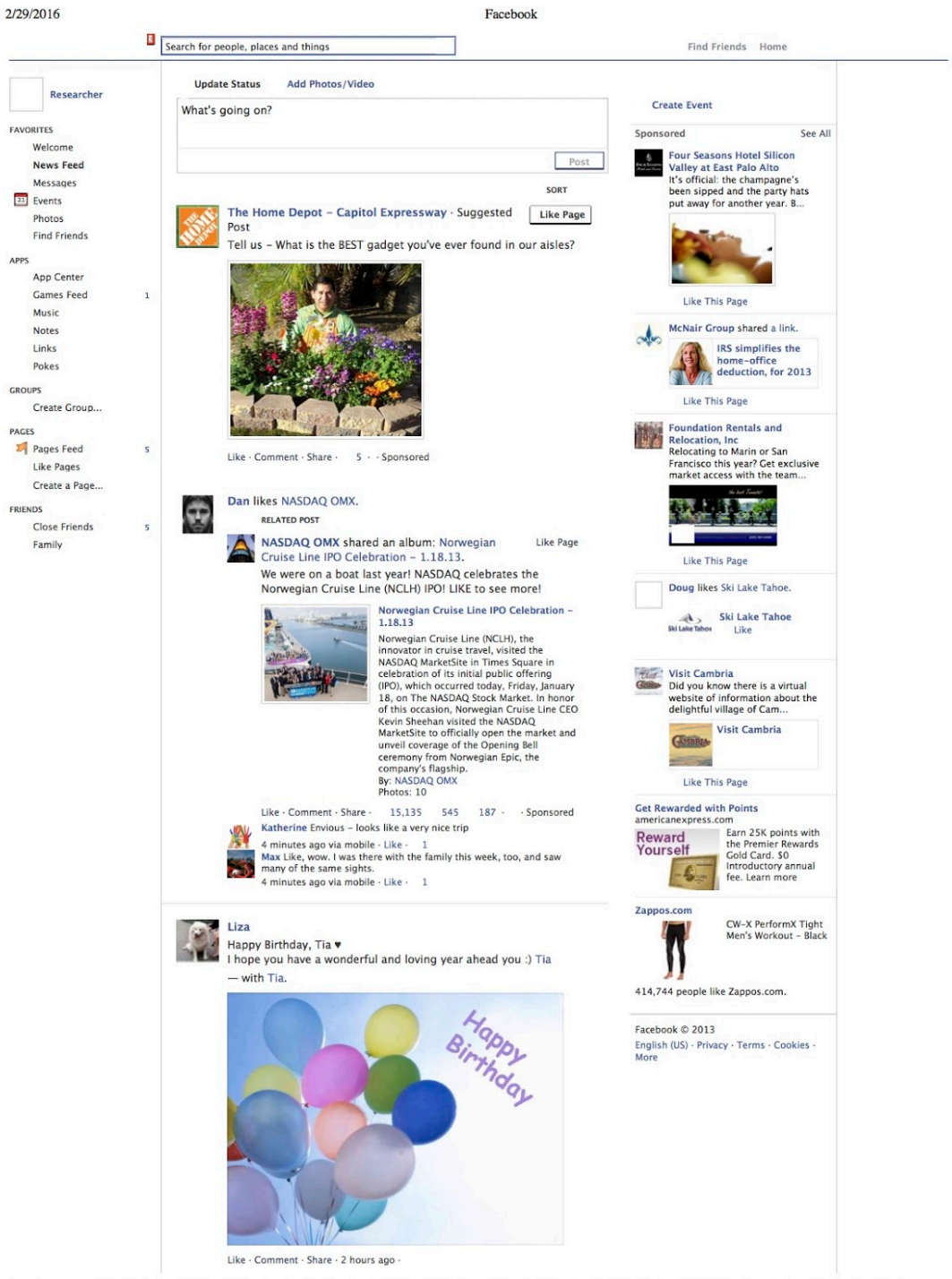
Human beings are social creatures. The social connection and the sense of belonging are part of the fundamental needs of every human being. Insights about how deprived social belongingness affects the way we connect with others and solve problems in our daily life can have significant impact on revealing the underlying connections between social function and cognition, and inform ways to create, maintain, and remediate damaged social connections.

The studies reported in this chapter provided evidence that a deprived sense of belonging can disable people's ability to sense social cues online and initiate new social connections. With a manipulated sense of belonging, participants obtained a less rich impression of the member formation in a social group. They retained less socially relevant information and remembered fewer socially significant details. With a lower sense of belonging, participants were less active in initiating new social connections and shared less information about themselves to others.

A jeopardized sense of belonging also had significant impact on people's problem-solving ability in scanning and processing information in common online search tasks. When the problems that need to be solved are easy, the impact is minimal. When the problems are hard and require more cognition and concentration, participants who had lower sense of belonging were not able to effectively engage with the problem. Their eye movement fixation duration remains the same as encountering easy problems, whereas participants in the control group exhibit significantly shorter fixation duration, likely as a result of increased concentration.

6.8 APPENDIX: FULL PAGE FACEBOOK DESIGN

Page 1



Dan
WE went to Ano Nuevo to see the elephant seals! They were having a quiet Tuesday afternoon and we didn't see any fights. But we did see a ton of pups (quite literally) and a bunch of huge males. Now we're drinking hot chocolate on our way back home. Ahhh. #birthday surprise – with Jen

Like · Comment · Share · 2 hours ago ·

4 people like this.

James Anne gets major girlfriend points. Multiple birthday surprises???
4 minutes ago via mobile · Like · 1

Katherine Hey, that was my birthday surprise for Dave two weekends ago! Dan, Jen, great minds think alike!
4 minutes ago via mobile · Like · 1

Katherine Dave was very well prepared! The weekend slots were all booked up by December.
4 minutes ago via mobile · Like · 1

Max Nice birthday surprise. Happy Birthday!
4 minutes ago via mobile · Like · 1

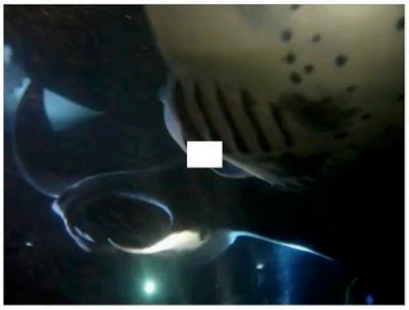
Ashlee added 5 new photos.

3 hours ago via mobile ·

Dan added a video from March 20, 2013 to his timeline.
under a full moon, in the ocean off kona... i got to swim with these beautiful majestic creatures flying through the dark.

it's an experience i want generations of people to be moved by. let's keep them around... let's start with this petition:

http://www.avaaz.org/en/petition/Protect_Manta_Rays/?fpvASdb&pv=42 — with Crystal Skinner and Heather Traher at Kona,Hi.



Like · Comment · Share · 19 hours ago ·

12 people like this.

Dan this was dive years ago with Heather Traher and Crystal Skinner for my birthday—still one of the most moving experiences i've had. Today, with the efforts of great friends and conservationist like Shawn Heinrichs, you might have a chance of swimming with Manta Rays in the coming years:)
19 hours ago · Like · 1

Katherine Wish I could have a trip like this.
19 hours ago · Like · 1

Darcy Tahnks for the wonderful video.
19 hours ago · Like · 1

James This is gorgeous! Such a nice birthday trip!
19 hours ago · Like · 1

Ashlee
The amount of sample food I opened for my cat to try today. She refuses them all except for the gravy (blue package on the foreground)

Like · Comment · Share · 15 hours ago via iOS ·

9 people like this.

View all 9 comments

James I'll call to see if they can take her, she had not needed cleaning till this most recent vet exam.
12 hours ago · Like

Dan We did Harley and scout. It was expensive but very quick.
12 hours ago via mobile · Like · 1

Liza They have requirements such as your pet needed to be less than 2 or had a recent cleaning which we don't satisfy
12 hours ago · Like

Tia I wish she will get better soon.
12 hours ago via mobile · Like

Dan and David are now friends.
Like · Comment · Add David as Friend · Saturday at 11:08pm

Max
My friend and colleague Alan 's Kickstarter project was featured in Wired:

http://www.wired.com/design/2013/01/voronoi-bookshelf/

Awesome! (Looks like it ends tomorrow, though!...)

Interactive Geometric Bookshelf Brings Design to the Crowd | Wired Design | Wired.com
www.wired.com

Artist and neurobiologist Alan Rorie's Kickstarter offers the opportunity to design your own bookshelf based on the Voronoi pattern, a clever method of subdividing space into polyhedrons.

Like · Comment · Share · Saturday at 2:39pm ·

2 people like this.

Dan likes a link.

Alanna
HEYOO! my image of James Daniel Bowien up on Wall Street Journal! (plus an awesome recipe...)

Catfish a la Sichuan
online.wsj.com

Satisfying and seasonal food in about 30 minutes from the Mission Chinese chef.

Like · Comment · Share · Saturday at 1:35pm near San Francisco ·

Anne and 20 others like this.

Ashlee nice shot
Saturday at 1:37pm · Like

Tia Congrats!
Saturday at 2:53pm · Like

Darcy great shots!
Saturday at 3:52pm · Like

Dan
I spent the weekend visiting my parents in Vancouver WA. I love visiting them – after all these years they still make me feel good and very blessed. It's good to see how happy they are too.

9 people like this.

View all 9 comments

Darcy Happy Birthday, Dan
12 hours ago · Like

Tia Another belated wish for a wonderful year to you!
12 hours ago via mobile · Like · 1

Max Happy, happy birthday to you, Dan. I'm so glad that you can visit your parents, and find them enjoying life and happy to see you!
12 hours ago · Like

Tia I wish she will get better soon.
12 hours ago via mobile · Like

Max likes Charles Bukowski: Poetry.

Charles Bukowski: Poetry
Author
Henry Charles Bukowski, born Heinrich Karl Bukowski, (August 16, 1920 – March 9, 1994) was an American poet, novelist,...

Like Page · Find More Pages · Saturday at 9:25am

Liza
I miss my dog, shasha ..... She is gorgeous ♥

Like · Comment · Share · Saturday at 11:41am ·
Louisa likes this.

Max likes DesignCrowd.

DesignCrowd
Company
DesignCrowd is an online marketplace providing logo, website, print and graphic design services by providing access to...

Like Page · Find More Pages · Saturday at 8:34am

BBVA Compass · Suggested Post Like Page

Design your home for a chance at $10K. www.tiny.cc/projectme
NO PURCHASE NECESSARY. Sweepstakes ends 4/12/13

Chapter 7. SUMMARY, IMPLICATIONS, LIMITATIONS, AND FUTURE WORK

7.1 INTRODUCTION

In the previous chapters, I reported three studies that examined the relationships between the fundamental need to belong and social behaviors, the impact of need to belong on cognitive ability, as well as the validity of think aloud protocol methodology which was used in the second study.

In this chapter, in section 7.2 I will first summarize the key findings we have. In section 7.3, I will then discuss the implications of our findings, from how the need to belong can be established as one of the main social traits to study social networking, to innovating designs and technologies to help improve support for the need to the belong and help people in making connections, as well as how researchers can reliably use the think aloud protocol method to understand people's thoughts and strategies in solving problems.

Every study has limitations. In section 7.4, I will explore the limitations we have in our studies, and brainstorm things that we could do differently and do better if we were to study it again (to gain more research power).

In section 7.5, I will list several research directions for future exploration. Researchers who are interested in this topic area can use what we learn in this work and further explore these future topics to expand the domain and build up the body of knowledge for the field.

7.2 SUMMARY OF FINDINGS

Nowadays, a lot of people come online to socialize with friends who they know already in real life, and strangers who they only meet in the online digital world. Social networking sites provide a platform for connecting to people. The research reported in this body of work has obtained the following findings related to need to belong in online activities.

7.2.1 *Need to Belong and Coming Online*

We investigated the roles the need to belong, one of the most fundamental social needs, plays in driving people to come online for social interactions. We found that a majority of people come to Facebook and post or broadcast information on a weekly basis. The need to belong is associated with the size of people's online social circle, but not the total number of connections people have. We confirmed the hypothesis that the need to belong is significantly related to how frequently people come to a social networking site. People who have a higher need to belong are more motivated to come to a social networking site more frequently, and need to belong is associated with how often people participate in social activities to create connections online. People with a higher need to belong were found to post status updates, broadcast messages or questions, and react to others more frequently than others.

Table 7.1. Hypotheses on Need to Belong and Coming Online

Hypothesis	**Conclusion**
Hypothesis 1: People who have a higher need to belong have more connections on a social site than people who have a lower need to belong.	**Supported**
Hypothesis 2: People who have a higher need to belong come to a social site more often than people who have a lower need to belong.	**Supported**

Hypothesis 3: People who have a higher need to belong post a status update more often than people who have a lower need to belong.	**Supported**
Hypothesis 4: People who have a higher need to belong broadcast messages more often than people who have a lower need to belong.	**Supported**
Hypothesis 5: People who have a higher need to belong respond to other's posts or comments more often than people who have a lower need to belong.	**Supported**
Hypothesis 6: People who have a higher need to belong share or reshare more often than people who have a lower need to belong.	**Supported**
Hypothesis 7: People who have a higher need to belong like posts more often than people who have a lower need to belong.	**Supported**
Hypothesis 8: People who have a higher need to belong stay on a social site longer than people who have a lower need to belong.	**Not Supported**
Hypothesis 9: People who have a higher need to belong have different motives as people who have a lower need to belong.	**Not Supported**
Hypothesis 10: People who have a higher need to belong have higher levels of concerns about privacy than people who have a lower need to belong.	**Supported**

7.2.2 *Validity of Think-Aloud Protocol*

We investigated the validity and reliability of stimulated retrospective think aloud (RTA). Our study supported the validity of stimulated RTA, which doesn't vary with different levels of task complexity. This study shows that the logic inference and strategy explanation information in people's verbalization also provide valid information about users' task performance. When

users were struggling to complete tasks, the verbal reports provide low density and high abstract level information. These findings are useful in any field that uses RTA to collect user's performance information.

Table 7.2. Hypotheses on Validity of Think-Aloud Protocol

Hypothesis	**Conclusion**
Hypothesis 22: People's recounting of what went on in their task performance in a stimulated RTA describes the same sequence of objects in the same order that the subject attended to in the original task performance.	**Supported**
Hypothesis 23: The validity defined in hypothesis 22 is not affected by the task complexity, which is defined in terms of visual information processing complexity.	**Not Supported**

7.2.3 *Need to Belong and Problem Solving*

We studied how deprived social belongingness affects the way we solve problems in our daily life. Our study provided that a deprived sense of belonging lowered people's ability to detect social cues online, initiate new social connections, obtain rich impressions of the member formation in a social group, retain socially relevant information, and remember socially significant details. With a lower sense of belonging, participants were less active in initiating new social connections and shared less information about themselves to others.

The deprived need to belong also had a significant impact on people's problem-solving ability in scanning and processing information in solving difficult online search tasks. Their eye

movement fixation durations became longer in solving difficult tasks, which is often the consequence of less efficient thinking applied in problem solving.

Table 7.3. Hypotheses on Need to Belong and Problem Solving

Hypothesis	**Conclusion**
Hypothesis 11: People who were primed with need to belong are more likely to scan the designed Facebook page (with shorter fixations) than to read the content carefully (with longer fixations).	**Not Supported**
Hypothesis 12: People who were primed with need to belong pay different attention to social information (e.g., people's posts) and objective content (e.g., company's posts or ads) than people who were not primed.	**Not Supported**
Hypothesis 13: People who were primed with need to belong pay different attention to the content itself (e.g., the core social posts) and the social interaction (e.g., the replies) than people who were not primed.	**Not Supported**
Hypothesis 14: People who were primed with need to belong pay different attention to the posts made by the main contributor and the posts made by others than people who were not primed.	**Not Supported**
Hypothesis 15: People who were primed with need to belong pay different attention on visual posts and textual posts than people who were not primed.	**Not Supported**
Hypothesis 16: People who were primed with need to belong remember more content from the designed Facebook page than people who were not primed.	**Supported**

Hypothesis 17: People who were primed with need to belong remember more people from the designed Facebook page than people who were not primed.	**Supported**
Hypothesis 18: People who were primed with need to belong are more likely to talk about themselves in a future encounter than people who were not primed.	**Supported**
Hypothesis 19: People who were primed with need to belong read more search results to find the right answers than people who were not primed.	**Supported**
Hypothesis 20: People who were primed with need to belong spend more time finding answers for search tasks than people who were not primed.	**Not Supported**
Hypothesis 21: People who were primed with need to belong apply different scanning strategy to find answers for search tasks than people who were not primed.	**Supported**

7.2.4 *Summary of Contribution*

The studies reported here contribute to our understanding of 1) the effects of the need to belong on online social participants, 2) people's strategies in consuming belongingness-related information, and 3) effect of the need to belong on people's cognitive skills in solving problem online.

Our research confirmed the roles that need to belong, as one of the most fundamental social needs, plays in driving people to come online for social interactions. The results show that the need to belong is significantly associated with several key metrics on social participation, including the size of people's online social circle, frequency of visiting social networking site, frequency of social activities to create and maintain connections online. The study confirmed our

hypothesis that the need to belong plays a significant role in how people react to others' social interaction (e.g. posts or comments). Our study provided evidence that a deprived sense of belonging disabled people's ability to sense social cues online and initiate new social connections. An elevated need to belong results in getting fewer meaningful socially relevant pieces of information and becoming less active in initiating new social connections, as well as sharing less information about oneself to others.

In addition to social information processing, a jeopardized sense of belonging had significant impact on people's problem-solving ability in scanning and processing information in common online search tasks. When the problems are hard and require more cognition and concentration, a deprived sense of belonging prevented users from effectively solving the problems. The results of this research provide researchers of online social networking sites with insights about what matters to people in terms of promoting need to belong. The findings also benefit the designers of online social networking sites by providing them with a different way of looking at the impact of their site - fulfilling people's fundamental need to belong.

Besides contributing to the fundamental understanding of need to belong, the research is also the first to empirically confirmed the validity and reliability of stimulated retrospective think aloud (RTA). The validity of stimulated RTA was confirmed in that people's recounting of what went on in their task performance describes the same sequence of objects in the same order as what they attended to during the original task performance. These findings are useful in any field that uses RTA to collect user's performance information.

7.3 IMPLICATION

7.3.1 *Look at Online Behaviors via the Lens of Need to Belong*

Social networking sites provide an online environment for old friends to communicate and new friends to connect. They have a powerful influence on how friendships are supported and mediated in today's digital world. Users of social networking sites are invited and encouraged to come to the site often and consider this place a home where they belong. The continuously updated information stream shows the public activities, thoughts and feelings of new or old, close or more distant friends. This formulates a dynamic sense of connection, as exemplified in Facebook's mission statement:

> **"Facebook's mission is to give people the power to share and make the world more open and connected. People use Facebook to stay connected with friends and family, to discover what's going on in the world, and to share and express what matters to them."**

Though social networking sites set up their mission to connect people, not everyone uses the social networking sites in the same way.

Though Facebook and related sites make it easier than ever to facilitate people's social presence online and support people in making connections, different people have different levels of need to belong may use and perceive the social networking sites differently. Some are eager to be accepted and approved by peers, and some are less bothered by being rejected by a group. Some get excited with having over 10,000 Facebook friends, some are simply satisfied with handful of online friends who were already friends before joining Facebook.

Through our research, we found that people who have a higher need to belong have goals that are different from people who have a lower need to belong. As a consequence of having different goals, they do different things when they come onto social networking sites.

Our study shows that people with a greater need to belong tend to have a bigger online social circle than people who don't have as strong a need to belong. The need to belong plays a significant role in how frequently people come to a social networking site; people who have a higher need to belong are motivated to come to a social networking site more frequently. In addition, the need to belong significantly correlates with how often people participate in social activities to create connections online.

The need to belong also correlates with how often social networking site users update their status online, broadcast messages, or post questions. Those with a higher need to belong also react more to other's social interaction (e.g. posts or comments).

Given these differing behavior patterns, one can argue that we should take the need to belong as one of the psychological drives in classifying social networking users and understand its impact on all aspects of social presence and social engagement. In our study, we focused on the relationship between user behaviors and need to belong. A comprehensive look at the influence of need to belong on a broader spectrum of user behaviors (e.g. likelihood of responding to friend's messages, patterns in responding to friend's updates, how they respond to the signals regarding to social engagement, etc.) could shed more light on why people behave as they do when they come online.

In addition to adopting need to belong as one of the social drives in understanding behaviors on social networking sites, it would be also very impactful to take into account the need to belong in designing social features for people who have varied levels of need to belong.

For example, we know that people who have a higher level of need to belong tend to appreciate a larger circle of friends; we could design certain features to help these users in reaching out more to people who are in more distant friend circles, whereas people who have lower level of need to belong may not appreciate this type of feature as much. In another example, for people who have a higher need to belong, we might raise the awareness of social attention someone has received from their online friends. Knowing how many people have paid attention to their updates could also help in mediating the need to belong and reduce the sense of being left out.

7.3.2 *Need to Belong for Online Presence and Privacy*

It might have been true 20 years ago that "On the Internet, nobody knows you're a dog," [152] but not so much nowadays, especially on social networking sites. Our study shows that people usually do not provide fake information on social networking sites. We found that, on average, only 4% of users chose to provide fake information across the different categories of information that people could provide.

The identity represented on social networking sites is hard to manipulate because it can be generalized from the activities people put up on the sites on a daily basis. The social presence online can be very close to the identity people have in the real world, if they choose to be open and transparent. The level of transparency someone chooses to have and the amount of information someone chooses to display on social networking sites could have a profound impact on how others view them, and subsequently interact and connect with them.

In formulating online presence, we found that need to belong has a significant impact on how open people tend to be. People with a higher need to belong tend to open themselves more. The need to belong is statistically significantly correlated with how transparently they provide their personal information.

People with a higher need to belong score tend to be more open to providing more information publicly, including having a picture of themselves on the profile page and in their status update, showing their real birthday, listing their phone number, residence city, email, gender, relationships, as well as personal interests.

It is not surprising to see that people with higher need to belong open themselves up more than people who have a lower need to belong. Ultimately, the perceived value of coming to a social networking site is to make connections. People who have a higher need to belong naturally have a higher need to feel to be included in a group, therefore, they would more willingly socialize more. The desire to make connections can lead to making more personal information public so to form a good and warm first impression. Willingly putting personal information online is likely driven by users' explicit intent. Our study shows that people who have a higher need to belong do feel that they can control how they are perceived online.

Social presence online helps users create a virtual image of the self and formulate their identity. Knowing that people who have higher need to belong make an effort to control their presence by showing more information online, we could design features to help them even further. Taking information provided by users, we could help them effectively formulate an enhanced representation of themselves. We could also take their interests into account to lead them to groups that they might want to make connection with.

In addition to helping users with social presence, social networking sites could also take extra cautions in protecting users' privacy. When someone puts relatively more personal information online, it is important to also deliver a sense of control to users that their information is protected. Users should be made aware of when and how their information is viewed by others. Information such as what information was viewed for how long by others, or what actions

others take after seeing their information, would be very helpful in delivering a sense of control over how others think about them online.

7.3.3 *Design Social Networking Sites to Fulfill the Need to Belong*

Now that we know that the need to belong affects how people come online, how they position themselves, and how much they are willing to reveal themselves to people whom they don't know, we could think harder about how to design an environment to encourage further interactions on social networking sites. People's need to belong can be fulfilled by creating a sense of belonging to a group. Creating a virtual field and environment on social networking sites and formulating opportunities for strangers to come together could greatly help foster people's sense of belonging.

Idea I: Help people with higher need to belong to better present themselves

On social networking sites such as Facebook, the information provided in the personal profile was mostly shown in the "About" section. While it is good to solicit this personal information from users, the social networking sites can take further actions to turn the information into a better presentation of the user. Translating the textual information into a more visually appealing representation of the individual in various contexts could help users with their self-presentation. For example, a person who lists "swim" among his interests could be provided with an option to use a swimming image (of himself or a generic one) to present himself, or a person who lists "gardening" could use a garden image to help people know him or her better.

Idea II: Help identify people of similar interests and experience

While it may not be easy for social networking site users to identify a group that he or she could belong to, it is relatively easy for the site to use algorithms to help identify groups or individuals who share similar interests or experiences. This type of information can be

intelligently surfaced to the users based on the interests they have expressed in the past or even in real time.

For example, if someone posts an update of a topic relating to "skiing" in a local place, the site can mine the topics posted by others. These topics and the individuals who are behind them can be dynamically grouped together. A visual presentation of this group can be shown next to the "skiing" post to draw the attention of the original poster. A person who is willing to discover new friends would likely be attracted to read and follow the topics, which could result in a greater chance to meet someone who has similar interests and experience.

Idea III: Help highlight social cues inside a group to foster opportunities for people to make connection

Our study showed that people with higher need to belong are less efficient in remembering the social environment, e.g. who is in the group, and who said what, etc.). When they face a group of strangers online, they don't always remember all the people in the group, and they are less likely to reach out to people. When they do, they speak very little about themselves. All these effects make it harder for people to sense the meaning of social cues (for instance, recognizing who is the most friendly one in the group), and less efficient in creating opportunities for others to know him or her.

To help people who have higher need to belong to effectively get acquainted with a new group, the social networking site can provide features for users to algorithmically extract the key metrics about a social group (e.g. how many people in the group, how users start the conversations, etc.), and highlight the key personnel's characteristics (e.g. who created most posts, who is more friendly to the group, who initiated most new friend requests, who received

most friend requests). This can greatly help people read the social cues inside the group, and subsequently effectively make the connections with people of the interests in the group.

We also found in our study that people with higher need to belong are less skilled in initiating friend requests and starting a new conversation. To help people start a social conversation, social networking sites can design certain ice breaking features. This can help the effort needed to initiate the conversation. For example, a few types of ice breaking templates can be provided for users to adopt to talk about themselves and ask questions. The templates can even be dynamically updated to reflect the communication style of the person with whom the user wants to connect.

7.3.4 *Satisfy the Need to Belong to Maintain Cognitive Performance*

Besides improving social connections for people who have higher need to belong, the need to belong study reported in Chapter 6 shows that someone's cognitive performance can be improved by taking the need to belong into account. Our study shows that when the need to belong is elevated, people become less efficient in solving difficult search tasks. This implies that someone who is rejected by a group could spend too much of his cognitive mental power to sense the social cues to fulfill his or her need to belong, and is less likely to be effective utilizing their cognitive ability to solve difficult problems at hand.

This could have very broad implications for a variety of domains - be it exam time at school, a work task at a critical moment, a high pressure performance time in front of a lot of people, or a critical game in sport competitions. When it is time to solve a task or face a situation that requires more cognitive ability, people around the person can best support him or her by supplying him or her with a heightened sense of belonging. A simple gesture (or online equivalent) of giving a hug (e.g. a signal of being loved), saying encouraging words (e.g. we are

together), or even as simple as a powerful handshake could release the person's tension of wanting to belong. This decreased need to belong migrates the person's attention from social signals to more cognitively demanding tasks that need his or her attention.

7.3.5 *Studying Task Strategies using Retrospective Think Aloud Protocol*

Our study supported the validity of stimulated RTA. The finding is useful in any field that uses RTA to collect user's performance information. The study shows that the logic inference and strategy explanation information in people's verbalization also provide valid information about users' task performance. This has a big implication on how user experience researchers could use this approach to obtain a valid re-account of the mental processes in solving the problem without interfering with task performance.

The inferential and explanatory information collected via retrospective think aloud protocol can indicate how information was processed and clarify what specific strategies people used to complete tasks in a usability study. Usability evaluators can use this information to assess whether a product or interface is successful in supporting users in doing the tasks it is designed for and to identify what parts of the design negatively affect user's behavior.

Practitioners can also try to identify low density and high abstract level information to match with the pattern of critical moments. The former has been proved to be a valid indicator of problems in usability study.

7.4 LIMITATIONS

For any given topic, there is always more than one way to study it. There is no doubt that the topics studied in this dissertation fall in that category. In my research design, there are a few

things that I could have done differently in the studies reported in this dissertation. In the following sections, I will discuss the limitations of the studies, propose ways to study the relevant topics differently, and identify resources needed if we were to choose a different research approach for the topic.

7.4.1 *Measuring the Need to Belong*

Need to belong is hard to measure. This is not something people are consciously aware of. When the need to belong was first studied by Leary, Kelly, Cottrell & Schreindorfer in 2001, the team identified a 10-item questionnaire to measure the need to belong by asking people whether they agree or not agree with different types of statements. These statements either reflect how they would respond to rejection, e.g. "My feelings are easily hurt when I feel that others do not accept me," and "Being apart from my friends for long periods of time does not bother me", or clearly describe their own traits, e.g. "I have a strong need to belong". This 10-item scale was used in the studies reported in this dissertation.

Though this 10-item scale was reported to demonstrate adequate reliability, with Cronbach's alpha being 0.83, the users who responded to the scale could manipulate the results easily if they are aware of the goal of the questionnaire. Using this same scale for online studies suffers a few additional risks.

First, we assume that the same scale can be used for both online and offline, whereas the online need to belong may be different from the need to belong experienced offline. When people are online, they do not face strong pressure to make connection and they don't respond to online rejection as strongly as they could experience in physical world. For example, lurking is very common in an online community, where silent existence can be very discreet and cannot always be detected by others. Someone who has a strong positive answer to "my feelings are

easily hurt when I feel that my **real world friends** do not accept me", may feel very indifferent to "My feelings are easily hurt when I feel that **my online friends** do not accept me".

Secondly, the reliability of using this scale online is yet to be verified. The original scale was tested and demonstrated adequate reliability, with Cronbach's alpha being 0.83. However, it was originally tested in paper and with participants in the lab. In our study, we migrated the questionnaire to online. The reliability of the scale could be compromised when it is conducted online where fewer face-to-face constraints were present.

7.4.2 *Measuring User Behaviors*

In our study, we used the survey approach to ask users to recall their frequency of usage. The survey allowed us to reach out to participants who have a variety of backgrounds (e.g. students, professionals, etc.). We successfully recruited 274 Facebook users to answer the survey, which allows us to gain a deeper understanding of how the need to belong relates to social interactions on social networking sites. Any study has its limitations, and. our study is no exception. This study is limited in several aspects, including the sample size and questionnaire design.

Because of technical limitations, we chose to conduct a survey to answer the questions. With more technology support and access to personal data, the main research questions could also be answered by conducting a logs-based analysis. If the personal data about Facebook users' history, online interaction, as well as friends' connection were open for the public to access, a large scale log analysis could shed more light on the broader impact of need to belong. For example, we could analyze hundreds and thousands of Facebook users' history of use of Facebook to understand whether need to belong plays a role in motivating users to start their interaction on Facebook.

The second limitation we recognize is the questionnaire design. We have 33 questions in total in our online survey questionnaire. Since our focus is the need to belong, we decided to use the 10-item need to be belong scale instead of the one-question need to belong scale. The former was developed by Leary et. al., who are extremely knowledgeable about need to belong. This 10-item questionnaire has been used widely by researchers to study the need to belong. In comparison, the latter was developed much later and more practice with it needs to be seen. In addition, we also asked intensively about people's activities on a Facebook page. This allowed us to look into each different activity people do on social networking sites (e.g. making a post, commenting to friend's post, sharing and resharing, etc.).

As the result of using the longer form of the need to belong scale, as well as intensive inquiry about online social participation, our section about other motives is very brief. More specifically, we had only one question about each possibly related psychological motive. For example, we used only one question to measure loneliness ("How often did you feel very lonely or remote from other people during the past few weeks?), where in other psychology studies, more inquiry would be given to each individual motive. Our study was limited by a single-item measure of satisfaction with personal relationships, loneliness, and satisfaction with life in general.

There is also the possibility of a biased sample of people who agreed to participate in the online survey. However, it is not clear whether or not this self-selection process would have any influence on the variables assessed in this study.

7.4.3 *Measuring the Need to Belong Effect*

To understand the relationships of need to belong on users' social behaviors and cognitive skills, we conducted a lab study with a selected group of users. The users were selected

from the nearby university and recruited via a public classified site. A study of this size has a limited statistical power. Therefore, we could only test a limited set of hypotheses. If we want to achieve larger statistical power, a social networking site could run it as a live experiment. Imagine that we could identify a few potential stimuli that might elevate users' need to belong (e.g. a long ignored member in a hot debate, etc.), and then observe their behavior change afterwards.

As with any human subject studies, the researchers should be extremely careful in conducting such experiments when the manipulation could have real impact on how people think of themselves and think of their friends. Appropriate precaution should be practiced here to avoid any ethical issues of affecting people in their real life.

Mmeasuring the impact of need to belong on cognitive skills can also be done via an experiment. Imagine that the website can invite users to play an online game (similar to the cyberball game used in the study), and then observe the search tasks people complete online. This approach would allow us to collect more data points, which ultimately warrants it with a much bigger statistical power to test a broader set of hypotheses.

7.5 FUTURE WORK

We investigated the need to belong and people's participation in social networking sites. This is just the first step towards understanding how human being obtains the sense of belonging and fulfill the need to belong. Humans, as social beings, long for connection. Relieving the feeling of being rejected and being happily connected are the ideal state in a social world, be it physical and real or digital and virtual.

We can envision several directions that future research teams can take to extend the field of understanding the need to belong on its generation mechanism, impact mechanism, as well as fulfillment mechanism.

Social psychologists have done a lot of work in establishing the need to belong as one of the fundamental needs a human being has. With a world where virtual and online social networking becomes a part of the environment that people grow up with, how does the need to belong relate to a broader group of fundamental needs, such as loneness, self-esteem, self-identification, etc.? Will the need to belong still be a significant and fundamental need in a world where virtual connections may ultimately outweigh physical and real social connections? Will the need to belong be able to relieve the loneness that people experience in the real world? How does being a part of group online help people's self-esteem? How does the need to belong relate to having a strong and unique online identification that distinguishes someone from other people online who they may never see in a real world? Besides being rejected directly, what are the triggers that uniquely exist in an online world?

Past research has shown that the connections people have in an online social networking site partly reflect what they have in the real world. At the same time, the participation in online social networking sites has grown rapidly. We found that the elevated need to belong could deteriorate the performance of difficult tasks. What if the rejection happened in a virtual world? What social activities could trigger a compromise in the sense of belonging? What actions would someone take if the need to belong is suddenly elevated? Will an ignored status update or a missed birthday update significantly affect someone's need to belong, and subsequently affect how people do critical work?

Coming to and updating status on a social networking site has become a normal activity for the new generation. The social networking sites differ in their sizes, user composition, and ways of interaction. For example, the younger generation tends to use SnapChat and Instagram more than Facebook. How does the social networking site design affect the formation of the sense of belonging? Is one social networking site working better than another in helping bring people together and creating a sense of belonging? How does that design mechanism further impact the user composition and ways that they communicate that the chance of being rejected gets lower? How could someone design a social networking site that creates a strong tie to form a sense of online community, like the way that interest groups or churches do in real life?

On the methodology part, findings presented in the work included in this dissertation on retrospective think aloud are preliminary work in establishing the fundamental validity of stimulated RTA. Future work can be done following two trends. One is to design an advanced algorithm to extract high level information from ET, so that it could be used to compare with high level verbalization. Second is to study how a specific dimension of task complexity affects the degree of omission found in people's retrospective verbalization.

7.6 SUMMARY OF THIS CHAPTER

In this chapter, I started by summarizing the findings we presented in the previous chapters. The significant findings we have are the new knowledge I established between the need to belong and people's social participation. Not only did we find that they are related, the need to belong is playing a statistically significant role in how much people actively participate or passively respond to others online. Our research also showed a clear connection between the need to belong on people's ability to retain social cues, as well as start and maintain social

connections. In addition, the need to belong has been shown statistically to lower people's cognitive ability in solving difficult problems.

I also discussed the implications of the body of work presented in this dissertation, from taking the need to belong as one of the fundamental needs in understanding online social behaviors, to designing social networking sites to fulfill the need to belong, to satisfying the need to belong to improve cognitive performance, as well as the practical implications of applying retrospective think aloud in applied user experience research.

After discussing the implications of this work, I explained its limitations, and presented several ideas on how other researchers can do better on research approaches. Finally, I discussed the research directions that other researchers might take to further our understanding in the need to belong.

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