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ABSTRACT

A CONVERSATION CENTRIC APPROACH TO UNDERSTANDING AND SUPPORTING THE COORDINATION OF SOCIAL GROUP-ACTIVITIES

by
Richard P. Schuler III

Despite the widespread and large variety of communication tools available to us such as, text messaging, Skype, email, twitter, Facebook, instant messaging, GroupMe, WhatsApp, Snapchat, etc., many people still routinely find coordinating activities with our friends to be a very frustrating experience. Everyone, has at least once, encountered the difficulties involved with deciding what to do as a group. Some friends may be busy, others may have already seen the movie that the others want to see, and some do not like Mexican food. It is a challenge everyone has faced and continue to face. This is a result of system designers and researchers primarily focusing on understanding and supporting workplace coordination. This workplace bias has led to an assumption that the same technologies employed to facilitate workplace coordination can easily transfer to social coordination. This has created a divergence between how people actually communicate and coordinate for social reasons versus how the systems and technologies developed to support such coordination and communication are designed. As a result, researchers and designers are faced with dearth of knowledge about how to design and research systems that support people engaging in coordination and communication for more social reasons.

This dissertation moves beyond previous work, both academic and commercial, which has either focused on providing structured and process oriented communication and coordination support or on the creation of yet another text chat. This research focuses on a narrower aspect of social communication and coordination, specifically, the problem of

social group-activity coordination. Generally, this is the *stuff* people do to coordinate going out to dinner or the movies with a group of friends. This area has been under researched and as personal experience informs, poorly supported.

This dissertation contains four main contributions. First, a diary study of 37 young adults aged 18 to 28 investigated the current social group-activity coordination practices resulting in an expansion of the knowledge about how social groups coordinate social group-activities and what technologies people use and why. Second, via iterative design and testing following a research through design methodology the design space for social group-activity coordination is explored over multiple design iterations. This results in the design and instantiation of a social group-activity coordination support tool improving understanding of the design requirements of tools that support social group-activity coordination. Third, a quantitative survey which confirmed many of the findings discovered during the dairy study. Fourth, the tool is evaluated in a laboratory study with 84 participants during 21 sessions. This study finds that using the conversation centric design perspective presented in this dissertation it is possible to reduce information overload and support consensus building. Also, the features provided are overwhelmingly desired with 91.4% of the participants desiring the ability and interface to make suggestions about important activity details (vs open chat) and two-thirds of the participants reporting they would prefer to use this tool over text messaging.

The combination of all these different investigations into social group-activity coordination extends the knowledge about how to improve the support of social group-activity coordination and move beyond the process and systems oriented perspectives and towards conversation centric designs.

A CONVERSATION CENTRIC APPROACH TO UNDERSTANDING AND SUPPORTING THE COORDINATION OF SOCIAL GROUP-ACTIVITIES

by
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A Dissertation
Submitted to the Faculty of
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CHAPTER 1

INTRODUCTION

One of the primary uses of interpersonal communication channels such as texting, instant messaging (IM) and mobile phone conversations is to coordinate social group-activities, such as the planning of a future face-to-face meeting. It has been estimated that from 34 to 64 percent of SMS messages (Grinter and Eldridge 2003; Ling 2005; Schiano et al. 2007) are for social coordination purposes, as are a similarly sizable proportion of IMs (Nardi et al. 2000). The problem is that while social group-activity coordination is typically conducted through mobile communication and is one of the main uses of mobile communication devices, existing mobile applications provide limited or ineffective support for coordinating these activities. Also, much of the effort in understanding and supporting group coordination and communication has been directed towards the needs of the workplace. As a result, previous research has focused heavily on the use and development of calendaring and scheduling systems or on specific instantiations of a technology without understanding its use in broader contexts.

While there has been extensive research and theories proposed about group work, workplace communication and coordination, virtual teams, etc., there are few conceptual frameworks and little empirical knowledge of user requirements, attitudes, and the efficacy of system designs that extend beyond the workplace to everyday social activities. Current research and commercial systems are stuck with the perspective that workplace solutions can easily transition to social settings. This is despite the fact that in more than 20 years of Computer Supported Cooperative Work (CSCW) research into coordination processes

researchers have yet to instantiate social group-activity coordination support systems that demonstrate a systematic understanding of the overall design space. This results in people losing a significant amount of time and effort in coordinating everyday activities using unstructured serial one-to-one communication media. What is needed is a new perspective that values providing this support by understanding existing group norms and process and the development of systems that complement these norms and process. This dissertation argues for a new perspective – conversation centric design.

The broad goal of the research presented in this dissertation is to use a conversation centric design perspective to: 1) further our knowledge about how social groups coordinate social group-activities and gain a greater understanding about what technologies they use and why, 2) understand how to effectively design systems and features that support social group-activity coordination using this new perspective. The investigation was conducted in the following ways:

1. A review of previous literature and theory related to coordination and small group communication. This review shows how the previous work's focus on workplace coordination and communication with a preference for process and system oriented perspectives have left researchers and system designers we a lack of knowledge about how to build truly supportive coordination systems. A theoretical framework for a conversation centric design perspective is outlined and used to review previous research for important design principles for building systems from a conversation centric design perspective.

2. A qualitative diary study of 37 undergraduate college university students aged 18 to 28 that investigated how they coordinated their social group-activities over a two week period. The study specifically focused on the motivations and decisions to use various technologies to assist the social activity coordination process, how the various aspects of these technologies impact the coordination process, and what aspects causes coordinating social activities to be difficult and complex or simple and easy.

3. A series of iterative designs following the research through design approach with the purpose of understanding about what aspects support social group-activity coordination. These designs were informed by and also facilitated the formation of a conversation centric design perspective. The resulting designs iterations

ultimately led to the instantiation conversation centric design of a social group-activity coordination tool.

4. The evaluation of the final design from the iterative design process. This resulting design represents the theoretical framework and conversation centric design principles discussed later in this document. The evaluation was achieved by a mixed methods laboratory study of 84 participants in 21 groups. Each group performed two coordination tasks, one with the coordination tool, and another using group-chat (a typical social group-activity coordination technology).

These studies not only resulted in the design and instantiation of an innovative approach to supporting social group-activity coordination but they also further our understanding of how to design for social group-activity coordination and highlight the limitations of current theory and research which does not adequately provide guidance for designers and system builders attempting to support this type of coordination.. The findings from this research show how approaching this area from a conversation centric perspective overcomes the limitations of the current and previous research predominately work place and process oriented perspectives (discussed in subsequent chapters) and provides a new avenue for future research in this field.

This dissertation is structured in the following manner. Chapters 2 through 4 provide a definition of terms used throughout this dissertation and present background research. Chapters 5 and 6 provide a theoretical framework and design principles for a conversation centric perspective. Chapter 7 provides a brief overview of the research plan and studies conducted for this work. Chapters 8 through 11 contain the results of each study in detail. Chapter 12 concludes the dissertation and provides an overall summary of the contribution from this dissertation and future research possibilities.

CHAPTER 2

GROUPS, SOCIAL ACTIVITIES, SOCIAL COORDINATION, AND COORDINATING SOCIAL ACTIVITIES

To begin it is necessary to provide some definitions and outline terminology that will be used throughout this dissertation. Some of the terms and definitions used will first be presented as used and interpreted in previous research and extended or redefined as necessary. When reading this chapter bear in mind that some of the topics discussed are limited by the current state of research and theory regarding how people manage routine social activity coordination. Specifically, the definitions and terminology are focused on how they are used and discussed within the field of computer supported cooperative work (CSCW) and human-computer interaction (HCI) and how the perception and use of these terms influence designers and their design work. The concepts of social, coordination, group, and activities are wide ranging and span multiple fields (from anthropology to sociology to psychology) and the CSCW and HCI communities at times have borrowed from these various disciplines. As a result, precisely agreed upon language, definitions, and terms, on the whole, are lacking.

Let us start with what is considered a *social activity* for the purposes of the research presented in this dissertation. A *social activity* is an activity that a group participates in outside the boundaries of their employment or other formal organizations for primarily recreational purposes. Subsequently, *social activity coordination* is defined as the communication, negotiation, and coordination actions that *social groups* perform with the aim of participating in a *social activity* together.

In the following sections the terms *social activity*, *social group*, coordination and communication, and *social group-activity coordination are* discussed in greater detail. The discussion of these terms will draw upon previous research from primarily CSCW and HCI research communities but also from other related fields..

2.1 Social Activity

The term *social* is broadly defined as: "of or relating to society or its organization," which, in regards to this research, is an overly broad definition. The Oxford English dictionary provides a closer definition of social: as a noun meaning "an informal social gathering". This definition is much closer to what is desired, however, it is also circular in which the term *social* is also used in its definition. *Activity* fares much better with two definitions that are useful: 1) "a recreational pursuit or pastime" and 2) "actions taken by a group in order to achieve their aims". Both are useful in that they describe *things* that happen.

Researchers have struggled with an adequate definition and classification that distinguishes and separates *social* from *work* activities. This is because there is not a clear delineation between what should be considered a work activity versus one that should be considered a social activity. Also, much of what takes place in the workplace is in many respects social in nature. The challenge then is to provide some manner in which to separate the workplace activities that are required for the functioning of the organization from those that individuals perform to interact and engage with each other separate from – or at least not primarily motivated by – the goals of the organization.

Kowitz et al. (2005) investigated *impromptu activities* which they defined as social gatherings that are planned less than two days in advanced. The main issue with these terms is that it is largely left to the reader to form their own interpretations. In addition, the idea

of an *impromptu activity* is subsequently defined by yet another term, a *social gathering,* which is also not clearly established.

Schiano et al. (2007) used the term *leisure outings* and implied the scope of the activities from the term and avoided boundary issues by relying on this implicit definition. The term *leisure outing* has an implicit meaning that clearly separates it from workplace activities. However, it can also imply that the activity is motivated by recreation or for entertainment.

Both of these terms are adequate for the research conducted using them. The idea of a *leisure outing* is closely related to this dissertation' conceptualization of a *social activity, however,* it is important that when conducting research in new areas that the definitions used to frame the research is refined and explored as well.

Deduction is another means of exploring the definition of *social activity*. A *social activity* can be viewed as an activity that is not for the purposes of employment or work. An example of a common work activity is the meeting: a group of people (e.g., employees, students) gathering to discuss various details necessary for their work to be accomplished and their organization to function. Implied is a sense of employment and / or obligation in which the individuals feel compelled to attend. This contrasts with a *social activity*, such as, going to the movies or hanging out with friends, because the motivation to attend differs between these *social activities* when compared to *work activities*. The distinction between a *social activity* versus a *work activity* is due to the relation to an individual's or group's employment. This is useful, however, it is also limited since there are quite a few other activities that people take part in outside of work that are not social in nature. As a result,

the distinction should be expanded to at least include school group projects and volunteer work performed for the benefit of structured and recognized organizations.

This requires a delineation between social and work activities for the purposes of this research. First, examples of *work activities*: a meeting to discuss the upcoming end of quarter report, a planned business luncheon, a training session, etc. These examples are clearly defined by the boundaries of employment. One's participation is required in order to maintain employment. In contrast, examples of *social activities*: an informal lunch with other people you work with, pizza and beer with a group of friends, a movie night with a significant other. In this case there may or may not be any implied or implicit obligation to participate and if one exists it is due to the individual's desire to maintain and / or establish social connections. This is where the idea of a *social activity* and a *leisure outing* differ. The emphasis for a *social activity* is on the desire to engage others socially, to spend time with them, etc., with the secondary emphasis on the fact that it is separate from the workplace activities that is required of them. In this way a *social activity* is separated from a *work activity* by the individual's motivation for participation. The participation in *work activity* is primary motivation by maintaining employment and fulling the needs of the organization. This contrasts with a *social activity,* where the primary motivation is to engage with others who are also participating indicating a desire to engage with each other separate from any enforced reasons.

Between well-defined *work activities*, and activities such as going to the movies with friends, there are activities that are social in nature but have a more formal expectation of participation. Examples, such as, sport practice, prayer group, ski-club meetings, etc., represent activities that are social in nature but have a more structured and implicit

obligation to participate similar to *work activities*. One may not maintain their ski-club membership unless they participate in the meetings; however, you can still belong to a group of friends even if you cannot attend many of their gatherings. This gray area is potentially the most interesting and presents the most difficulty in establishing a clear definition of *social activity*. This is due to the fact that there are many examples of activities that are typically social in nature, e.g., a party, but participation may be compelled and obligated to greater or lesser degrees, e.g., a soccer team's summer barbecue or an office holiday party. This ambiguity exists because in many cases the distinction cannot be made from the type of activity alone and instead also relies on the relationships between the social group's members to provide context. In other words, what makes an activity social is the social relationships, how they are perceived, and how the activity relates to the relationships of the individuals engaging in them.

Outside and perhaps orthogonal to these concepts are various other activities that we participate in, jury duty, doctor visits, depositions, etc. These activities also occur but are obviously distinct from both social and work activities; however, they are similar to work activities in that they have an implied obligation and requirement to participate but the motivation is not due to interpersonal reasons.

This dissertation takes a broad view of what constitutes a *social activity* and defines it as an activity that a group participates in outside the boundaries of their employment or other formal organizations primarily for the purposes of establishing and/or maintaining their interpersonal relationships and as a signal to the group the desire to have these relationships. The boundary of employment and other formal organization is meant to distinguish activities that are required in order to maintain employment and the

organization to function. This definition is broader in scope than *leisure outings* due to the difficulty in establishing a clear delineation between a work / workplace activity and what constitutes a *social activity*. Also, this definition of *social activity* does not limit the exploration of those activities that are not as easily defined as primarily for recreational purposes and allows for placing more emphasis on the interpersonal relationships of the group members rather than on the activities.

2.2 Group

The Oxford English dictionary defines *group* as "*a number of people or things that are located close together or are considered or classed together*" (OED 2014). This definition embodies both the idea of group as a collection of *things* and as a collection of *people*. This definition of group is more applicable for inanimate objects because of the focus on describing based on their physical proximity or their shared features. When discussing groups of people it is much more interesting to frame it in terms of what, why, and how they do things together.

The importance of understanding the capabilities of groups of people acting together has been a topic concerning small group researchers for over a half century. Homans (1950) defined a *small group* as "a collection of people, few enough in number to be able to interact and communicate with each other on a regular basis in order to reach a common goal". From this definition Hirokawa et al. (2003) identified five basic elements of a group that are implicit in this definition: number of people (size), shared purpose (or goal), interdependence (the actions of one member affect the group and other members), perceptual boundary (shared understanding of who is or is not a member), and regular interaction. Homan's definition and explanation by Hirokawa et al. is much more useful

for perceiving and understanding groups of people than the one provided by the dictionary. However, there is some implicit bias with this definition and these five elements when viewed from the perspective of social groups. This stems from the embedded assumption that a group must have a shared purpose it is acting towards. This is problematic when attempting to understand and describe a group of friends. While a group of friends shares many of the other elements it may not always have a shared purpose that is clearly identifiable by all group members. The concepts of perceptual boundaries and regular interaction are problematic when discussing social groups. One issue is that the style and frequency of interaction and communication of social groups is varied and not all members share the same level of interaction with all the group members. Also, members do not always interact and communicate together as a group, social-group members frequently communicate independently with each other. In addition, the perceptual boundaries of social groups are established, defined, and maintained by the regular communication and interactions, i.e., friends are friends because they regularly do things together. The boundary (i.e., the characteristic that identifies individuals as group members) is their regular interaction. While this is not always the case, for example, there are 'work friends' or 'college friends' that have additional boundary features, the regular interactions between group members to maintain the group is still the most important boundary feature. While this definition of group is problematic when examining the concept of a social-group, the five basic elements are still useful as a starting point and provide a source for additional reflection.

From a systems perspective of group Arrow et al. (2000) define *small group* as a "loosely coupled system of mutually interacting, interdependent members, projects, and

technology with a shared collective identity". Their definition is further refined by rejecting the inclusion of groups based on social categories (e.g., race, gender, nationality). They also exclude people who are only in close physical proximity but are not interacting with each other (e.g., people at a bus stop or train station) from their definition of a *small group*. This is effectively a nullification of the dictionary definition of group, i.e., the features of the group are unimportant in and of themselves. This definition, like the one provided by Homans, includes the concept of shared identity or perceptual boundary. The idea of shared purpose is not explicitly stated in this definition, however, the idea of projects and technology alludes to it. The concepts of projects and technology are problematic when you consider social or friend groups. There is the implied conceptualization of a small group as an entity existing primarily for, or at the least heavily motivated by, the completion of certain tasks. These tasks are undertaken by the group and the various technologies that are used to complete these tasks helps identify and construct the idea of the group. This is a result of bias that a systems perspective brings and is more useful for understanding work groups due to the nature of the how groups of people operate in the workplace. Work groups have tasks and the group members share and collaborate using various technologies to complete these tasks. This is a problem when considering *social groups.* First, the idea of technology is a problem because on one hand it can be considered too narrow. What does it mean if some friends use text messages to communicate while others use phone calls and yet others use email? On the other hand it is too broad since you would have to include all the technology that is in common use for social communication purposes. Second, in terms of a group of friends, what is the shared project? It is possible to define the shared project as the maintenance of friendship. Defining the shared project

in this manner is a problem since provides very little insight and descriptive power about the group and its members. Also, it forces the investigation to be external from the motivations of the group members and their reason for maintaining the group and places the emphasis on how they operate and interact with the world. These aspects are a result of a predisposition towards work and workplace groups and results in a problematic definition when regarding social or friend groups.

One concept that these two definitions share is the idea of groups being comprised of members that share the understanding of being in a group with the other members. This has been explored by sociological researchers using the concept of *in-group* and *out-group* identification (Tajfel 1974). *In-group* identification is a process of classification of the self – identifying oneself with a group that matches his or her view (or matching one's view to that of the group), and *out-group* identification is a process of reinforcing this identity partly through excluding themselves from groups they have no affinity for (i.e., identifying and establishing the 'other'). These conceptualization of group are what comprises social identity theory (Hogg and Tindale 2005) and self-categorization theory (Hogg and Reid 2006). These theories and the research based on them view group membership as something requiring adherence to and the following of *group norms.* These are the shared views (interest, commonality, unsaid rules, etc.) that the members of a group share and develop to establish the groups' boundaries and belonging criteria (Cohen 1969; Tilly 2004).

For the purposes of this dissertation, it is necessary to reduce the requirement for a group to have an explicitly defined goal or purpose. It is also important to not have the definition of the group rely upon the technologies and processes they use to achieve these

goals. Also, it is key to acknowledge that a group requires some form of boundaries and some shared agreement about what constitutes the group. Therefore, the definition of group will draw upon both Hirokawa's and Arrow's definitions. A group is defined as: *a collection of people that loosely share a collective identity and are few enough in number to be able to interact and communicate with each other on a regular basis*. This definition of group is centered upon the idea that the existence of a group is defined by the fact that members can more or less identify who belongs to the group and that they communicate and interact with each other. This allows for the examination of groups beyond those that exist for the purposes of completing tasks, e.g., groups of friends.

2.3 Coordination and Communication

Malone and Crowston in their conception of Coordination Theory (1990, 1994), one of the early theories discussing coordination in the CSCW literature, begin the discussion with the American Heritage Dictionary's (circa 1981) definition that coordination is "*the act of working together harmoniously.*" They termed this as their common sense definition of coordination to note its breadth and lack of ability to inform about what aspects of coordination is important for study. Therefore, they identified various components of coordination: goals, activities (processes or steps), actors, and interdependencies. They subsequently define coordination as: "*the act of managing interdependencies between activities performed to achieve a goal.*" (Malone and Crowston 1990). In a later publication they refine the definition and state that "*coordination is managing dependencies*" (Malone and Crowston 1994). This is similar to Structuration Theory (Giddens 1976; Poole et al. 1985) in that the disparate aspects of coordination are being separated and identified in order to provide meaning towards the entire process. However, both of these perspectives

view coordination from a systems perspective that limits the view of coordination as a process between actors (typically the group members) and the structures that comprise the rules that they follow. This view of communication is very process oriented and is dependent upon proper identification of the actors and structures before understanding the system. There is also an inherent assumption that groups are comprised of rational actors conscious of their own particular desires.

Waldeck et. al. (2002) summarize the predominate theories of small group communication: functional theory (Gouran and Hirokawa; Hirokawa 1980, 1983), symbolic convergence theory (Bormann 1972, 1973, 1975), group structuration theory (Giddens 1976; Poole et al. 1985), and bona fide group perspective (Putnam and Stohl 1990; Putnam 1989). The examination of these theories in relation to each other highlights their differences and the problems that arise due to their conflicting definitions. This is most easily displayed by the dichotomy between the definitions of communication put forth by functional theory and symbolic convergence theory. Functional theory defines communication as the means by which a set of critical requirements of a task are satisfied by group members. These requirements enumerate the minimal things that a group must do in order to communicate about a task. This definition is a result of functional theorists' main concern being to understand decision-making groups and the process those groups go through in order to reach decisions and complete tasks. In contrast, symbolic convergence theory begins with the assumption that people have separate and distinct *symbolic worlds* from each other and that the act of communicating is the bringing together portions of these worlds to create shared meanings. This theory views communication as a means to generate mutual understanding through the process of symbolic convergence. The result of

communication from symbolic convergence theory is similar to the concept of *common ground*. Clark et al. defined *common ground* as shared "*mutual knowledge, beliefs, and suppositions."* (Clark et al. 1983)

Much of the research both in the small group communication community and in the CSCW community have focused on understanding communication and coordination from a process oriented perspective. Also, the various definitions of coordination and communication are tailored to specific theoretical frameworks and are only truly useful within the context of those theories. For the purposes of this research, coordination is viewed as much broader than presented by any one of these theories. Herein, *coordination* is defined as: *the actions that groups and group members undertake while attempting to reach a shared understanding and consensus*.

2.4 Social Group-Activity Coordination

Previous research also provides some help in defining and understanding what social activity coordination entails. While previous research did not explicitly define *social group* and *social activities* as previously presented in this dissertation, there has been some research exploring this area providing some insight into this type of coordination. Basttestini et al. (2010) observed that "*many of these conversations were related to planning future events/get togethers, coordinating around meal times, and organizing rides*". An exploration into Norwegians' use of SMS described many of the observed conversations "*as making agreements for activities that had not already started and were to take place within the next few days*" (Ling 2005). Researchers exploring teenage use of text messaging observed that many of the conversations were about "*arranging activities such as going to the pub, seeing a film, meeting at the cinema, and getting tickets for a*

club." (Grinter and Eldridge 2001) Various aspects of these definitions and observations hint at those encompassed by *social activity coordinatio*n.

For the purposes of this research, a *social group* is: *a group of two or more individuals that are related to each other outside the boundaries of employment or formal organizations and typically come together to participate in activities together for recreation or leisure*. The members of the social group may or may not share some form of shared identity, however, individual members may perceive other members as part of the group. This definition makes a distinction between the 'soccer team' and 'my friends from my soccer team', with the former being a group that has a formal organization and the latter being a *social group* that is comprised of friends that also happen to be members of the team. Similarly, there is a distinction between 'work colleagues' and 'my friends from work' because the former is defined by the boundary of employment, i.e., the people at work are a group due to the requirements of their shared employment.

This allows us to define *social activity coordination* as the communication, negotiation, and coordination actions *social groups* perform with the aim of participating in a *social activity* together. It is also possible to define social activity coordination using Coordination Theory as: *the act(s) that a collection of individuals perform in order to manage the interdependences that are required for a social group-activity to occur*. However, it is important to note that coordination is more than just the actions performed to manage interdependences. There are a myriad of other actions people perform when coordinating as a group that is not directly associated with the management of interdependencies.

CHAPTER 3

EMPIRICAL STUDIES INTO GROUP COORDINATION

Early work in group coordination started with the introduction of the concept of networked computers (Licklider 1960). Eventually the systems developed within this research area came to be known as Groupware and the field as Computer Supported Cooperative Work (CSCW) (Grudin 1994b). The field and term Groupware has its historical roots both in the workplace and academia. The focus on the early research and system building was on improving and supporting workplace communication and coordination. Much of this focus was on the technical and system building aspects but also on the dynamic communicative acts that occur when groups are performing their various work tasks. This was a primarily workplace oriented perspective with much of the investigative effort focused on understanding, deriving, and supporting the process and mechanics of group coordination.

As the area matured some researchers perceived this as a limitation and began to argue that there are other aspects of coordination and communication that is important. One example of this is the discussion of the social-technical gap by Mark Ackerman (2000) in which he identifies the tension between understanding and supporting the social dynamics of group coordination and communication and the focus on supporting and understanding the mechanics. This is not to say that researchers were not investigating the various social aspects of group coordination and communication, in fact, in 1994 the Communications of the ACM had a special edition on *social computing* (Schuler 1994). Therein *social computing* was defined as “any type of computing application in which software serves as

an intermediary or a focus for a social relation." This definition is probably intentionally vague and ambiguous in order to leave room for interpretation and evolution of the term.

The concept of social computing is now becoming synonymous with the fields of CSCW and CMC (computer mediated communication) and, in fact, at the 2013 ACM conference CSCW officially changed its name to include social computing. While the evolution of this research has evolved towards investigating areas outside the workplace and is shifting focus to settings that are purely social in nature, there was and still is a strong emphasis on the workplace and process. However, this does not mean that it is not possible to learn from research that was workplace-oriented and to make inferences towards understanding more social settings and systems.

The rest of this chapter will discuss previous research in the areas of CSCW, CMC, and HCI from an empirical perspective starting with an examination of workplace coordination. This research is primarily focused on understanding how to design systems to support coordination and communication in the workplace and the adoption and use of such systems. The second section provides a summary of research that was directly motivated by the desire to understand social activity coordination.

3.1 Studies into Workplace Coordination

A substantial amount of empirical research has informed the study of workplace coordination. This review samples work done investigating the systems and technologies created to support workplace coordination and also the varied field research conducted to informed these technologies. It is broadly grouped into two sections. The first section concerns calendaring and scheduling and the second on research that sought to extend our understanding beyond the use of such systems.

3.1.1 Calendaring and Scheduling

In the early 1980s, Kincaid et al. (1985) pioneered work on understanding the use and requirements of calendaring and scheduling systems. They explored the use of the then prevalent paper calendars and the newly introduced electronic calendaring systems in the context of a governmental department. This early research highlighted how the recording and communication of scheduling information, the meeting times, attendees, conference room, etc., on the paper calendars was done in a much more informal and less structured manner than required by users of the electronic systems. These (then) new electronic systems did not reflect the manner in which this information was communicated at the time and this impacted the acceptance and use of these systems. Many users found it frustrating that they were required to specify and determine various meeting details that were previously implicitly understood and accepted. This was most commonly expressed by various users discussing their frustration with being required to explicitly provide meeting duration and/or end time for the electronic calendars when this information was previously known and understood by the meeting participants.

The disconnect between the current social practice and / or the use of unstructured or semi-structured meeting details versus various systems requiring and enforcing the entry of specific and structured details is a reoccurring theme throughout this area of research (Grudin 1994a; Palen and Grudin 2003; Palen 1999). Attempts have been made to overcome these limitations. One typical method is a form of preference mechanisms that allow individuals to provide the system their preferences or the system learns them through use or both (Beard et al. 1990; Brzozowski et al. 2006). Another is the automatic discovery

of individuals habits and behaviors to provide information for agent systems (Modi et al. 2005; Tullio et al. 2002).

A review of previous research identifies various problems with solely relying on calendaring and scheduling tools as mechanisms to support coordination. Some of these important problems are:

1. Calendaring and scheduling systems are dependent on up-to-date personal information by groups of users, which is not always available, or willingly provided (Beard et al. 1990; Brzozowski et al. 2006; Grudin 1988);

2. The main beneficiary of shared calendaring information in the workplace is often not the person maintaining calendaring information (Beard et al. 1990; Brzozowski et al. 2006; Grudin 1988). While this is less of a problem in the context of a shared family calendar (Neustaedter et al. 2007), the high cost of data-entry to user utility appears to dissuade their use in broader social contexts.

3. Privacy issues can arise when used for social coordination outside of the work environment (Brzozowski et al. 2006; Schiano et al. 2007).

4. Social groups composed of individuals residing in diverse locations do not need constant tightly coupled coordination systems, and as a result do not desire or need a shared view of highly personal calendaring information.

Closely related to calendaring and scheduling systems is the research and development of automatic agent-based meeting scheduling systems (BenHassine and Ho 2007; Brzozowski et al. 2006; Chun et al. October; Chun and Wong 2003; Crawford and Veloso 2006; Ephrati, Zlotkin, and Jeffrey S Rosenschein 1994; Ephrati, Zlotkin, and Jeffrey S. Rosenschein 1994; Franzin et al. 2004; Garrido and Sycara 1996; Modi et al. 2005; Wainer et al. 2007; Zunino and Campo 2009) and the electronic calendaring systems that many of these systems depend on. While these systems are closely related to the calendaring and scheduling systems previously discussed, they go one step further and seek to remove the users completely from the decision making processes. The panacea for this

research area is a system wherein the user informs it of their desire for a meeting, its topic, and possibly the various attendees. Then various agents act on the users' behalf to perform all the work to coordinate and schedule the details required for the meeting to occur. However, researchers have identified on many occasions that while automatic meeting scheduling and the calendaring features required to enable them are often the most requested they are also the least used (Bullen and Bennett 1990; Grudin 1994a; Palen and Grudin 2003; Palen 1999).

A large issue with this agent-based perspective, beyond that of removing the individual's agency (Shneiderman and Maes 1997), is that scheduling is only one aspect of social coordination (Beard et al. 1990; Grudin 1994a) and cannot generally be managed independently of other aspects. Palen explains that meeting scheduling is a social task and has many underlying social implications unrelated to finding the most optimum time and that it is "less an 'optimizing' task and more often a 'satisficing' task." (Palen 1999) Beyond the social dynamics and their implications on the applicability of these systems there is the issue with data reliability. These systems require that the entered and inferred data is accurate and up to date; however, this is frequently not the case. Blandford and Green (2001) found that "many users have developed the strategy of blocking out time for individual activities just so that they can control what meetings get booked." They also identified various social issues that may arise, in particular, when a user "had set aside a contiguous chunk of time which they did not particularly want to break, and yet to refuse a meeting at that time (when they are apparently 'free') would have appeared impolite." Moreover, similar to shared calendaring systems, many people are still wary of using agent-based systems to handle social coordination tasks (Brzozowski et al. 2006).

3.1.2 Coordination and Groupware

Calendaring and scheduling systems were not the only means in which researchers investigated how to support group coordination. Other work focused more on supporting groups' work activities rather than organizing when these activities will occur. The motivation for this research was to examine and understand group-work itself and how to best support it which lead to the creation of various groupware systems and also the area of research commonly referred to as group decision support systems (GDSS) and meeting support systems.

Researchers have investigated various group decision support systems and their various mechanisms (Fjermestad et al. 1995; Kraemer and King 1988; Niederman et al. 1993; Watson et al. 1988; Whitworth et al. 2001). The focus of this research was to support coordination by identifying the processes that groups perform to complete their work and derive the requirements for building systems that support those processes. While this area of research provides some insight into the coordination and communication of group activities, there is the problem that much of the research in this area focused on deriving, implementing, and understanding the use of various processes and mechanisms to support group decision making. This imposed a biased towards process and structure and the various features and mechanisms developed to support group coordination must be understood with that bias in mind. This makes it difficult to extend reasoning of group coordination and communication beyond that of process and structure. However, one of the main takeaways from this area of research is that those systems that focus on narrow and more tangible aspects of group decision making are the ones that are the most successful in supporting groups in their decision making tasks.

In addition to GDSS, researchers investigated how to support groups during their meetings leading to the creation of meeting support systems (Blythin et al. 1997; Nunamaker et al. 1991; Reinig and Shin 2002). This research focused on supporting groups' interactions during meetings instead of the arrangement and coordination of the meetings (e.g., time, place, agenda). Researchers investigated the support of both co-located and distributed groups using various computer based mediation systems. The motivation of this research was to facilitate the meeting process and also create more tangible meeting artifacts in the form of automatic meeting minute generation, recordings, and various brainstorming support mechanisms. Unfortunately, this research did not generate much information regarding the coordination and communication required for the meetings to take place. Instead the assumptions were that meetings have to occur in order for group work to happen and the meetings will be scheduled regardless so the importance was placed on investigating and supporting the meetings themselves.

This focus on meeting support systems and GDSS has resulted in a large gap in our understanding about how workplace activities are communicated and coordinated. What is interesting is that while researchers were focused so heavily on understanding process and the creation of various mechanisms to support and enforce those processes they ignored the important fact that the most used feature of various groupware systems were the open and unstructured messaging systems contained within (Bullen and Bennett 1990), all of which resembled email and its precursors.

3.2 Studies into Social Activity Coordination

Schiano et al. (2007) present their results from a series of interviews, focus groups, and surveys motivated to gain an understanding about the practices and resources required for

young Japanese people's leisure outings. Much of the research conducted by Schiano et al. (2007) relates to why people chose to participate in leisure activities, what resources they used to find out about various activities, what activities required or did not require outings. In addition, for the activities that required outings they examined what kind of activities these were, how many people participated, and what technology was used to plan the outing. Unfortunately, the results do not provide us with much insight into social activity coordination. Fortunately, the authors did report on what they called the *structure of leisure outings* which provides us with some clues. They found that many of the outings were undertaken by groups of friends ranging in size of 4-6 persons and typically of mixed gender. Also, in order to coordinate these outings one member of the group would take on the responsibility of being the primary planner and coordinator. When the group members were not co-located they would choose to initially meet at a specific location before engaging in their outing. They also found instances of microcoordination (small coordination messaging events focused on when, where, etc., typically associated with rendezvousing (Farnham and Keyani 2006; Ling and Yttri 2002)) actions via text messaging among group members while coordinating the outings.

Kowitz et al. (2005) present research in understanding how to support *impromptu gatherings* which are defined as activities that are planned less than two days in advance and provide a set of design guidelines for what they term *impromptu activity support*. Data was collected by having informants keep a journal of all communications relating to social activities. The participants logged collected data such as, the activity, when the communication took place, where the informant was, the communication method used, various factors that might influence the informant's participation in the activity, and a free form comment area about the communication. They found that the majority (83%) of the communications happen on either the day of or the day before the activity. Also, 41% of the communications were over the phone, 25% via email, and 19% in person. The strongest factors influencing participation in the activity were scheduling (43%) and the other

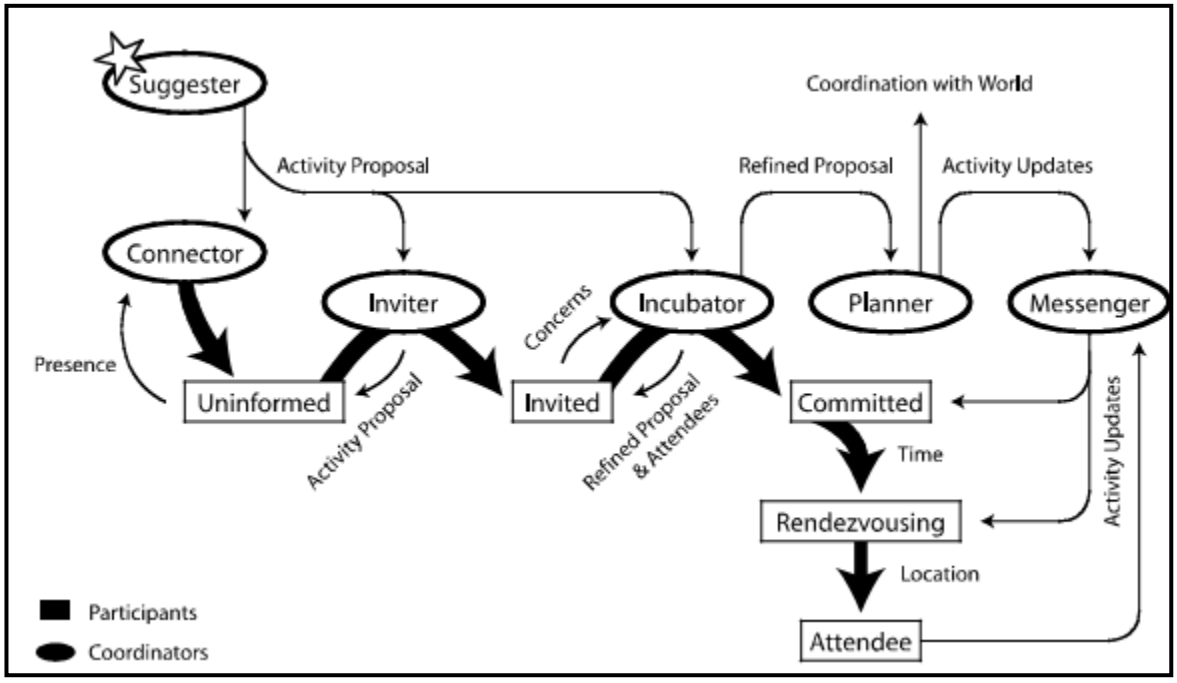

Figure 3.1 Conceptual model of impromptu gathering by Kowitz et al.

Source: Kowitz et al. (2005)

members of the group (28%). They also performed a series of focus groups and from that combined with the journals derived a conceptual model of impromptu gathering (Figure 3.1). In this model, they identified a set of participant roles: uninformed, invited, committed, rendezvousing, and attendee; and a set of coordinator roles: suggester, connector, inviter, incubator, planner, and messenger. This research into *impromptu gatherings* and the resulting model provides some insight into understanding social activity coordination; however, there are issues when applying this research to social group-activity coordination. The definition of an *impromptu gathering* does not closely relate to a *social activity* which may be planned further in advance than two days. The model also does not provide for participants having more than one role and being in more than one state. While having this model to reflect upon is useful it shows that more research is needed and that adopting a conversation centric perspective to understand what a *social activity coordination conversation* is and how to support it would be useful.

Clearly, the entirety of social activity coordination is not represented and supported by calendaring and scheduling systems. The outcome of social activity coordination may result in something that can be put on a calendar; it may have a date and time, possibly a place and a group of people. However, the process of social activity coordination is not the same as scheduling. A review of the previous research that inquired about what tools people used to coordinate social activities calendaring and scheduling systems typically were not mentioned; and if mentioned, it was to point out that they were not used for social activity coordination. This is highlighted well by Schiano et al. (2007) who reported that when respondents were asked about using shared calendars to coordinate leisure activities there were many concerns about privacy, words, such as, "'*scared', 'worried', 'hesitant',*

'uneasy', 'and bothered' came up repeatedly in this context." The trepidation to these systems can explained by acknowledging that social activity coordination is more than just finding the best time and place. Grudin (1994a) notes, in regards to meeting scheduling but also relevant to social activity coordination, that it is a social task and has many underlying social implications unrelated to finding the most optimum time, it is "*less an 'optimizing' task and more often a 'satisficing' task.*" Also, there is the problem of the disparity between who does the work and who benefits from the work (Grudin 1988) of maintaining calendars. With the open-communication channels, there is less disparity. Participation among the parties involved in the coordination is required in order for the activity to happen and this is not the case when it comes to calendaring and scheduling systems. While researchers exploring calendaring and scheduling acknowledge that "*users like to feel in control of their schedules and tend to resist systems that deprive them of agency in the scheduling process*" (Brzozowski et al. 2006), it is the preconception that it is a scheduling problem and not a *social activity coordination* problem that is limiting. Grudin made a similar point: "*more often than not, CSCW and groupware conferences include papers on automatic meeting schedulers that were developed in ignorance of the fate of a decade of commercially available products.*" (Grudin 1994a)

CHAPTER 4

TECHNOLOGY USED FOR SOCIAL COORDINATION

Previous research can provide some understanding about various aspects of social activity coordination, however, much of this understanding stems from researchers primarily focused on examining the use of various communication technologies, such as:

- Instant messaging (IM) and text messaging (Grinter and Palen 2002; Grinter et al. 2006; Handel and Herbsleb 2002; Herbsleb et al. 2002; Nardi et al. 2000; Quan-Haase 2008) (Battestini et al. 2010; Counts 2007; Faulkner and Culwin 2005; Grinter and Eldridge 2001, 2003; Grinter et al. 2006; Schiano et al. 2007; Taylor and Harper 2003)

- Open communication technologies developed for research purposes (Counts 2007; Farnham and Keyani 2006; Farnham et al. 2004; Heyer et al. 2008; Isaacs, Walendowski, and Ranganthan 2002; Jung et al. 2005; Kowitz et al. 2005; Peters and Allouch 2005; Viégas and Donath 1999)

- And the previously discussed calendaring and scheduling systems (Beard et al. 1990; Blandford and Green 2001; Brzozowski et al. 2006; Crabtree et al. 2003; Gervasio et al. 2005; Grudin 1988, 1994a; Hooff 2004; Kincaid et al. 1985; Modi et al. 2005; Neustaedter et al. 2007, 2009; Palen and Grudin 2003; Palen 1999; Payne 1993; Plaisant et al. 2006; Sohn et al. 2012; Tullio et al. 2002) (Beard et al. 1990; BenHassine and Ho 2007; Brzozowski et al. 2006; Ephrati, Zlotkin, and Jeffrey S Rosenschein 1994; Ephrati, Zlotkin, and Jeffrey S. Rosenschein 1994; Gervasio et al. 2005; Jennings and Jackson 1995; Modi et al. 2005; Rodenstein et al. 1999; Sen and Durfee 1998, 1994; Shin and Higa 2005; Tullio et al. 2002; Zunino and Campo 2009).

Nardi et al. (2000) performed an ethnographic study investigating the use of instant messaging (IM) in the workplace through the lens of media theory. While this research was not performed with the aim of gaining an understanding of social activity coordination, it still provides key findings that help further the understanding of this area. First, there is the definition of the term *outeraction* as "*a set of communicative processes outside of*

information exchange, in which people reach out to others in patently social ways to enable information exchange." This definition is slightly problematic because it is framed through the lens of data flow and information processing. This position ignores some of the important social dynamic and conversational aspects that IM allows and may influence the use of such systems. When a conversation centric perspective is used to reflect on their findings, it suggests that what is called *outeraction* may be interpreted as a *coordination conversation*, a conversation that is *focused on the coordination of a future activity*. Another finding is that IM was often used for coordination and scheduling purposes due to its ability to provide immediacy. This was contrasted to email which was reported as not having an adequate level of immediacy for these coordination and scheduling actions. This highlights a limit to our current understanding of these two technologies, IM and email, and which aspects facilitate the process of coordination as a conversation. The last significant finding relating to social activity coordination is the IM was used to "*coordinate impromptu social meetings,*" the primary example is finding others to go to lunch with. This directly relates to the previous definition of a *social activity* and that while there are hints in the current literature that various technologies can support *social activity coordination* there has not been much comprehensive research done.

Other relevant research on IM is its use as a technology among teenagers, performed by Grinter and Palen (2002). They found that the three primary uses of IM were for socializing, event planning, and schoolwork collaboration. Event planning was defined as "*meeting others for shopping, seeing a movie, and so forth*." This definition is also closely related to what was previously defined as a *social activity*. In addition to the *social activity coordination* conducted via IM, they also reported that some of the schoolwork

collaboration aspects were also to coordinate various meetings and face-to-face group work. In a subsequent paper Grinter et al. (2006) stated that "*for teens, IM excels in the coordination of the potentially complicated planning phase of events because it allows multiple people to chat simultaneously, rather than iterate multiple times over multiple people as times and places to meet get further and further refined.*" Unfortunately, much of the research into IM focuses on its use in the workplace or its use as a technology (Handel and Herbsleb 2002; Herbsleb et al. 2002; Isaacs, Walendowski, Whittaker, et al. 2002; Quan-Haase 2008; Rao et al. 2009) which leaves us wanting to understand how IM supports social activity coordination and why people choose to use it for that purpose.

Text messaging (SMS) is another technology that has received focus from various researchers. Prior research of text messaging has been in the form of surveys and questionnaires (Faulkner and Culwin 2005; Ling 2005; Schiano et al. 2007), quantitative analysis of diary studies (Barkhuus 2005; Faulkner and Culwin 2005; Grinter and Eldridge 2001, 2003), interviews and focus groups (Ling and Yttri 2002), and data and content mining (Battestini et al. 2010; Do et al. 2011; Ling 2005). While this research was not undertaken to understand social activity coordination or even coordination in general, it still provides insight into how people used this technology to coordinate. The primary use of smart phones is text messaging (Do et al. 2011) and of those text messages 32% -51% [32% (Battestini et al. 2010), 33% (Ling 2005), 51% (Grinter and Eldridge 2001)] of the messages are related to coordination. These numbers are important because they suggest that the primary use of smart phones is for text messaging and that the majority of text messages pertain to coordination.

Grinter and Eldridge (2001) remarked on an interesting finding where many messages were sent to reaffirm or adjust plans which they attributed as an example of micro- and hyper-coordination (Ling and Yttri 2002). One possible reason for these reaffirming messages is the possibility of media switching occurring during the course of the coordination. This act of media switching during social coordination is supported by Battestinit et al. (2010) where they reported that "*participants would move to text messaging if a conversation needed to switch from online chat to mobile, or they wanted to share email/web addresses with each other. This category of conversations reveals that users communicate with each other across a variety of services, and text messaging is often used as a mediator between them.*" While they were reporting on text messaging conversations in general and not ones specifically related to social activity coordination, it is not unreasonable to infer that due to the number of messages related to coordination that social activity coordination is spread across various media.

There has also been previous research into the construction, deployment, and use of various open-communication channels support various aspects of social activity coordination, such as, group messaging in support of leisure (Counts 2007), microcoordination (Farnham and Keyani 2006), group communication and coordination (Farnham et al. 2004; Heyer et al. 2008), and supporting awareness (Isaacs, Walendowski, and Ranganathan 2002; Viégas and Donath 1999).

Counts (2007) created Slam as a group-based mobile messaging system for the purposes of supporting the social side of leisure. It was an early investigation into supporting fast and easy photo sharing, group creation, and group messaging. Part of the design motivation was to support two types of groups, "*long-standing groups, such as close*

friends, and temporary groups, such as business travelers coordinating a dinner." Messages were identified and coded into seven types: chatting, coordination, microcoordination, joking, experience sharing, intimate, and photosharing. There was also a distinction made between group messages and one-to-one messages. The completed coding showed that 18% of the messages, both group and one-to-one, were for coordination purposes and 3% of group messages were for microcoordination while only 1% of one-to-one messages were for that purpose. These numbers are interesting because they contrast to those reported by Heyer et al. (2008) who created Rhub with the goal "*to explore how small social groups communicate, coordinate, and share, and how a prototype system offering basic cross-channel communication and group maintenance support might be used to support these activities,"* and found that 64% of the messages were related to coordination. This could be due to various reasons; Rhub was built on top of the SMS while Slam was created as a separate client-server system. The participants may have been more inclined to use Rhub for coordination purposes due to the previously reported prevalence to use text messages for coordination purposes. There could also be discrepancies due to the coding; the users of Rhub participated in a style of communication that was termed by the Heyer et al. as *half-invites* (Heyer et al. 2008). A half-invite "*tell[s] a group of people that an event is taking place and others are welcome to join, or as one interviewee stated, "we're doing this, come show up.*" Counts would have coded these types of messages as a status update and therefore they would have fallen under the code of chatting. The results of Rhub is corroborated with those from Swarm (Farnham and Keyani 2006), another text message based group communication tool. The content of Swarm messages was examined

and 68% of all messages were related to social coordination and many of those messages were microcoordination in nature.

The creation and research of Wallop (Farnham et al. 2004) was undertaken with the goal to "*explore how [to] integrate communication and social awareness tools to meet the social goals of a friendship group*." Part of their research into designing and developing Wallop was an investigation into their target population. A very interesting finding relating to social activity coordination was when asked which technology people used to plan social activities people reported that face-to-face was used 25%, phone 33%, email 21%, mailing lists 12%, other 4%, chat / IM 3%, and text messaging 2%. The 2% of text messaging and 3% of chat / IM is quite striking when compared to the numbers reported by other research. This is most likely due to the fact that the age of their participants averaged in their 30s while much of the other reviewed research focused on young adults and teenagers.

From the above, we can conclude that for the purposes of social activity coordination people highly favor the use of open communication systems and for the majority of these systems social coordination constitutes its main use. This is most likely because open communication systems support the natural actions people perform while coordinating these activities. This contrasts the prevalent perspective that coordination and communication should be interpreted from a systems perspective and supported as a set of processes. Instead, the favoring of open communication systems argues for more of a conversation centric perspective on the nature of social activity coordination.

CHAPTER 5

A THEORETICAL PERSPECTIVE FOR CONVERSATION CENTRIC DESIGNS SUPPORTING SOCIAL GROUP-ACTIVITY COORDINATION

Almost 20 years ago, calendaring and scheduling researchers noted that after more than a decade of work on automatic meeting schedulers over which these systems became the most widely available groupware application, ultimately, they were found to be the least useful (Grudin 1994a). The following 20 years has also been rife with continual work on automatic meeting schedulers (Beard et al. 1990; BenHassine and Ho 2007; Brzozowski et al. 2006; Chun et al. October; Chun and Wong 2003; Crawford and Veloso 2004, 2006; Ephrati, Zlotkin, and Jeffrey S Rosenschein 1994; Ephrati, Zlotkin, and Jeffrey S. Rosenschein 1994; Franzin et al. 2004; Garrido and Sycara 1996; Gervasio et al. 2005; Jennings and Jackson 1995; Modi et al. 2005; Ndumu and Nwana 1997; Rodenstein et al. 1999; Sen and Durfee 1994, 1998; Sen 1997; Sen et al. 1997; Shin and Higa 2005; Wainer et al. 2007; Zunino and Campo 2009, 2009) without much change in their perception (Schiano et al. 2007). The conclusion that should be reached is that supporting social group-activity coordination via calendaring and scheduling systems is not a sound strategy. Therefore, what is required is a new perspective and design principles based on a conversation centric approach. This chapter lays the foundation of such a conversation centric design perspective drawing upon previous research in coordination and communication.

The Language Action Perspective provides part of the foundation. Winnograd argues that it is necessary to frame our understanding and view of the world through the

lens of people acting through language and language actions. This perspective views coordination as a "*sequence of acts that can be interpreted as having linguistic meaning. It need not be a spoken conversation, or even involve the use of ordinary language*" (Winograd 1987). This is contrasted by the perspective that people process information and make decisions which predominates much of previous and current research. This process oriented perspective focuses on understanding the information and the manner of which it flows, the actors and how they process that information, and the features required to facilitate those processes (Flores et al. 1988; Winograd 1987). This prevalent perspective has influenced many of the subsequent designs focused on supporting coordination and communication. Instead, as part of a design philosophy centered on understanding and supporting social activity coordination it is necessary to move beyond this process oriented perspective. As such, part of the design philosophy should include the view that social activity coordination is, in part, a social-group acting through language and language actions. The implication is that designs supporting social activity coordination should facilitate and embody the speech acts used during coordination. It is also important that the design frames the coordination not as a process but as a conversation in which the members of the social-group participate. This shifts the design philosophy from supporting and understanding process, data flows, information, etc., and instead towards understanding the conversational actions social-groups perform and how to best support them.

While the Language Action Perspective provides insight into 'how' people coordinate, the 'what' people coordinate also needs to be considered. Discussed previously was Malone and Crowston's definition of coordination from their Coordination Theory as*:* "*the act of managing interdependencies between activities performed to achieve a goal.*"

(Malone and Crowston 1990) and later refined as "*coordination is managing dependencies*" (Malone and Crowston 1994). Malone and Crowston did not view coordination as conversations, instead they were investigating it from a systems and process oriented perspective. Therefore, much of their discussion is framed around the processes involved in coordination and specifically those processes that support the management of dependencies. They argue that to support coordination you must first characterize the different kinds of dependencies and identify the coordination processes that can be used to manage them (Malone and Crowston 1994). To further this, they provided some initial questions that may be used to guide this inquiry. Some examples are, "*how can actions be assigned to groups or to individual actors? How can resources be allocated among different actors? How can information be shared among different actors to help achieve the overall goals?*" (Malone and Crowston 1990) They also identified some base dependencies that are common to coordination: shared resources, producer / consumer relationships, simultaneity constraints, and tasks / subtasks. These were presented as a set of basic dependencies not as the complete set. Therefore, it is left to those using Coordination Theory to understand the dependencies unique to the type of coordination being examined and then the subsequent design goal is to support the coordination of those dependencies. This suggests the obvious design implication: support the management of the dependencies. However, issues arise when attempting to understand and identify those dependencies and how to best support their management. This is where Coordination Theory is lacking, and since it also does not provide much guidance for system design and implementation it cannot be used in isolation.

When coordinating a social activity, a group must move through a series of actions in order to arrive at a shared understanding about the details of the social activity. It is possible to view these series of actions as the process of *grounding* (Clark and Brennan 1991). An issue with supporting the actions necessary to achieve shared consensus is discovering what information needs to become common ground. While examining the use of calendars in the home Crabtree et al. (2003) observed that collaborative access to the calendar underpinned the negotiation of planning future family events. The grounding process was supported by access to a common artifact (Robinson 1993). Robinson described common artifacts as objects that "*neither anticipate sequences of actions nor attempt to enforce procedures*." Grudin (1994a) reflected on a similar design prescription when he stated that "*groupware may be resisted if it interferes with the subtle and complex social dynamics that are common to groups*." These observations and prescriptions support an argument that to aid the social-group in coordinating social-activities it should be done by providing access to shared artifacts that expose and enable the language actions that comprise the negotiation. Also, not only do groups need access to shared artifacts but the use of those artifacts should not impose their own processes and instead enable those that are already in use by the groups.

If a design supporting social group activity coordination should avoid the explicit and implicit encoding of a process that leads to the question: What and how should something be designed to support this type of coordination? In the paper "Design for unanticipated use" Robinson (1993) outlined the concept of a common artifact and implied that the result of providing a common artifact would result in a design that supported unanticipated use. What is lacking is a prescription about how the individuals and the group

should interact with each other through the common artifact. Coordination theory provides some insight into how this can be achieved: "*Another intriguing possibility suggested by this framework is that it might be possible to implement "primitives" for a number of different coordination-related processes in the same environment and then let people combine these primitives in various ways to help solve particular coordination problems"* (Malone and Crowston 1994). In other words, the design should focus on the development of a set of tools or processes that can be composed together to support the social activity coordination based on the requirements of that coordination and the social norms of the group. In addition, those tools and processes should encode the language actions that social-groups use to coordinate social-activities and through these actions enable the creation of shared artifacts that comprise the details of the activity.

When designing for groups, there is always tension between designing for the group versus the designing for the individual (Gutwin and Greenberg 1998). Design aspects that may make the group more effective and support the group's work may not benefit or may even be a detriment to the individual's work. The challenge is how to go about relieving this tension and support both the group and the individual. Early groupware designs focused on providing a strict "what you see is what I see" (WYSIWIS) interfaces (Stefik et al. 1987) that did not distinguish between group and individual work modes. Gutwin and Greenberg (1998) argue that strict WYSIWIS interfaces are limiting and instead designs should provide relaxed-WYSIWIS interfaces. This is done by providing the individual the ability to work separate from the group and not locking the entire group into one shared view. The resulting design implication is best described using the concept of shared views and artifacts (Erickson et al. 2006; Stefik et al. 1987; Tee et al. 2009). The group shares an

artifact and various views onto that artifact. This allows consensus building that is grounded by the artifact. In addition, the individual is provided various means to create and manipulate information that will then be shared to the group via changes to the shared artifact. The individual also requires informational views related to the shared artifact so they can understand the details of the shared artifact (e.g., a history of changes).

While researching CSCW and calendaring applications Grudin and Palen identified important design implications (Grudin 1988, 1994a; Palen and Grudin 2003; Palen 1999) that are relevant when thinking about how to design to support social activity coordination. Palen noted that "scheduling is less an *optimizing* task and more often a *satisficing* task, where, because of the complexity, the appointment is typically made as soon as the requirements are met" (Palen 1999). This observation, combined with the previous implication and the report that members of social-groups are extremely reluctant to share their calendars and schedules (Schiano et al. 2007), is important when considering how to design for social activity coordination. While researching electronic calendaring applications and scheduling systems, Grudin (1988) noted that the primary users of the schedulers were those responsible for scheduling the meetings (primarily the managers or their secretaries). However, in order for the schedulers to function everyone is required to maintain accurate electronic calendars regardless of their need for the automatic scheduling features (Grudin 1988). This resulted in regular employees being required to maintain accurate electronic calendars for the benefit of the few individuals who used the scheduling systems. The design implication drawn from this research is that social activity coordination support should focus on limiting the disparity of work between participating social-group members and, as much as possible, allow the individual members to perceive

the benefit of their actions. In addition, the design should not focus on finding the optimal solution and instead allow the group to find a good enough solution with as little hindrance as possible.

CHAPTER 6

CONVERSATION CENTRIC DESIGN PRINCIPLES FOR SUPPORTING SOCIAL GROUP-ACTIVITY COORDINATION

The previously discussed theoretical perspective provides a conversation centric lens that can be used to evaluate prior research in communication and coordination to gain insight into various design aspects that can be useful for supporting social activity coordination. This lens also provides a means to gather important conversation centric design implications that help guide how to support social group-activity coordination.

- The design should aim to facilitate the natural language actions that social-groups use among each other while coordinating social-activities.
- The various interdependencies that occur during social activity coordination need to be identified and their coordination should be supported by the design. The design should also take into account that not all possible interdependencies can be identified a priori and should provide means for the unforeseen interdependencies to be coordinated.
- The design should support and provide a means for the social-group to understand the current state of consensus via the creation and use of shared artifacts.
- There should be a focus on designing for unanticipated use and avoiding and explicit and implicit encoding of processes that would alter the natural actions social-groups take when coordinating social-activities.
- The tension of designing for the individual vs the group should be reduced by providing the individual informational views about the shared artifacts that are created and maintained by shared group views.
- There should be a minimal disparity of work between the social-group members. Each member should be able to perceive and enjoy the benefit of the work that they perform during the coordination process.
- The design should support the social-group reaching a good enough solution, i.e., allow the group to perform coordinated satisficing instead of optimizing.

This set of design implications is only a starting point. While there has been no previous research conducted following a conversation centric design perspective it is possible to examine previous work using this perspective and derive further design implications. This chapter will explore previous research from this perspective in order to gain more understanding about how to design and build systems that support social group-activity coordination.

6.1 Supporting Conversation

A conversation centric perspective allows for framing social group-activity coordination as a conversation. An important aspect of a conversation centric design that prior research can provide is insight into the role of group messaging plays in social group-activity coordination and what design principles can be derived from its use and built upon

Previous researchers examining the use of instant messaging (IM) in the workplace were intrigued that one of its predominate uses was to coordinate future interactions (Nardi et al. 2000), i.e., to coordinate a future activity. Instant messaging is not unique; many other messaging systems are also heavily employed for coordination. For example, one of the primary uses of text messaging is for the use of social coordination and negotiation of future activities (Faulkner and Culwin 2005; Grinter et al. 2006; Grinter and Eldridge 2003; Schiano et al. 2007; Taylor and Harper 2003). This is true for many other messaging systems (Counts 2007; Farnham and Keyani 2006; Heyer et al. 2008; Isaacs, Walendowski, and Ranganathan 2002).

The primarily used messaging technologies, IM and SMS, have a fundamental design limitation when it comes to support social-group social activity coordination. That is the lack of a shared and persistent chat space (Bradner et al. 1999; Erickson et al. 2006;

Gergle et al. 2004; Halverson et al. 2003). These messaging systems treat the message as a data packet to be sent and the processing and display of that message is dependent on the design of the application receiving it. What one user sees displayed may be different from another user. The designs of many IM clients do not guarantee message persistence and if they do provide it is not shared among the participants. Text messages have a similar problem which is exacerbated by the limited number of messages retained by many phones and text messaging applications. Additionally, even if all IM clients kept persistent logs and text messaging applications lacked these limitations we are still left with the problem that these applications and systems are designed for the individual and all data is stored on behalf of the individuals, e.g., individual users are allowed to clear logs and delete messages. All individuals are allowed to manage their data as they see fit, as a result, there is no one single repository of the conversation. Another issue with these technologies is that people are involved with multiple simultaneous conversations (Battestini et al. 2010; Grinter and Eldridge 2003) about different topics that are all interleaved together. This interleaving is due to the fact that the design of the IM and text messaging applications focus on grouping the display of messages by individual contacts instead of by topics of conversation. Regardless of these limitations these systems are highly used for social group-activity coordination and therefore the support of open ended conversation must be included in any design. However, it is important to reduce these limitations and mediate their negative impacts. This can be achieved by augmenting open ended conversation with the concept of shared artifacts. A design can employ a shared artifact in the form of a persistent chat space centered on the social activity being coordinated that is shared among all members of the coordinating social-group.

When considering how to design a persistent chat space, prior research provides some design suggestions and considerations. One important aspect of the design of a persistent chat space is the tension between the synchronous and asynchronous of chat (Handel and Herbsleb 2002; Roseman and Greenberg 1996; Voida et al. 2002). Awareness of this tension is important because not all of social activity coordination is performed synchronously and when synchronous coordination does occur it typically only involves a subset of the group. There are some identified means of mitigating this tension. One method is providing support for directed replies and messages (Bradner et al. 1999) that allows a user to indicate to whom or what their message is intended for. Another possible way to support this is to allow a user who was not involved during a synchronous conversation to choose specific messages from that conversation to reply to. This provides a means for someone to participate in a conversation that they were not a part of at the time it occurred. Directed replies and messages (e.g., public @ replies) that are used during synchronous conversation also provides members who are asynchronously reviewing it more context about the conversation and a greater ability to understand who was talking to whom and about what was missed if they were not actively participating at the time.

Researchers have found that people do not actively wait for responses to messages (Voida et al. 2002) and commonly switch to different tasks and this is especially true in the mobile case. The design needs to incorporate some aspect of notifying users that activity is occurring or when details of the social activity changes (Beard et al. 1990; Kowitz et al. 2005).

When thinking about a persistent chat space as a historical record of the coordination conversation, it is important to consider how to facilitate browsing and review

of that record. This can be done by providing a visual distinction between the individuals who are participating and a visual distinction to the types of messages displayed (Viégas and Donath 1999).

6.2 Language Actions

Thus far, this dissertation has presented a framework arguing that in order to support social group-activity coordination it is necessary to view coordination from a conversation centric perspective. A useful approach for deriving conversation centric design principles is employing the concept that communication and coordination is conducted through various language actions. Prior research into how individuals and groups use various communication technologies provide some insight into the types of language actions that social-groups use. This research is viewed though this perspective and various design implications are developed and discussed in this section.

Researchers investigating the use of text messaging and the content of the messages noted an interesting behavior where people would send out short messages that would refine the state of social-activities and if they were on-time, late, etc., This behavior was termed *microcoordination* (Ling and Yttri 2002). Grinter et al. were also investigating this concept and defined it as "the practice of frequently revisiting and revising arrangements with others using a mobile [device]" (Grinter and Eldridge 2001) which they termed as hyper-coordination. The two terms and definitions are highly similar and used interchangeably in the literature with microcoordination being more prevalent. As such, subsequent uses will refer to this concept as microcoordination. Regardless of the terminology these findings identify social-groups performing social activity coordination using language actions. A review of this research suggests two language actions that are

used during social activity coordination. The first being actions that relate arrival status and intent, i.e., letting others know that you are running late or have already arrived (Grinter and Eldridge 2001; Ling and Yttri 2002). The second are actions that convey a refinement and iteration of the social activity details from more general to more specific (Grinter et al. 2006). While the refinement of social activity details could be perceived as the more general language actions of offer and counter offers (Winograd 1987) this lack of granularity risks missing many important nuances of social activity coordination.

Early research in electronic calendars identified various needs that are required to help support office meeting scheduling (Kincaid et al. 1985). While this document has argued that there is a quite a difference between a social activity and an office meeting it is still possible to view this early research through the stated theoretical lens and gain insight into language actions that are used during activity coordination. Three identified language actions from this early research are: 1) statements about attendance and participation; 2) statements confirming details of the activity (e.g., where, when, who); and 3) statements concerning the state of the activity (e.g., canceled, scheduled, in planning).

A review of the findings from research into various open-communication systems (Bradner et al. 1999; Farnham and Keyani 2006; Kowitz et al. 2005) also provides a number of language actions that are used during social activity coordination. One is a request or query by one member to another to reply or respond to some aspect of the social activity coordination. For example, asking someone if they are ok with the time or if they are going or not. Related to this is a request for action about an aspect of the social activity, e.g., asking for a decision to be made about the place or to invite someone. There is also a language action is similar to a query but is more like a calling out or broadcast. Farnham

et al. noted that "*people commonly broadcast that they were available for socializing even without any intended location or activity in mind. Their goal was primarily to find company, not to achieve a particular destination.*" (Farnham and Keyani 2006) This observation is noteworthy because it does not directly map to the concept of a query, that being a directed question with the expectation of a response. This action has aspects of a query but also aspects of communicating a state of desire or willingness to do something with the hope of a response but not the expectation of one.

6.3 Interactions and Input

An overarching viewpoint presented throughout this document is the idea of deemphasizing the importance of process and instead facilitating the conversational aspects of social activity coordination. Unlike a process, which is typically represented by structured input, output, and information flow, a conversation consists of a myriad of specific, broad, and sometimes ambiguous statements. As a result, designers, researchers, and software developers typically find it is much easier to design and implement applications that embody the structured nature of process. This is because once a process is defined and understood it provides a template of what an application should be. This is unlike the unstructured and ambiguous nature of conversations which does not provide designers, researchers, and software developers a straightforward and defined path to implementation. This presents a significant design challenge. Inherent in the goal of providing a technological device that supports some activity the implementation requires some manner of gathering data that it can interpret and process. The challenge is how to facilitate consensus building while supporting and accepting the nature of conversations.

A social activity has many required details that must be coordinated and confirmed by the group. One important piece of information necessary for a social activity to occur is when it will happen. A process oriented design would likely require a user to provide exact start and end times as is typically seen in many calendaring systems. An alternative design approach that seeks to embrace the nature of conversation could use the concept of semi-structured input (Jermann and Schneider 1997; Kincaid et al. 1985; Malone et al. 1987). Such a design, instead of requiring start and end times and predetermining their formats, may instead provide an input method that allows the user to specify when the activity should occur via unstructured text. This is an example of semi-structured input. The data is not able to be interpreted directly by the system; however, the system does benefit from knowing what the text is about. This approach still supports the conversational aspects of coordination while also including the ability for a system to capture information. Also, it is not limited to providing text entry support with a simple label. This allows for the relaxation of explicit and required data entry and supports more ambiguous nature of conversation. For example, a design can allow the entry of an exact start time while leaving out an end time or duration (Kincaid et al. 1985). This relaxation is important because the end time and/or duration may already be understood and known by the coordinating social-group and there is no positive benefit to requiring a user to provide the information if it is already known. The only benefit gained from requiring such information to be entered goes to system. What these examples illustrate is that while a design providing semi-structured input may miss out on the ability to capture and process exactly defined information it instead facilitates the conversational aspects necessary to support social activity coordination.

While people regularly engage in social activity coordination, and as previous research has identified much of our communication is related to coordinating these social activities, people do not spend a great deal of time on the actions associated with this coordination. Also, previous research and everyday life informs us that people are involved with the coordination of multiple social activities at any one time and potentially with multiple social groups. Also, each one of these coordinations involves multiple individuals providing details about all the different aspects of each of these activities. Therefore, a design seeking to support social activity coordination should not expect users to spend a great deal of time interacting with it and should support quick and easy access to whatever the user desires to accomplish at each instance of use. There are two design principles that provide a means to overcome this challenge, 1) the concept of lightweight interactions (Brzozowski et al. 2006), i.e., interactions that can be completed quickly, are intuitive, and for which the result is predictable, and 2) quick drilldown and escape (Cadiz et al. 2002), e.g., having the ability to quickly navigate views while maintaining a history of previous views that can be easily restored. It is worth noting that these design principles are also highly prevalent in the two most popular mobile operating systems, iOS from Apple, and Android from Google, both of which want to provide a user with a high degree of functionality and depth but cannot expect the user to devote extended amounts of time during each instance of use.

6.4 Additional Design Considerations

When people coordinate social activities, they are required to reveal personal and sometimes private information about themselves and their schedules and therefore there is a need for those coordinating to manage the revelation of this information. This leads to an

important aspect to consider when designing for people who will be communicating and coordinating with each other. This is supporting those coordinating the ability to maintain plausible deniability (Brzozowski et al. 2006; Grinter et al. 2006; Schiano et al. 2007). The term plausible deniability generally has a negative connotation that is associated with sheltering one from, and as a consequence, reducing the ability to be implicated of nefarious, unethical, or criminal intent. This negative connotation is problematic since it engenders the idea that designing to support plausible deniability is by association also unethical and should be avoided. The extreme of this view is that plausible deniability should be actively discouraged by the design. This is unfortunate because the ability to maintain plausible deniability is one of the backbones on which the white lies that smooth social interactions are built upon. Schiano et al. (2007) noted that Tokyo teenagers were very reluctant to share personal electronic calendars with other members of their social-groups. They interpreted this as a concern for privacy and security, however, another interpretation is that these teenagers were aware of the social need for maintaining plausible deniability and did not perceive the benefits of electronic calendars outweighing the loss of freedom to tell the ever important white lies. Therefore, it is important for any design that aims to support social activity coordination to support the ability for members of coordinating social-groups to maintain plausible deniability and that providing this functionality is just as important as providing any other function.

Another important design consideration is how to balance the design of social activity coordination support from a conversation centric perspective versus a process oriented one. This document argues that there has been too much weight given to the process oriented perspective of coordination, however, there are interesting ways systems

can help facilitate coordination through process. One example is the concept of automatically setting an activity as confirmed once a threshold of participants have indicated their intention to attend (Kowitz et al. 2005). This is a more process oriented design; however, it automates a task that could otherwise be tedious and uninteresting. A potential design principle is to establish process if it can reduce tedium and undesired work without greatly impacting the conversational nature of coordination.

6.5 Summary

This review of previous research has identified important design aspects and implications required for supporting social group-activity coordination.

- Support for open communication should be provided, however it should be persistent and shared throughout the coordinating group. In addition, the open communication should be centered on the activity that is being coordinated and provide some means of focusing the conversation on the coordination.
- The conversation and coordination event history should be provided to all the group members in order to provide a shared understanding of how the coordination developed over time.
- The common language actions performed during social group-activity coordination need to be identified and supported.
- Some structure should be provided to support the coordination of the important details of the activity (e.g., who, what, where, when) and can be achieved using semi-structured input and supporting the creation of shared artifacts.
- It is important to be aware of the tension between enforcing process and supporting conversation. Current research shows that each extreme is not effective.
- Plausible deniability must be an inherent design trait and its fundamental importance should be considered in any design that supports social group-activity coordination.

These conversation centric design principles are only a starting point for researching the support of social group-activity coordination. In order to further our understanding about how to design and build systems to support social group-activity coordination it is necessary to go through the process of understanding the problem and design space. To understand the problem space requires, investigation into the current state of social group-activity coordination and how people currently achieve the coordination of their social activities. To understand the design space, it is necessary to go through the design process and explore the various impacts that these design principles have. The next section will outline the research plan that achieved this understanding.

CHAPTER 7

RESEARCH PLAN

The goal of the research and associated research questions is to gain an understanding about how people and groups currently perform social activity coordination, the technologies and strategies they use, and how to support social group-activity coordination from a conversation centric perspective. The dissertation achieves this through research involving the insanitation of a tool using research through design methodology guided by the previously discussed theoretical perspective and design implications informed by a diary study of social group-activity coordination practices. The tool is evaluated in a laboratory study with the objective to understand and explore the various aspects of this perspective and the impact the resulting design had on social group-activity coordination.

7.1 Research Questions

In order to understand social group-activity coordination and how to support, it many important questions needed to be considered and answered. Such as, how do social groups communicate, coordinate, and share information in order to reach common ground and agreement about the activity and its details and to what extent do people's technology choices impact consensus building? Which aspects of these technologies facilitate consensus building and why? What are the motivations and decisions that lead to using certain technologies in preference to others? What design aspects are necessary to support the various aspects of social group-activity coordination and help facilitate the development of shared understanding and agreement between the coordinating members?

What design aspects are most influential in their impact on social group-activity coordination and how coordination methods and dynamics change when compared to typically used coordination technologies? Reflection on these questions resulted in the following research questions.

RQ1: How do social groups communicate, coordinate, and share information in order to reach common ground and agreement about the activity and its details? To what extent do people's technology choices impact grounding and consensus building?

RQ2: How does a design that provides the creation and maintenance of shared artifacts impact social group-activity coordination? How will these shared artifacts impact the creation and maintenance of a shared understanding of the activity details such as who, where, when, etc.?

RQ3: In what way does supporting social group-activity coordination from a conversation centric perspective change the manner in which that coordination is performed?

RQ4: What design aspects are most influential in supporting conversational social group-activity coordination when compared to typically used coordination technologies?

In order to adequately support social activity coordination, it is necessary to first understand the behavior and the challenges that occur during social activity coordination. To gain this understanding, an elicitation diary study combined with semi-structured interviews was performed. Also, additional understanding was gained during a research through design process that employed an iterative cycle of design and implementation of a tool supporting social group-activity coordination using the conversation centric design perspective. Finally, this tool was examined in a laboratory experiment that contrasts social

group-activity coordination support from this perspective as embodied by this tool with a typically used coordination technology (group-chat).

The following sections will provide a brief description of each of the studies detailed in the subsequent chapters.

7.2 A Diary Study Focused on Understanding Current Social Activity Coordination Practices

In order to properly support and design for social group-activity coordination, it was important to gain an understanding about the current manner in which social group-activities are coordinated. This entailed gathering information about which technologies are used, the motivations for using various technologies, what strategies groups use to coordinate, what are the typical activities, what is the normal size of the group that participates, etc. The purpose of the research conducted for this study was to gain an understanding about these and other aspects of social group-activity coordination in order to inform the subsequent studies. Two main research questions guided this study. First, how do social groups communicate, coordinate, and share information in order to reach common ground and agreement about the activity and its details? To what extent do people's technology choices impact the grounding processes? Second, what are the dependences of social group-activity coordination? What challenges do the people face when managing them and what role does technology play in supporting this? This study was also motivated by a desire to provide future researchers and designers the information they need to build better social group-activity coordination support.

Performing a qualitative investigation may seem redundant in lieu of previous research; however, after close examination of the previous research conducted in this area

it was determined that it was necessary to start at the beginning. This determination was made because much of the previous research has either focused solely on an individual technology and how that technology is used. Many implications regarding social group-activity coordination were only from the perspective of that one specific technology. This has resulted in a fragmented view of social group-activity coordination and before this research was conducted there was no research that investigated its main focus.

Also, in much of the previous research there has been a large focus on understanding the use, usability, and adoption of calendaring and scheduling systems. However, as noted before, previous research strongly suggests that social group-activity coordination is not performed via calendaring and scheduling systems. In addition, much of this research was conducted from the perspective of understanding workplace environments and coordination which neglects the unique aspects of social group-activities and their coordination requirements.

7.3 Intervention – Designing a Tool to Support Social Group-Activity Coordination

An important part of understanding a design space is the process of actually designing and developing technology in that space. This is because a fleshed out and reasoned design does not arrive fully matured that is easily implemented without any investigation and reflection. This investigation and reflection cannot take place without the pain of redesign and reimplementation that is inherent in iterative nature of the research through design methodology.

It should be an undisputed fact that the reality of design is that it is an iterative process where the exploration of ideas and solutions with each iteration leads to further

refinement and additional understanding. This is because any meaningful design is fundamentally a wicked problem. Rittel and Webber (1973) define a wicked problem as one where the information required to understand the problem is dependent on the ideas about how to solve it. In other words, the process of solving the problem helps define the problem. This represents view distinct from traditional science which requires repeated experiments and measures. Fortunately, Zimmerman et al. (2007) provided HCI researchers the with concept of *research through design* wherein the process of exploring the design problem is also the process used to explore a research problem. They propose that through the act of understanding a problem, formulating and evaluating potential solutions, and iterating on earlier findings to produce new designs researchers produce artifacts and knowledge that are valuable findings in their own right (Zimmerman et al. 2007, 2010).

This research focused on understanding the wicked problem of generating a conversation centric design and implementation that supports social group-activity coordination conversations using a research through design approach. Specifically, the objective of this design work was to explore ways to:

- Provide a shared persistent conversation space that supported open activity coordination and communication.
- Provide structure for coordinating the important activity details, who, what, where, when, by supporting the creation of a shared artifact.
- Support important language actions that are used during social group-activity coordination (e.g., indication of attendance or participation, activity detail is decided).
- Use semi-structured input mechanism throughout the design when structured input would traditionally have been used. I.e., do not require the entry of a specific time (e.g., 4.30pm) instead provide the ability to enter ‘after work’.

This research has generated a series of design iterations where each subsequent iteration was informed by previous design efforts and evaluation. These iterations have generated understanding about how to support and create a conversation centric design for social group-activity coordination and also how such designs should be evaluated.

7.4 Laboratory Study – Experimental Study of Social Group-Activity Coordination Support

The purpose of this study was to evaluate and understand how a design that supports the conversational nature of social group-activity coordination is used and its impact on the coordination. Since typical usability evaluation was performed in the previous study the focus of this research was on the evaluation of the design and design philosophy and not its usability. The study was focused on two research questions. First, what affect, if any, does conversational support for social activity coordination have when compared to group chat. Second, is that conversational support desired and perceived as beneficial? In order to explore these research questions a mixed methods laboratory study was completed to evaluate the design instantiation that resulted from the design iterations.

The evaluation was conducted by having a series of groups coordinate typical social group-activates in two conditions. In the one condition the social group coordinated via a group chat which is a typical method currently used for this type of coordination. In the other condition, the group coordinated another activity using an instantiation of the design. Data was collected from the recorded coordination events captured by the system and by having participants complete various surveys at critical stages of the experiment;

CHAPTER 8

QUALITATIVE INVESTIGATION INTO CURRENT SOCIAL GROUP-ACTIVITY COORDINATION PRACTICE AND TECHNOLOGY CHOICE

The goal of this study was to gain an understanding about how people coordinate their social activities, specifically, what aspects of the coordination process makes coordinating social activities difficult and complex, what aspects makes the process simple and easy, and the motivations and decisions to use various technologies to assist the social activity coordination process.

Previous research has investigated various aspects of the social coordination process. Colbert (2001, 2002) used a diary study to investigate how people perform the task of rendezvousing. This is similar to the work done by Ling and Yttri (2002) where they identified the rendezvousing process as microcoordination. Grinter and Eldrige (2001) used a diary study and interviews to understand how British teenagers use text messaging. They reported that 26% of the text messages were sent in order to coordinate social activities. This number climbs to 51% if you include the text messages used to coordinate times to have instant message chats, phone calls and face to face conversations. Schiano et al. (2007) preformed a series of interviews and diary studies investigating the practices related to Japanese youth leisure outings. Their findings are similar to the previous research, a large percentage of text messages, phone calls, IMs, etc., were devoted to the coordination of these leisure outings.

While the previous research has investigated various aspects of social coordination, they focused only on specific aspects. The actions performed at a specific point in the social

coordination process or the communication methods and their use in the aggregate. This purpose of this investigation was to understand what methods and tools people use to coordinate the entire social activity process from initial inception to the end point with the activity either occurring or not. The knowledge gained from this study was used to inform the design and evaluation of a tool to facilitate social activity coordination providing a means to evaluate the various aspects of the design philosophy. This knowledge also provides important insight into social activity coordination in its own right.

8.1 Study Motivation and Focus

In order to facilitate the creation of the diary form and semi-structured interview questions, there are certain areas of the social-group social activity coordination process suggested by previous research, pilot interviews, and personal experience that were selected to be starting areas of focus.

Group Size: What impact, if any, does the size of the group coordinating the social activity have on the coordination process? Previous research has shown that the size of the groups performing social activity coordination is from between 2-6 people. Is this always the case?

Group Type and/or Makeup: Does the group makeup, social structure, typical activities, etc. affect the coordination process? The level of familiarity the group members have with each other may influence the social activity coordination.

Activity Type: The social activity being coordinated most likely influences the coordination process. The familiarity with the social activity may influence the social activity coordination a more routine activity that occurs frequently without changing details

may be less difficult to coordinate while one-off activities and that have many interdependencies and resource requirements may be more difficult.

Group Cohesion: A group may be more interested in performing an activity together regardless of what the activity is, therefore, is the chosen activity influenced more by the social aspects such as maintaining group cohesion or some other motivation? Activities may have some interdependency independent of the group and must occur regardless of which group members can participate what impact does this have on the coordination process?

Coordination Methods: Previous research and practical experience suggests that there are many various methods individuals and groups use while coordinating social-activities. It is important to understand what methods groups and their members use to coordinate. What influences the use of various coordination methods? There was also a motivation to investigate if and for what reasons group organizer(s) delegated tasks, how group members reached consensus and achieved common ground, how suggestions were made and acted upon, how decisions were made and finalized, how resources and interdependences were allocated, etc.

Communication and Coordination Tools: Previous research shows that many social activities are coordinated using primarily one-to-one communication such as, text messages, instant messaging, and phone calls. Infrequently groups use tools such as Facebook events, Google invites, evite, Tungle, etc. Therefore, it is important to understand when and why different communication and coordination tools are used, how they impact the difficulty and complexity of the social coordination process, and why groups and their members select certain communication and coordination tools over others.

On media switching: Pilot interviews suggested that one of the reasons that media switches occurs is due to not all parties using the same media. Is this due to access or personal objection to the technology or media? How does this impact the social activity coordination process? What coping strategies, if any, do social-groups employ during media switching?

8.2 Research Questions

The research questions are focused on gaining a holistic understanding of the dynamics of social group-activity coordination in the context of today's technology rich environment. Specifically, the following research questions were explored:

RQ1: How do social groups communicate, coordinate, and share information in order to reach common ground and agreement about the activity and its details? To what extent do people's technology choices impact the grounding processes?

RQ2: What are the dependences of social group-activity coordination? What challenges do the people face when managing them and what role does technology play in supporting this?

8.3 Method

The above research questions were investigated through a diary study (Carter and Mankoff 2005; Rieman 1993), with a total of 36 participants who recorded their social group-activity coordination efforts over a two week period and were then interviewed in depth about their experiences using the diary forms as a recall artifact. The study was conducted over two rounds during two university semesters. Diary studies have previously been used successfully to explore this research space (Kowitz et al. 2005; Schiano et al. 2007) and

also used to obtain detailed users insights about the process of reading documents (Adler et al. 1998) to methods for capturing information (Brown et al. 2000)

Procedure: The study protocol consisted of 1) participants recording on a paper based diary all the social-activities that they were a part of and all the coordination and communication events for each social group-activity at the end of each day over a two-week period and 2) a semi-structured interview with probes guided by on diary entries of the participants.

At the beginning of the diary study, the participant were provided with an instruction sheet and briefed on the proper way to fill out the diary forms. The diary consisted of two forms. On one form the participant lists the activities that they were a member of and coordinated during the study time. This includes any activity that they participated regardless of their involvement of the coordination process. The second form was completed for every activity that was included on the first. On the second form, the participant detailed each coordination action that occurred during the study period. As this was an elicitation diary study where the majority of the data collected is expected to happen during the interview process, the participants were encouraged but not required to fill out the second form after every coordination action. They were instructed to fill out all the forms at least once a day and were periodically probed to make sure they were filling out the forms correctly.

8.4 Participants

Previous research in this space focused on teenagers and young adults (Faulkner and Culwin 2005; Grinter and Eldridge 2001, 2003; Grinter and Palen 2002; Ling and Yttri 2002; Schiano et al. 2007) because they are typically the demographic that embraces and

uses new technologies in their daily activities. They are also likely to shed light on how routine coordination practices have been transformed by the new collaborative technologies and for this reason, they are an appropriate focus of study. Accordingly, participants were undergraduate university students from the age of 18 to 28, attending various courses offered in a research university. The first round consisted of twenty-one participants, 16 male and 3 female, while the second round consisted of seventeen participants, 13 male and 4 female (the gender mix reflecting the male dominated student population). One participant was dropped from round one due to an incomplete diary while all other participants completed the study.

8.5 Diary

The diary was in two parts an activities overview and a communication and coordination event log. The overview listed the activities that the participants were coordinating during the two-week period (e.g., going to the movies, class study group). The activity overview recorded, for each activity, what they were coordinating, how many people were involved in the coordination (this is the number of people who were providing ideas, suggestions, making comments, etc.), how many people were participating in the activity, who the main organizers were, if it was a recurring or one-time activity, what details were known or understood before the coordination began, and if there were particular resources necessary for the activity to occur (e.g., reservations, tickets). The event log recorded the individual communications: date, time and duration of each coordination communication, the communication channel, the number of people involved the communication event, what was discussed, and if they were the initiator or receiver.

8.6 Semi-Structured Interview

The completed diaries were used as a recall artifact that guided the interview and probes. The interviews took between 30 to 120 minutes and began with asking the participants basic overview questions about their recorded activities (e.g., which were routine and were atypical). In addition, the participants were asked to identify the activities that were the most difficult / complex and the most easy / simple to coordinate to better help guide the interview towards those coordinated activities that would best answer the research questions.

The bulk of the interview was focused on understanding three important areas. First, there was focus on gaining an understanding about the activities in general, how typical or unusual they are, how are they remembered or kept track of, and what the participants normal involvement in the coordination process is like. Second, an examination of the individual activities to understanding about the identified areas of focus previously outlined, such as, group make-up (e.g., friends, family, co-workers), familiarity (i.e., are peoples schedules known, best-friends vs. acquaintances) impacted coordination and how they reached consensus (common ground). Finally, there were more general questions that focused on comparing the activities to each other and teasing out more nuanced understanding by examining the differences and similarities of the activities and their relation to the areas of focus. Also, throughout the interview there was a discussion probing about how various technologies were used during the coordination process and the motivation behind the choice.

While the diaries and interview guide was refined and updated numerous times before conducting this study, the nature of qualitative research that aims to ground findings

(Glaser and Strauss 1967) lead to interview guide iterations. As a result there were differences between the two diary rounds. The initial round of interviews focused on understanding the nature of social group-activity coordination as suggested by the diary, i.e., a close examination and probing of each recorded coordination event. The second round of interviews focused more on the challenges people face when coordinating social-activities and what motivated the use of various technologies.

Procedure: The diary forms were used as a recall artifact and guide throughout the interview process. The interviews began by asking the participants overview questions about their recorded activities (e.g., which were routine and were atypical) and also to help guide the interview they were also asked to identify the activities that were the most difficult / complex and the most easy / simple to coordinate. Once the activities were ordered by the participant, the interview focused on a complex activity followed by a simple activity and continued in that manner. Towards the end of the interview, the questions then focused more on their coordination practices in general.

8.7 Data Analysis

The analysis method used to extract understanding from the interviews and diary forms used was a grounded approach. This is a common and accepted approach for this type of qualitative research. The initial case of using a grounded approach for ethnographic research is from Grounded Theory (Glaser and Strauss 1967). The base premise of Grounded Theory is to iterate the data collection and analysis process together so that understanding and patterns will emerge from the data alone. After the inception of Grounded Theory variations have been advocated and discussed (Furniss et al. 2011 & Matavire and Brown 2008). Of specific note, is a relaxation on the need for entering the

investigation without any prior knowledge or assumptions used to build a foundation for the data collection and coding. It is important to note that to properly facilitate a grounded approach to the data collection and analysis stating initial knowledge assumptions is useful, however, they must not be strictly adhered to so that the emergence of patterns and themes can come from the data.

8.8 Study Findings

The findings are grouped into four subsections: 1) the types of reported group-activities 2) the nature of social group-activity coordination, 3) complexities and challenges of social group-activity coordination 4) core organization in social group-activity coordination and 5) role of technology in group-activity coordination.

8.8.1 Reported Social Group-Activities

The types of social activities reported by the participants can be broadly split by the number of invited members. Large activities, such as, birthdays, bachelor, cook-outs, dance parties, mixers were often reported very specifically as a "party", such as, "*Jenny's birthday party*", or "*Brian's football party*." These were typically organized by a small group of people and then the large group was invited, ranging in our sample from 15 to over 100 people. The small social group-activities were more varied, for example, *going lifting, going to lunch, hanging out with friends, going to or watching a movie, playing soccer, football, camping, or shopping*. These activities represented the things that people do with their friends and family in their day to day lives. The names of these activities were reported more generally, for example, "*hangout*", "*lunch with friends*", "*dinner*", "*meeting friends*". While the size of the attendance between these two types of activities differed greatly the size of the group

coordinating these activities did not. In both large and small activities the typical number of people participating in the coordination ranged between 1 and 6 people.

8.8.2 Nature of Social Group-Activity Coordination

8.8.2.1 Group-centric vs. activity-centric initiation. It was found that social group-activity coordination conversations typically begin in two distinct ways: group-centric or activity-centric. Activity-centric coordination begins with a set activity already in mind of a few interested group members and then expanding to include more as the conversation evolves and the details are discussed. The conversation typically begins with a discussion not about what the activity will be but rather when it would take place and how. The discussion and negotiation about the dependences such as, time, place, attendance, reservations, tickets, parking, and etc. drives these types of coordination conversations.

In contrast, group-centric conversations begin with a group of people already known and involved at the onset. That is, group members are somehow interacting and / or there is a desire to do something together. As a result, the focus is on activity the group desires to do together and initial conversations typically begin as an expression of this desire to do something together. As these types of coordination conversations progress from the beginnings of "let's do something this weekend," there is then a gradual move towards the introduction of additional dependencies, and onward to specific ideas and ultimately a decision, e.g., "Batman at 8pm Friday night."

8.8.2.2 General to specific conversations. An important observation is that regardless of how the coordination conversations began there was always a need for a series

of sub-conversations discussing the dependencies of the activity. These sub-conversations were commonly centered on what various activities the group should do, the times and dates they should do it, where they should go, etc. Sometimes these sub-conversations would then introduce additional dependencies that would spawn other conversations. Coordinating members would offer suggestions about various details and a discussion about these suggestions would ensue. As the sub-conversations about each aspect of the activity progressed, the suggestions offered for each detail / dependency would transition from being very general to specific. For example, an initial offer of "this weekend" would spawn suggestions like, Friday night, or Saturday afternoon, until reaching a specific and agreed upon detail, Friday at 8pm. Interestingly, while some dependencies would interact, e.g., if the activity is going to the movies then when the movie is playing impacts the time, each separate dependency / detail would transition from general to specific at its own pace. In other words, certain details would remain general and non-specific while others became more specific quickly or even finalized.

8.8.2.3 Group size. Group-size plays an important role in social-activity coordination and there is a distinction between large social activities, such as parties, and the smaller more mundane or intimate social-activities. Despite this, it is important to note that both these types of activities did not differ fundamentally in how they were coordinated. In both cases the discussion and coordination about the details was carried out by a small number of individuals. What differed were the actions taken once the details were decided upon. In larger activities there was a separation between the group of people who coordinated the activity and the group of people who ultimately participated in the activity once the details were decided and known disseminated to the larger group. In other

words, a small subset of social group would undertake the task of coordinating and deciding upon the activity details and then once everything was understood and finalized between them the larger group of members were notified. This notification was typically done through a variety of means, mass text messages, phone calls, assigning people to inform others, etc., However, it was commonly performed via a fairly public broadcast mechanism such as a Facebook Event.

8.8.3 Complexity and Challenges

To understand the nature of coordination an investigation into what aspects perceived as contributing to coordination being difficult / complex or easy / simple is important. Several factors such as the nature of activity, amount of time in advance one was planning, lack of familiarity with participating group members, lack of timely participation from members in coordination, were identified as contributing to the complexity of the coordination process.

8.8.3.1 Group familiarity. Participants frequently responded that it was harder to coordinate with people they do not do things with regularly, or did not know well. When coordinating with new people a lack of understanding of their interests or schedules were described as reasons for difficult coordination. The following accounts were typical: "*[with] new friends- I don't know them like my regular or best friends. So, I don't know what they like."* Also*, "when I communicate with friends, I don't care if he is busy or not.*

I will still call him or text him." When discussing a new acquaintance, "*but [with] this person I am not sure if he is free, or if he is working, I don't know his schedule.*"

8.8.3.2 Feedback. Participants also indicated that lack of response or not knowing if another member received information contributed to making coordinating more difficult, often prolonging the process: "*the reason it became hard for us is because we were trying to contact people and they weren't responding back so we weren't sure as to what was happening […] and the waiting time that we had from where we did text and from the time they responded, we weren't sure what was happening."* In contrast, participants considered routine activities that occur often without many changes in details were simple and easy to coordinate. Tony provides an example when he describes coordinating with his friend, "*it's like 'Hey you want to watch football this Sunday? Yeah well we are doing it at Will's' 'Okay I'll see you there.*'" Routine and familiarity provides casualness and previously known details which makes coordination easier.

8.8.3.3 More is not merrier. As the number of people coordinating and the number of details that needed to be worked out increases, there is an increase in the perceived complexity of the coordination. This was typically expressed as a greater number of conflicts and disagreements and resulted in an increased burden on the individuals responsible for coordinating the activity. Matt provides an example here: *The wine tasting [was difficult] because it involved more people and I wasn't the one that was solely organizing it. I was sending information back and forth between people. There were more*

people to take care of. Also Amy provides another: *[…] Why didn't we call this girl, when we called all the others?[…] and he said 'oh my I forgot'.*

8.8.3.4 Don't take too long. The participants also discussed how the duration of the coordination often led to complexity in coordination due to issues such as multiple conversations, remembering details and what was agreed from previous conversations, relaying information, etc. Matt: *the conversation lasted for almost a week between figuring out exactly what's going on, it was the length of the conversation. […] you have to keep track of who you're talking to and what they're saying.*

8.8.4 Core-Organization in Coordination

We observed from the diary and interviews that much social group-activity coordination begins with a small core group of organizers. The number of organizers (those who the participant felt was primarily responsible coordinating the activity) ranged between 1 and 6 people. This core typically begins the initial conversation to sketch out a rough idea about the activity. Once some initial details are decided among this subset then additional people are invited and additional coordination will occur.

8.8.4.1 Disparity of work. An important discovery is that there is large disparity of work between the core organizers and the other coordinating members. Organizers were typically responsible for maintaining and synchronizing the details, suggestions, and comments between the different coordinating members. To mitigate some of this work organizers would typically instruct other members to pass on information, collect suggestions and comments, etc., and only provide them after gathering them from contributing parties. Sarah described this during her interview, "*We promised we [would]*

go into town but I was working […]. So I just called Julia and said look I'm working, I can't talk to every person or text them. So I asked her to do that for me and see who else is willing to come."

8.8.4.2 Relaying. Participants often reported *Relaying* – when a person passes on information about the coordination to other people who were not part of a conversation – as common method of sharing information and when coordinating social-activities. The dynamics of relaying self-organized along lines of strongest familiarity and friend hubs as a way to off load the work required to inform others of changes. Martin explained this dynamic: "*I wasn't really coordinating; I was just relaying information. I have two very close groups of friends, one on one side and one group of friends on the other. They both know each other but I'm closer to both of them individually than they are with each other."*

8.8.5 Media Use in Coordination

Social-activities were coordinated across many different communication media with text messaging being the predominate choice. However, other media use was reported as well such as, phone calls, mobile group messaging (e.g., GroupMe and WhatsApp), Facebook chat, and email. Interestingly, there was no mention of standalone instant messaging (e.g., AIM, MSN) and the only form of instant messaging used was Facebook chat. The interviews and diaries revealed that social group-activities are typically coordinated using multiple media types and that the occasions when a single communication method is used the activities being coordinated are typically routine and / or casual and only the attendance is being coordinated.

Media choice was influenced not only by the features of the technology but also by the personal preferences and normative communication practices of individual participants

which Amy relates here: *[the media] varies, depending on the person […] well like for my friend, Susan, I tend to call her, same for my parents, for my stepsister, she's a doctor, so for her I'd prefer texting because of her schedule. I would rather text [my friends] when they're on campus because you never know they might be in class, so it depends on the person.* Other participants responded with similar statements about the context in which the communicator or the communicatee is often a motivator for the choice of communication media. Theodore: "*[…] I know he is a busy at work. So if I call him he will be busy doing stuff. So it is better to message him because he can reply to my message at anytime."*

There was also a heavy use of one-to-one communication media. This resulted in the coordination taking place across many separate conversations and across different media which resulted in an increase in relaying behavior. In addition, the information about the coordination was frequently distributed in message streams that were disconnected from the social group-activity being coordinated (e.g., text messages). This often led to confusion and a lack of shared understanding about the details of the social group-activity and may explain why social group-activity coordination is often carried out by only one or two primary organizers. They, in a sense, become the shared repository of all of the coordination details.

8.8.5.1 Familiarity influences media choice. The level of familiarity between the group members also influenced the media choice. Some of the participants expressed that they are uncomfortable using one media type, e.g., phone calls with people they do not know well and prefer to communicate with them via another media type, e.g., text messages. Amy tells us about coordinating with people she was not familiar with, "*I don't*

know them so I rather to text message first, if I know the person I call them." When discussing communicating with people, they were unfamiliar with the participants typically preferred to use text messages, however, when communicating with people they were familiar with we did not see a consistent preference.

8.8.5.2 Affordance. The decision to use one media over another is also influenced by what the participants perceived to be the best fit for their communication task. For example, phone calls were used for an immediate response, "*I called because it was time sensitive… phone calls are really fast,*" and for longer and more open ended conversations to avoid a lot of typing and text messages. Group text messages was commonly used for sending out the same information to the entire group as Anthony points out, "*if I have to call 23 people as opposed to text 23 people I'm going to text them."* The affordance of one media versus another may also cause people to switch from one to another. Theodore relates his experience when a text message conversation switched to email: "*Suddenly he sent me an e-mail, because the file is quite big, and it's better to look at a pdf file on the computer [than my phone]".*

When participants discussed using group messaging, it was discovered that there is a tension between the benefits it provides and problems with its use and design. Doug illustrates this tension when discussing the GroupMe (a mobile group messaging app): "*The most effective one is GroupMe. […] When using GroupMe you send a message and everybody sees your message and the responses. It's less time consuming."* However, later on he explained why he had to stop using GroupMe with one group of friends. "*I used to use GroupMe with them [but] I stopped using it with them because […] they go off on tangents and spam the chat room with nonsense. So the chat starts off good then it just*

deteriorates. This was found to be a common problem; group chat will frequently devolve and become unrelated to coordinating the activity.

8.9 Discussion

This provides insight into routine social group-activity coordination practices that is lacking in the current literature. Instead of focusing on examining a single technology or a small aspect of coordination, this work examined social group-activity coordination with the purpose of gaining a holistic understanding of this area.

The decision to focus on coordination as a whole and with the guidance of coordination theories allowed for a number of key observations to be made about the nature of group coordination conversations. First, group-centric and activity-centric coordination is initiated differently. Activity-centric coordination conversations begin with an activity already in mind and the discussion is about when and how it would take place and who should be involved. Group-centric conversations begin with the group already selected (e.g., close friends) and the discussion is focused on what they should do together. Second, coordination grounding typically involved discussion repeatedly moving from general to specific details (e.g. first agreeing that an activity would occur next week, then the day, then a specific time). Third, coordination conversations do not follow any single overarching process or order. As a result, individuals generally shy away from tools that attempted impose order on the coordination process such as shared calendaring tools. Fourth, coordination conversations often get overloaded, and as a result people routinely find social-coordination highly challenging / frustrating. Such conversational overload (Whittaker 1996), is associated with the number of individuals involved in coordination, the time period over which coordination is occurring, the familiarity of coordinators with

the various dependencies (e.g. the viability of various participants), and the number of unknown details. Finally, there is a significant disparity of work between coordinating members. The organizers nearly always end up performing a disproportionate amount of work, they receive incoming suggestions, update the other members, track attendance and scheduling conflicts, etc., and the other members benefit from these efforts. While this is interesting, it is not unexpected and is what one would assume would occur from their personal experiences. However, when examined from a broader level in context of the other findings it was found that there is not only a disparity of work between the organizers and other members but also a disparity of information. The organizers know more about what is going on because they are the ones receiving all of the information. The other coordinating members are separated from each other due to the heavy use of one-to-one communication media. This state is counterproductive to the coordination and interferes with the group's ability to achieve a common ground and agreement about the activity's details.

Coordination Theory views coordination as a dependency management problem. Further, that the first step in understanding coordination challenges is to characterize the different kinds of dependencies. This work has revealed three clearly identifiable themes for the types of dependencies that emerged during the interviews and diary. First, *resources,* these are the things required for the social group-activity to occur, such as, movie tickets, a restaurant reservation, food, a pool for a pool party, etc. Second, *interpersonal-dependencies*, these are the dependencies that develop from the people involved in the coordination that are typically in conflict and must be coordinated and negotiated. Some examples are, schedules (can only do it after work), desires / interests (I

don't feel like Mexican food), and relationships (I'll only go if my best friend goes). Third, *external-dependencies*, for example, if a group desires an outdoor party at a park a *resource* may be a permit but the *external-dependency* is nice weather.

Our participants consistently explained that the complexity of social group-activity coordination was directly associated with an increase in the number of resources, interpersonal, and external dependencies. When participants stated that coordinating was difficult with larger number of people, they were highlighting how additional people introduce additional interpersonal-dependencies that must be addressed. This is likely because there is no shared repository of information so the coordinating members must maintain the knowledge about the coordination individually. Much of the coordination was observed to have occurred over an extended period, across multiple media, and within open multi-faceted conversation streams which made coordinating frustrating and difficult. If an individual forgot or misplaced some information they then have to ask an organizer or one of the other members for the missing information. This explains why recurring coordination with a known set of participants was depicted as considerably easier. Since much of the information is already known and shared very little coordination, is required. In order to support anything beyond trivial social group-activity coordination a focus on understanding and supporting the distribution of the activity details, comments, suggestions, etc., is required to reduce the dependency on the organizers for maintaining the shared information and to facilitate a more equitable distribution of work across all the coordinating members.

The study findings, reinforces the position that social group-activity coordination is perhaps best understood as a series of iterative conversations performed to achieve a

shared understanding and agreement about the activities dependencies and requirements. During these conversations people talk, debate, share ideas and suggestions, etc., with each other in an unstructured and open manner. This explains why open communication media was strongly preferred by our participants as it directly supports interpersonal conversations in contrast to more structured tools such as shared calendars which are much more restrictive. However, decision of groups to use open unstructured communication tools often complicated matters by increasing the chances of conversational overload and the disparity of coordination-work within groups.

Important implications for the design of group-activity coordination tools can be derived from this study. In a general sense, the findings argue for a paradigm-shift in how designers and researchers reason about the design of coordination support systems. Instead of attempting to force individuals into highly structured coordination processes (e.g. scheduling) or providing individuals with yet another open communication tool it is imperative to support the natural conversational dynamic of social group-activity coordination by: 1) understanding and supporting the language actions that are routinely performed to communicate and coordinate the dependencies; and 2) providing consensus sharing and building / grounding artifacts that provide coordinating groups a means to create a shared understanding and agreement of the social-activities details and also reduce the disparity of work and disparity of information we currently observe. In other words, researchers and designers are required to investigate tools that intentionally support conversational coordination and in the process make life easier for both participants and organizers.

CHAPTER 9

EXPLORING THE WICKED PROBLEM OF SOCIAL GROUP-ACTIVITY COORDINATION SUPPORT

When presented with a problem or challenge that needs to be solved or overcome one of the greatest difficulties is gaining an understanding about what the problem is. What are the constraints, the requirements, what is the solution? Many people believe that the ultimate goal of overcoming a problem is to arrive at a solution, and not just any solution, but an optimal solution. For some problems this is easily done, finding the maximum amount of items to store in a shipping container given descriptions of their weights and size is a known and well understood problem. The optimal solution is computable and the methods to compute it widely known. Slightly more challenging would be finding the optimal method to compute that solution. That problem is well known but now the definition of optimal is dependent on requirements and constraints external to the problem definition. Is optimal evaluated in terms of speed, memory efficiency, ease of implementation, etc.? The definition of what is optimal becomes a problem on its own. The result is that the problem is actually as much about describing and understanding the problem as it is finding a solution.

Rittel and Webber (1973) classify this kind of problem a wicked problem. One in which the information required to understand the problem is dependent on the ideas about how to solve it. This can also be understood by saying that the problem space of a wicked problem is explored by one's attempts to solve it. Wicked problems also do not have a clearly defined stopping rule. There is no preexisting condition or set of observations that

can be made that determine that the problem is solved completely and at the optimal level. They also do not have any objective method of determining the fit of the proposed solution, the solutions are not correct or incorrect only better and worse.

The definition of the wicked problem describes the same process designers undergo during the design process. This similarity was not lost on HCI researchers when attempting to understand the process of design and how design relates to research. Zimmerman et al. (2007) describe the concept of *research through design* in which the process of exploring a design problem is also the process used to explore a research problem. They propose that through the act of understanding a problem, formulating and evaluating potential solutions, and iterating on earlier findings to produce new designs produce artifacts and knowledge that is valuable research findings in their own right (Zimmerman et al. 2007, 2010).

The understanding necessary to support social group-activity coordination is something that can be discovered solely through theory formulation and experimentation. What is required is to undergo the process of solving the problem while being informed by theory and previous research. In addition, the design process informs the selection and the interpretation of theory that is crucial to the discovery of any novel work.

Design is a messy process. While it can be informed by theory, design philosophy, critical thinking, user testing, ethnographic investigation, etc., it is often a meandering and cruel process that requires perseverance and a stoic conviction that you will ultimately arrive at, maybe not the end, but a point close enough to it.

Typically, the research focus of a design leans more towards evaluating the end result of this process; however, evaluation is not the only way to gain understanding. The steps along the way are informative and worthwhile in their own right. The design

discussed in this chapter has undergone numerous changes and revisions as a result of multiple rounds of usability testing, finding and reinterpreting previous work, and from this effort a greater understanding of social-group social activity coordination.

It is important to note that design is not a solitary process and not performed in a vacuum. Good design is dependent on working with dedicated and motivated people. The following series of designs is the product of many talented individuals working together over the course of many years.

9.1 Design Goals

Drawing from the discussion in previous chapters the following design goals were created.

- Provide a shared persistent conversation space that supported open activity coordination and communication.
- Provide structure for coordinating the important activity details, who, what, where, when, by supporting the creation of a shared artifact.
- Support important language actions that are used during social group-activity coordination (e.g., indication of attendance or participation, activity detail is decided).
- Use semi-structured input mechanism throughout the design when structured input would traditionally have been used. I.e., do not require the entry of a specific time (e.g., 4.30pm) instead provide the ability to enter ‘after work’.

These aspects were incorporated throughout the various design iterations in different ways and levels. During each design implementation and evaluation cycle the design goals, philosophy, and features were evaluated and changed. As a result, the perceptions at the beginning of the design process were not the same as those at the end.

9.2 Design Iterations

The design discussed in this chapter has undergone numerous iterations, each with periods of design, implementation, evaluation, and interpretation. Throughout the process there were many unexpected findings that prompted reevaluations of the design but also about what previous research tells us about how to support social group-activity coordination.

A direct result of undergoing the iterative design process was the finding that it is necessary to focus on providing design features that expose the actions people naturally perform when coordinating social-activities. The initial iterations were much more focused on providing shared views and artifacts and less on supporting the conversational aspects of social group-activity coordination. Ultimately, this process has led to the discovery that social group-activity coordination requires the unification of the two into a seamless process where the conversational actions that individual group members perform are also those that build and maintain the shared artifacts.

The conversation centric design perspective argues for the need to minimize unnecessary processes and dependencies that create artificial constraints on the coordination process. For example, much of the previous research involves a series of increasingly clever and complex means of gathering user preferences and calendaring information that can support complex scheduling algorithms. Researchers believe that the failure of these systems is a result of lack of data and that if more and better data could be collected than their use would increase. However, what was found is that these systems are not used due to the fact that they inject unnecessary and unwanted processes and constraints into social group-activity coordination. People perceive coordination as a social action in its own right and are not seeking optimal solutions to their social group-activity

coordination. Instead designs should provide the users the support they need to coordinate naturally and in the ways they desire.

An important aspect in coordinating any kind of activity is achieving a shared understand about the activity's details. Without this shared understanding the activity cannot occur. In order to facilitate the creation of shared understanding the various design iterations attempted to ground the coordination by having a title, name, subject, etc., identified at the start. The objective was to provide a means of identification for the coordination but also to provide a launching point for the conversation. However, what it was found that there is always a tension between 'title / subject' versus 'about' versus 'the activity'. The initial topic of coordination can begin as 'doing something this weekend' and the 'about' or 'activity' can change as the coordination progresses. This argues for providing a method to coordinate and center the conversation about what the activity is itself in much the same way as any other activity detail. This was always a problematic aspect of the design and one which has yet to be adequately solved. Multiple methods for supporting this were attempted and none were seen as a sufficiently natural fit. Ultimately, the problem was more or less ignored and users were provided the ability to change the 'title / subject' of the coordination with the acquiescence that this is adequate for users to work it out amongst themselves.

The following sections provide descriptions and insight into the major design iterations, the main design objectives and motivations, and what was learned from the process of design and evaluation.

9.2.1 Design Iteration 1

9.2.1.1 Design. The initial conceptualization for supporting social activity coordination was primarily motivated by providing the social-group a shared view of the current state of the coordination. The addition of a persistent group chat space was also provided as a secondary space that would allow the social-group to coordinate details about the social activity that was not explicitly supported. This initial design was partially focused on de-emphasizing use of the chat for coordination in favor of the shared views and semi-structured input.

The initial design targets were Windows Mobile 6 and 6.5 smartphones. This was a pre-iPhone era; however, the design was already focused on supporting thumb based input much as possible. The choice of this smartphone platform was due to the platform providing a considerable freedom in interface implementation. Therefore, it was possible

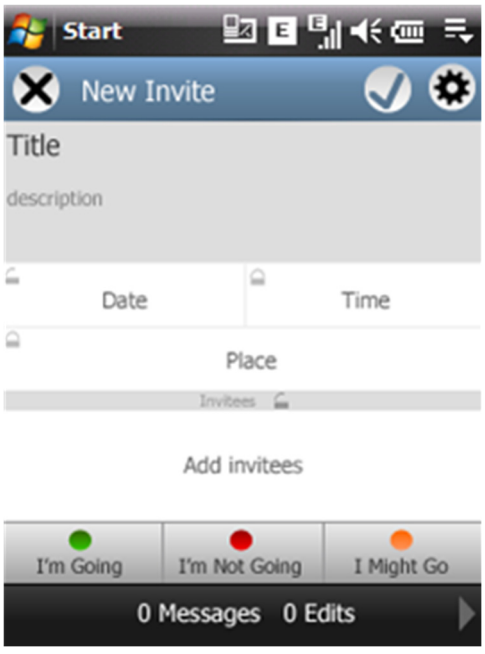

Figure 9.2 New invite.

Figure 9.1 Received invite.

to implement and test various different types of interactions that were not supported directly by the platform itself. This was primarily achieved by bypassing the platform's focus on stylus based interactions and instead supporting thumb based interactions. It is also worth noting that at the time of this initial design and user testing many people were unfamiliar with smartphones, their use and their existence, the primary phones at the time were clamshells with j2me (an early java micro-platform for phones and PDAs) being the primary development environment.

This iteration was also focused on providing shared information awareness about the coordination and providing the familiarity of group chat. Unlike calendaring and scheduling systems the shared information was not owned by a single person and was editable by any member of the group. This design did retain some concept of permissions and ownership in that the initial coordinator had the ability to lock fields (e.g., date, time) for editing. This was motivated by the desire to provide the group a way to indicate that some of the information was finalized or predetermined and cannot be changed. The information fields were selected to represent what was felt to be the most important when scheduling social group-activities these are: The title of the activity, the description, the date, the time, the place, and the invited members. One of the design goals was to facilitate a less structured manner of supporting the coordination by supporting semi-structured input. The different information fields provided some structure and organization by themselves but also ones like date and time also provided the ability to enter free form text, e.g., 'this weekend' for the date, or a specific date 'Saturday, Feb 1st'.

Any change to the information was visible to the entire group and that change was indicated on the information screen and in the conversation screen. Multiple information fields could be edited and then sent to the group together. The changed information was

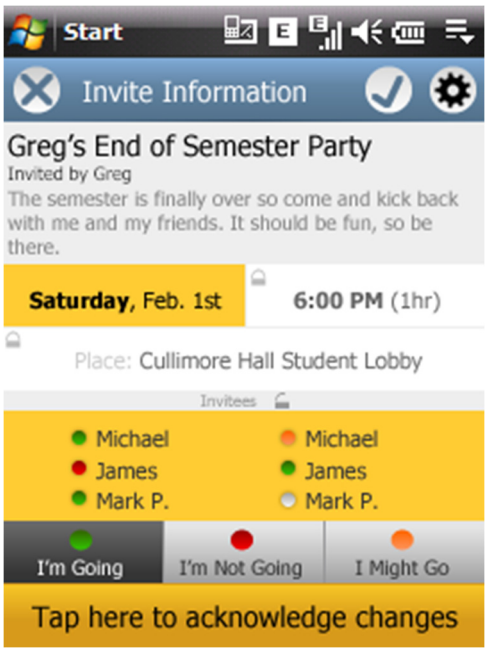

Figure 9.3 Invite with changes highlighted.

displayed in place with a visual indication to distinguish it from the current information.

Separate from the information display screen was a group conversation / chat screen. This provided the group the ability to have a free form conversation. This was chosen since it is similar to text and instant messaging which is commonly used for social group-activity coordination with the additional benefit that it is not a one-to-one conversation and that all members of the group share a collaborative space. In addition, the messages were persistent and could not be removed by any user.

9.2.1.2 Observed use and learning. After usability testing multiple design flaws and problems were discovered. There was confusion about which information fields were changed by whom and when they were changed. The lock / unlock metaphor was confusing and did not convey the design intention of indicating finalization about the information. The chat screen was overly used for much of the coordination time and only once the details were well established were they entered into the information fields. The description area was problematic since often the idea of what the activity actually is and what the group was going to do together is a result of the coordination effort itself and not something that could be properly pre-established.

The confusion about what was changed, by whom, why it was changed, and when it was changed was due to the manner in which updated information was displayed on the information screen. The state of updated information was conveyed by highlighting the information fields that were changed since the last time the user looked at the information screen. The user would then be prompted to indicate that they have seen the updated information and the highlight would be removed. The problem with this approach was that it leads to confusion about when the information was updated since fields were only indicated that they were updated. The users also encountered difficulties because multiple distinct updates could have occurred since the last time they looked at the information screen. They would be unaware of that the field changes resulted from multiple updates until they went to the chat screen and saw the history of updates.

The users also encountered difficulty connecting the information screen and the chat screen. When viewing the information screen, they were provided an indication of the number of messages that they have missed. However, this notification area was also used

to indicate updated information fields so when fields were updated the indication of new chat messages was lost.

Problems due to the limitations and familiarity of the devices used at the time were encountered as well. The devices used resistive touch screens which required physical pressure at a specific point to register. This is unlike current devices which can sense touch alone. Also, text input was only possible via a physical keyboard which required the rotation of the device. Many participants were unfamiliar with using small qwerty keyboards and indicated that they would have preferred access to t9-word which was a common text input method at the time.

Overall this design did not achieve the desired outcome of supporting social group-activity coordination. The users primarily used only the group chat screen to do the majority of the coordination and discussion about the activity and its details. It was only after they reached consensus and shared understanding did they use the information screen as a method to finalize their decisions.

9.2.2 Design Iteration 2

9.2.2.1 Design. Iteration 2 involved a lot of redesign and rethinking about how to better support the conversational nature of social group-activity coordination. It also was a complete redesign of the interface, interactions, and reimplementation to support the transition from Windows Mobile to the Android platform. The goal for this design iteration was to overcome the observed deficiencies with the previous design. Specifically, the

sparingly used information screen, the problem with the lock / unlock metaphor, and the disconnect between the group chat screen and the information screen.

The problematic lock / unlock metaphor was replaced with a question mark and a check mark to indicate an undecided or decided state. This was done to better represent the design intention for this ability and better convey the state and intent to the user.

The description area from Iteration 1 was removed and replaced with a new field called ‘about’ moving it to the same level as the other information fields. This motivation for this was to support the discussion around the activity and to remove the onus on providing a description of the activity before the coordination and discussion begins.

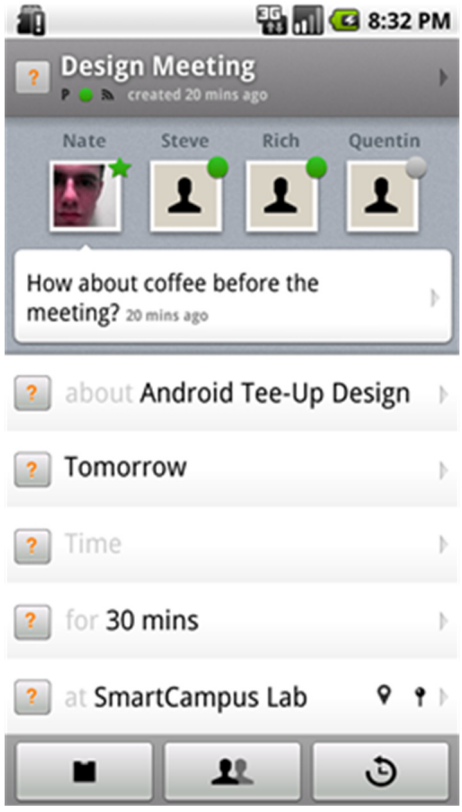

Figure 9.4 Design of iteration 2.

Since the new devices provided more screen space, the duration and time information fields were separated into their own separate fields. This brought the total number of information fields to five: about, date, time, duration, and where.

In order to overcome the disconnect between the group chat and the information, the design paired a chat bubble with the view of invited members. The chat bubble would display the last chat message sent and indicate who sent it. The purpose of this was to tie the chat to the information and allow users to have some idea about what was happening in the chat while viewing the information screen.

This iteration continued with using the highlighting of fields to indicate and updated state; however, it provided an additional method to view the history of changes. This was done by providing users an information history screen that provided users a means of viewing each change to the information screen in series and who made what change. The purpose of this screen was to provide the user a different manner of navigating and understanding the changes to the information screen during the course of the coordination.

9.2.2.2 Observed use and learning. This design iteration received more positive feedback from users than the previous iteration. This was, in part, a result of changes to the design to respond to the problems and issues discovered in the previous version. Also, the technological climate changed during the first iteration and this one as the adoption of iPhone and android devices increased. This contributed to a marked increase to the number of people familiar with these types of devices and many more of the users had or were familiar with how to use such a device.

It was observed that users still heavily favored using the group chat for much of the coordination; however, the changes to the information screen were perceived as beneficial.

The change from the lock / unlock metaphor to the decided / undecided indicated with a question mark and a check mark was understood by a majority of the users. As a result, this feature was used to a much greater extent than in the previous iteration. There was still a large tendency for users to only add information to the fields when it was discussed and more or less agreed upon in the group chat. However, with the provided information history screen users were now more inclined to use the information fields during the earlier stages of coordination. While the information history display was used and provided some benefit, users indicated frustration with having to switch between three different screens to understand the history of the coordination. They had to use the information screen for the current state, the group chat screen for the history of the conversation, and the history screen for the changes to the information. While each of these separate screens worked well on their own, they were not well integrated and did not support the users to fluidity move between them while coordinating.

Users indicated that they found the five separate fields overwhelming and that this discouraged their use. Specifically, the about field and the duration field were the least frequently used fields and the ones that were most confusing to the users. Users also expressed frustration with the split between the date and time. From observing the logged group chat and interactions with the information fields and with discussion with the users themselves, it was discovered that the date and time were discussed and changed together the majority of the time. It was also conceptually difficult for the users to have the information fields separated from each other since when the date would change it would normally require a change in time as well. It was also confusing to the users when one would change when the other did not change in accordance.

The addition of the chat bubble was well received by users. It provided some familiarity to the information screen; however, they indicated frustration that it only displayed the latest message. It was also found that the number when a number of chat messages occurred displaying only the very latest caused confusion. This led to the users frequently checking the group chat screen to see if there were new messages.

This iteration also still had a problem with how updated information fields were presented to the users. Like the previous iteration the information fields in this iteration were highlighted to indicate that were updated since the user that saw them but the changes to the design resulted in the discovery of problems with this method. From discussion with users and observing them during use it was learned that not only were they interested in the fact that information fields were changed but also in what order the changes were, why they were changed, and by whom. The users expressed frustration that the only way to access to this information was from the group chat and the information history screens which were separate from the information screen itself.

9.2.3 Design Iteration 3

9.2.3.1 Design. The main goal of Iteration 3 was to provide a higher integration between the information screen and the group chat screen. To facilitate this, the information area, now called the card, and the group chat, now called the conversation, was unified in a shared summary screen that provided the display of the current information and a view of the most recent conversation messages. This provided users a way to see what was happening in the group conversation while also viewing the information on the card.

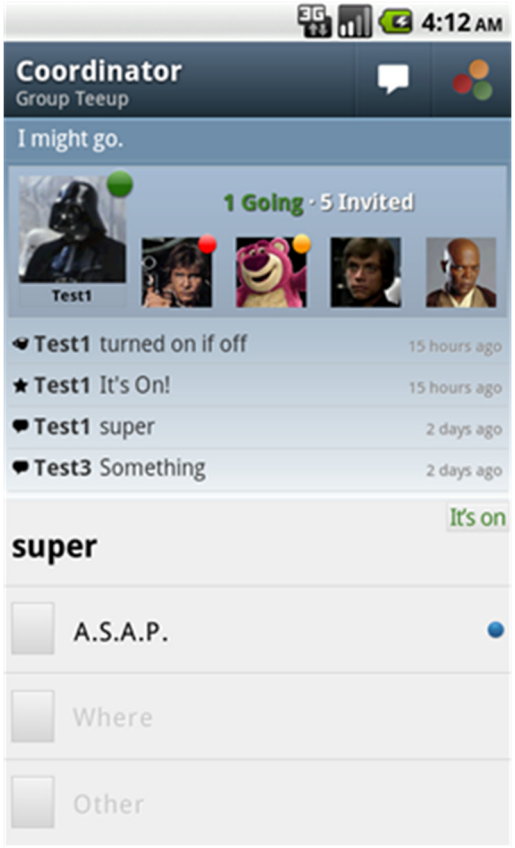

Figure 9.5 Design of iteration 3.

In response to what was learned from the prior iteration the design for this iteration reduced the number of information fields. It also unified the date and time into one field

providing means to coordinate date and time in one place. The purpose was to facilitate the previous observed user behavior where date and time were frequently changed together. The ‘about’ field was removed in favor of providing an ‘other’ field that could be used for whatever purposes the group saw fit to help support their coordination. Also, since this shared view now included some of the conversation messages the duration field was dropped due to its limited use, prior confusion, and lack of utility.

This iteration removed the separated information history view to reduce the number of separate screens required to understand the entire history and state of the conversation. This screen was the least used and after multiple iterations’ attempts to refine this view it was decided it should be removed. It was still important to provide users a clear view of the history of changes. In previous iterations, users spent much of the coordination time in the conversation view. Therefore, the design was changed to embed the information change indications directly into the conversation. This was done by indicating different types of updates via individual icons for each type of update and providing a textual summary of the changes. This change sought to improve the relationship between changes to information fields with the discussion surrounding those changes.

9.2.3.2 Observed use and learning. This was the first design iteration where it was observed that some users favored using information fields over the group chat conversation area. This is due in part to the merging of the information display, the card, and part of the conversation into a shared view. Also contributing was the unification of the conversation

messages and the information changes. This allowed for conversation messages and the changes to the information fields to be viewed as equally important and in context.

Throughout all the previous iterations multiple information fields could be changed and sent as one single update. In other words, the user could change multiple information fields and all of the changes would be sent together. Unfortunately, the unified display of user actions and messages in the conversation view uncovered some problems in the design related to updating information on the card. First, there was a usability problem for the user changing information on the card. Users found it confusing and difficult to use a design that was tailored to update multiple fields at once when their intention was to quickly change a piece of information and have it added to the conversation when it was relevant. Instead, users perceived the semi-structured input for the information fields as just another way to add a message to the conversation with the added benefit that it put that information on the card as well. This was unexpected. While the design intention was for users to use semi-structured input coupled with group chat to support coordination, this was the first time that the users were using it in the desired manner for a large part of the coordination. As a result, the multiple information field change support was problematic since it slowed users down and introduced confusion and added complexity to the process. Users viewed changing these fields as just another chat message and wanted it to be done quickly.

Users also found it problematic to view and understand the summary message for multiple information field changes. In the shared information and conversation screen, multiple changes were summarized to fit on only two lines and truncated in order of what was perceived as the most important first. In the full conversation screen, these edits were not summarized and presented in full. This was problematic because it resulted in a

different presentation of the same change in two different views. Also, when perceived in the context of the conversation a change to one field was not always connected to a change to another field, however, the grouping of these changes together encouraged the perception that the updates to multiple information fields were somehow related to each other.

The decision to use icons to distinguish between different information and conversation updates was problematic. The size and placement of the icons limited their utility as well as the fact that when a single update contained multiple information field changes only a single icon was used. This led to a problem users faced when they were using the conversation view to quickly scan for the history of information field changes. The users had to read and understand the update text for every update which reduced their ability to scan the conversation for only the changes to the information field they were interested in.

Due to the removal of the separate information field history screen, the only way to access the history of changes was to scroll through the conversation view. This was problematic since in order for a user to find out what all the changes done to an individual field they would have to scroll through the entire conversation history. This feedback from users led to the determination that it was necessary to provide users the ability to see all of the different changes that were done to a single information field quickly. This realization was important this for two main reasons, first, this would provide a method to easily understand the history of the conversation, second, an ability to see if a similar change was previously made so they would not duplicate the change and subsequent discussion.

9.3 Resulting Design

The current, and for the purposes of this dissertation, final iteration represents the combined learning from all the previous iterations. It was also highly influenced by the design philosophy presented earlier. In this iteration the concept of a separate information space and conversation space was drastically reduced. The design adopts the view that all user actions during the coordination are in support and part of the conversation. In that regard, the design intention is to support a coordination conversation. There may be different views into the conversation that supports users in performing their intended actions. However, the ultimate goal is to provide features to support the conversation that takes place when coordinating social-group activities. This design also focused on encouraging the use of explicit language actions over relying only on chat messages by providing users multiple benefits to themselves and the other group members. The intent, therefore, is that each action a user performs is just another part of the conversation.

Learning from previous iterations some important and significant design changes occurred.

- Removed support for multiple information field changes during a single update in favor of only one user action per update or conversational event
- Provided users the ability to add a suggestion for the different informational fields instead of only having one value per field at a time.
- Allowed users to like or dislike the different offered suggestions.
- Made different user actions visually distinct in the conversation view but not separate. Both actions and messages are first class citizens in the conversation.
- Allowed users to perform actions directly in the conversational view without having to navigate to separate informational oriented views.
- For each information field, provide a list of the different suggestions offered by the group

- For each suggestion offered, provide a filtered view of the conversation that shows the discussion around that single suggestion
- Adjusted and augmented the language and labels used in the various views.

9.3.1 Tool Components

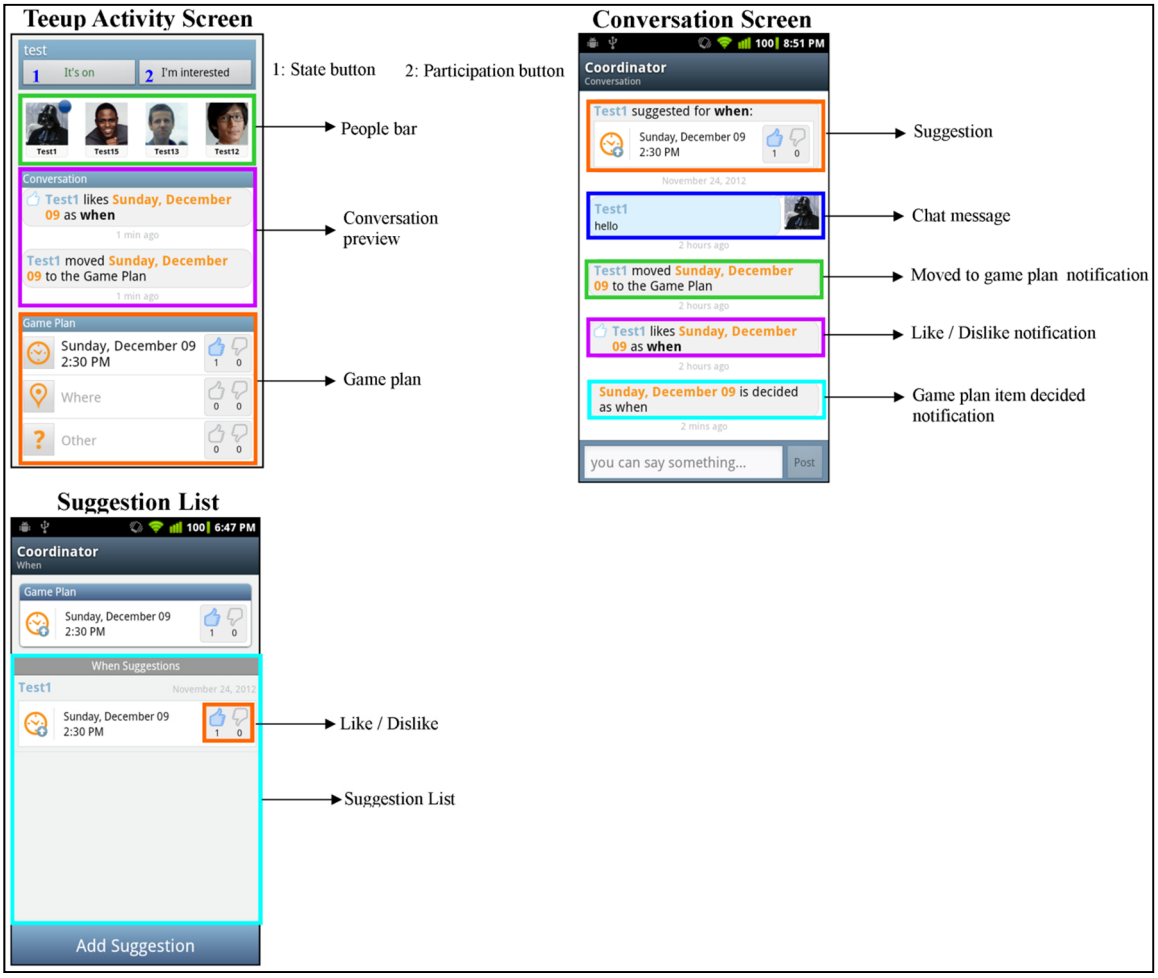

Figure 9.6 Primary interface components

9.3.1.1 The teeup activity screen. The design intent represented by this screen is to provide a shared view of all the important information about the coordination. The information provided by this screen is: who is participating in the coordination and their status, the last few actions / messages in the conversation (which are displayed the same

across the entire design), and the current state of the game plan (where the activity information fields are located).

People: This area allows users to quickly see the other people participating in the coordination and their status. It also provides a place to summarize the number of people involved in the coordination. It also provides a visual representation that indicates the current attendance status for each person displayed.

Conversation Preview: This provides a window into the conversation view by displaying the last few events have occurred. This helps facilitate a linking between the Teeup Activity Screen and the conversation.

Game Plan: This area allows the group a place to share and build their consensus about the activity's details. There are places for where, when, and an 'other' field. Each field allows any group member to provide a suggestion to appear there. This facilitates the more dynamic and self-organizational nature of social group-activity coordination. However, to help support shared agreement and understanding, similar to prior iterations, designated 'organizers' have the ability to mark each field as decided which disables the ability for other members to change a decided field.

9.3.1.2 Conversation screen. The conversation screen is more easily understood as an enhanced version of a group chat. Throughout the various iterations it was found that much of the coordination would be conducted inside of the chat space regardless of the provided language actions. It was not until the group chat messages and actions were unified did the additional coordination support mechanisms become used and viewed as beneficial. In this screen all of the actions that occur throughout the coordination are

displayed and available to be acted upon. In this way the group builds a shared history of the coordination.

9.3.1.3 Suggestion list. Suggestions are one of the major coordination support mechanisms that the tool provides. The previous iterations and the diary study provided knowledge that the activity's details are coordinated starting from the general to the specific in an iterative manner. This design supports this natural process through the concept of suggestions and the suggestion list. The suggestion list itself is a dynamically created shared artifact that allows all group members to share the knowledge about what has been suggested by whom. Each suggestion also allows other group members to indicate if they like or dislike a particular suggestion facilitating consensus building. These features provide structure to this aspect of coordination in addition to an intuitive way for users to create and access historical information.

The consequence of a conversation centric design creates an importance on providing a means of semi-structured input for the various details. This is realized by each field, when, where, and other, having tailored means of providing input depending upon field type and user intention, from unstructured text entry, to highly structured calendar entry.

9.4 Summary

The research through design methodology was instrumental in achieving this final design. It enabled the discovery of how important it is to support shared artifact building through conversational support. In the early design iterations the support for the conversational aspects of coordination was not as directly tied to, and were also separated from, the other

creation of shared artifacts and information. This is due to the early conceptualizations of conversation centric design not being as fully realized and understood. As each design iterations provided more and more understanding about the design and problem space and how these two aspects of the coordination support should best be integrated the conversation centric design perspective became more understood. Ultimately, what was learned is that the conversational process and shared artifact creation needs to be tightly integrated and be cohesive throughout the design.

Through the various design iterations and usability studies it is possible to list the most important design aspects for conversation centric design supporting social group-activity coordination.

- Provide a shared persistent conversation space that supports open activity coordination and communication that is shared among the coordinating group. The design should focus and provide means to center the conversation on the activity being coordinated. The conversation space is integral to how the group perceives the coordination history and therefore must be tightly integrated throughout the design.

- Provide structure for coordinating the important activity details, who, what, where, when, by supporting the creation of a shared artifact via the language actions that are used during social group-activity coordination (e.g., indication of attendance or participation, activity detail being changed or marked as decided).

- Shared artifacts should support and provide a means for the social-group to understand the current and previous states of consensus (i.e., where they currently are and how they got there). The actions required to create and maintain the shared artifacts should relate back to and be a means of contributing to the conversation directly.

- Not all possible interdependencies can be identified a priori and designs should provide methods for unforeseen interdependencies to be coordinated. Any design should take this into account and focus on designing for unanticipated use and avoiding explicit and implicit encoding of processes that would alter the natural actions social-groups perform when coordinating social-activities.

- Semi-structured input should be used in lieu of structured input, i.e., do not require the entry of a specific time (e.g., 4.30pm) instead provide the ability to enter ‘after work’.

- There should be a minimal disparity of work between the social-group members. Each member should be able to perceive and enjoy the benefit of the work that they perform during the coordination process.

- The design should support the social-group reaching a good enough solution, i.e., allow the group to perform coordinated satisficing instead of optimizing.

CHAPTER 10
SURVEY EXPLORING SOCIAL ACTIVITY COORDINATION BEHAVIOR

This chapter presents the results of survey collected concurrently with the experimental study presented in Chapter 11. The main objective of this survey was to reassess quantitatively the qualitative observations discussed in Chapter 8.

10.1 Research Questions

The overall research objective for this survey was informed by the results of Chapter 8

The following research questions that were investigated are:

RQ1: How difficult is social activity coordination?

RQ2: What technologies are used for social activity coordination?

RQ3: What are the preferred technologies regardless of use?

RQ4: How many social groups do people belong to and how many social activities have they recently coordinated?

RQ5: What difficulties are faced when coordinating social activities?

10.2 Method

The survey was completed concurrently with the larger experiment detailed in Chapter 11.2. At the start of the experiment, the participants were briefed and provided a short description about the experiment and what their participation would entail. After they were fully briefed, they were instructed to take this survey and answer as truthfully and completely as possible. There were experimental moderators available in order to answer any of the participants' questions and clarify any questions they may have had about the

survey. The participants' completed the survey on their own and were not guided by these moderators unless specifically asked to answer a question.

10.2.1 Procedure

The participants were told that they would be completing a survey to gather information about their prior social coordination habits and technology use. The survey was conducted electronically via computer either using the participant's own personal laptop or one provided for them. They were instructed to read each question and set of responses completely before selecting a response and if they did not understand any part of the question or responses to ask a moderator. The participants were informed they were under no time pressure to complete the survey.

10.2.2 Participants

There were a total of 84 participants that participated in the larger study that this survey was a part of. The recruitment of the participants is the same as outlined in Section 11.2.4.

The participants' ages ranged between 18 and 27 with an average of 20 and a mode of 19. Over half (64.3%) of the participants were under the age of 20. This age range is consistent with other research performed in this area and also matches those used for the diary study. The participants were queried about which country they lived / spent the longest time in (the University where this experiment was conducted has a large international population) and 71.4% (n=60) of the participants reported the United States with India at 17.9 % (n=15) being the next most popular country. The remaining reported countries were Bangladesh at 8.3% (n=7) and Pakistan at 1.2% (n=1). Undergraduates consisted of 81% (n=68) of the participants while graduate students comprised 19%

(n=16). Android users were 57.1% (n=48) while iPhone users were 39.3% (n=33) of the participants with the rest using some other type of touchscreen based phone.

10.2.3 Survey

The survey questions are detailed in Appendix A.1 and the questions directly addressing the research questions begin with Question 8. The initial questions (8-12) focus on current technological use in general and which technologies and media the participant uses for social activity coordination along which they prefer. Questions 14 through 18 focuses on the challenges and difficulties faced during social activity coordination.

Questions were informed by the diary study and our research through design process and are directly related to those prior observations.

10.3 Results

A total of 84 surveys were completed.

10.3.1 How Difficult is Social Activity Coordination?

Participants were asked how easy or difficult they find planning social activities. (see: Appendix A.1 Q13)

Table 10.1 Participant Responses to Difficulty of Planning Social Activities

N=84	**Frequency**	**Percent**	**Cumulative Percent**
Very easy	4	4.8	4.8
Easy	29	34.5	39.3
Somewhat easy	18	21.4	60.7
Not easy or difficult	12	14.3	75.0
Difficult	21	25.0	100.0

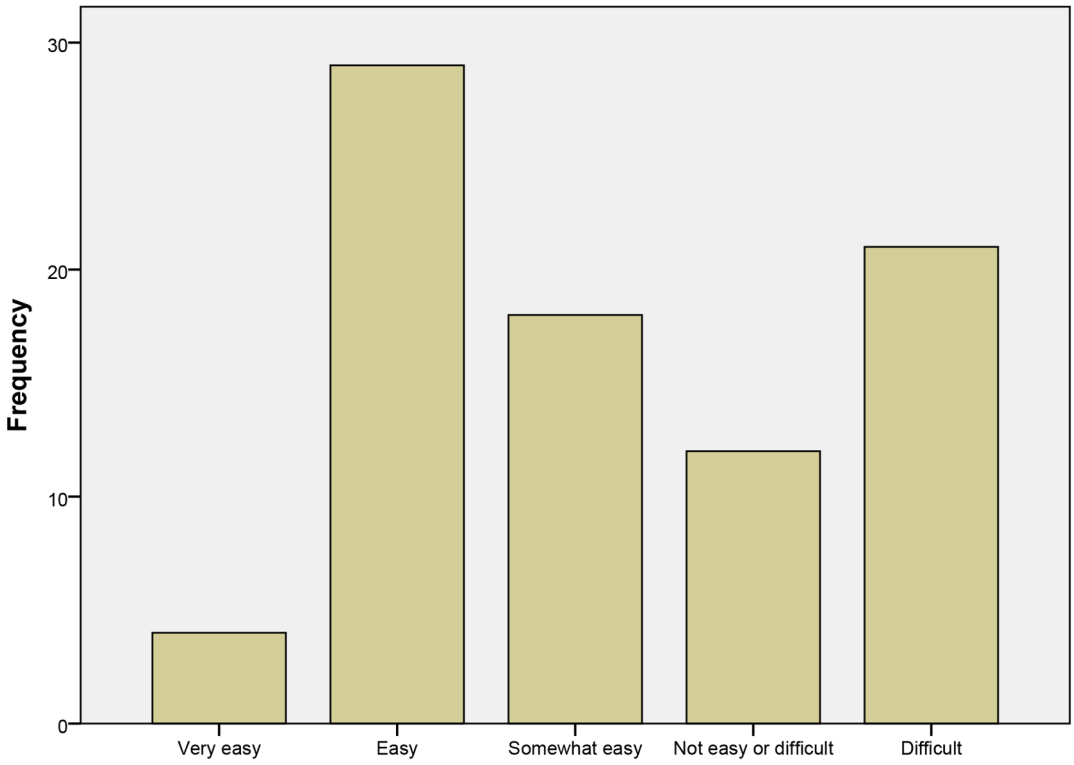

Figure 10.1 Planning social activities histogram.

There is a notable bimodal distribution with a large number of Easy and Difficult responses. Overall, these responses suggest that there is no clear perception on the difficulty of coordinating social group-activities.

The next series of questions probed further about the challenge of tracking the various pieces of information used when coordinating social activities. The results are detailed in Table 10.2 and Table 10.3.

Table 10.2 Difficulty Tracking Social Activity Coordination Information – Descriptive Statistics

N=84	**Track current agreement**	**Track suggestions**	**Track attendance**	**Keep people on the same page**	**Track who agrees with details**
Mean	3.67	3.65	3.65	4.11	4.02
Mode	2	3	3	3	5
Std. Deviation	1.58	1.46	1.62	1.51	1.57
Variance	2.49	2.13	2.64	2.29	2.46

Table 10.3 Difficulty Tracking Social Activity Coordination Information – Participant Reports

N=84	**Never (1)**	**Rarely (less than 10%)**	**Occasionally (about 30% of the time)**	**Sometimes (about 50% of the time)**	**Frequently (about 70% of the time)**	**Usually (about 90% of the time)**	**Always (7)**
Track current agreement	1.2% (n=1)	29.8% (n=25)	22.6% (n=19)	13.1% (n=11)	21.4% (n=18)	4.8% (n=4)	7.1% (n=6)
Track suggestions	2.4% (n=2)	22.6% (n=19)	25.0% (n=21)	23.8% (n=20)	14.3% (n=12)	7.1% (n=6)	4.8% (n=4)
Track attendance	6.0% (n=5)	22.6% (n=19)	23.8% (n=20)	16.7% (n=14)	14.3% (n=12)	11.9% (n=10)	4.8% (n=4)
Keep people on the same page	1.2% (n=1)	15.5% (n=13)	22.6% (n=19)	19.0% (n=16)	21.4% (n=18)	14.3% (n=12)	6.0% (n=5)
Track who agrees with details	2.4% (n=2)	19.0% (n=16)	20.2% (n=17)	14.3% (n=12)	25.0% (n=21)	14.3% (n=12)	4.8% (n=4)

About half of the participants (43.4%, 50.0%, 47.7%) reported that for 50% or more of the time they have difficulty keeping track of the currently agreed upon details, the suggestions made about those details during coordination, and the attendance status of the other group members. The last two questions, difficulty of keeping everyone on the same page 60.7% of the participants reported that for 50% or more of the time they had difficulty. There was a similar response to the task of keeping track of who has agreed on the activity details at 58.4%.

The last series of questions focused on gathering data about how the participants responded to information load as it increased during social activity coordination (Table 10.4).

Table 10.4 Responses to Questions Regarding Information Overload

N=84	**Strongly disagree**	**Disagree**	**Somewhat disagree**	**Neither agree or disagree**	**Somewhat agree**	**Agree**	**Strongly agree**
More people increases difficulty	2.4% (n=2)	3.6% (n=3)	10.7% (n=9)	8.3% (n=7)	25.0% (n=21)	27.4% (n=23)	22.6% (n=19)
More difficult the less I participate	6.0% (n=5)	15.5% (n=13)	9.5% (n=8)	22.6% (n=19)	28.6% (n=24)	16.7% (n=14)	1.2% (n=1)
Preference to leave the coordination to others	9.5% (n=8)	27.4% (n=23)	7.1% (n=6)	15.5% (n=13)	17.9% (n=15)	14.3% (n=12)	8.3% (n=7)

10.3.2 How Many Social Groups do People Belong to And How Many Social Activities Have They Recently Coordinated?

Participants were asked to report the number of social groups that they belong to. The average number of social groups is 4.5 (n=80) with a mode of 5 and a std.dev. of 1.99. The frequency and percentages of responses are detailed in Table 10.5.

Table 10.5 Reported Number of Social Groups

N=80	**Frequency**	**Percent**	**Cumulative Percent**
1.00	1	1.2	1.3
2.00	12	14.3	16.3
3.00	16	19.0	36.3
4.00	13	15.5	52.5
5.00	18	21.4	75.0
6.00	9	10.7	86.3
7.00	3	3.6	90.0
8.00	5	6.0	96.3
9.00	1	1.2	97.5
10.00	2	2.4	100.0

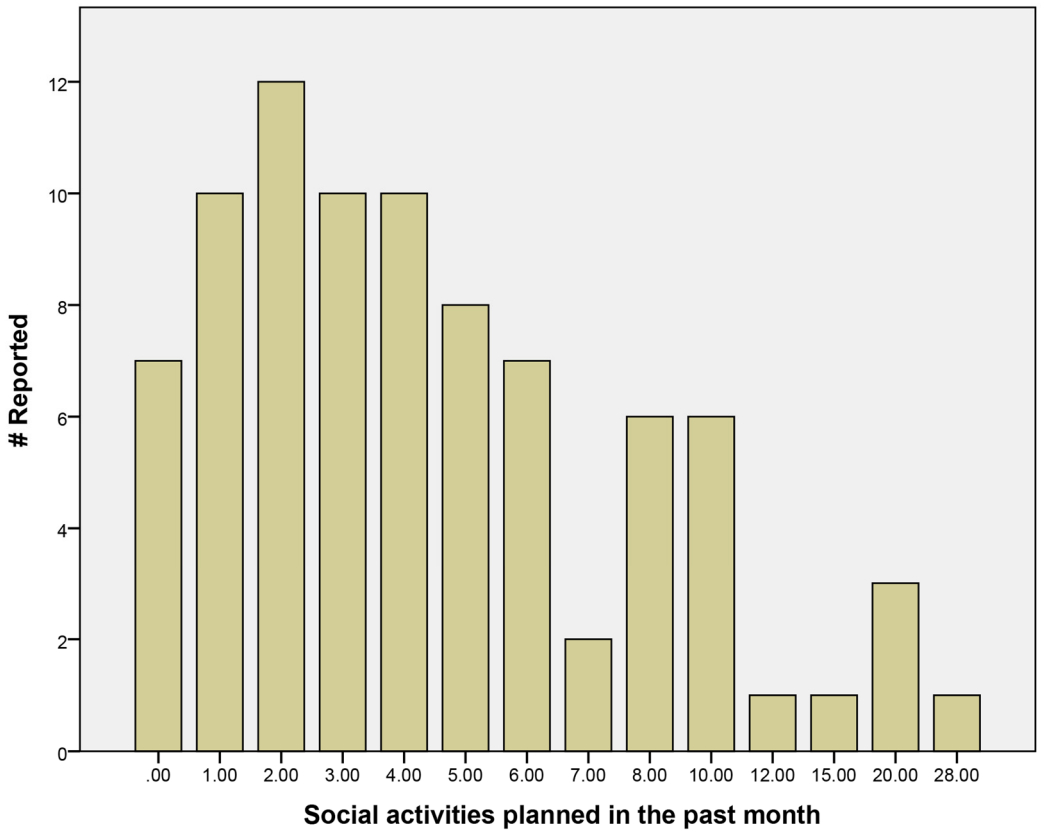

Figure 10.2 Reported social activities in the past month

Figure 10.2 shows the data the participants reported when they were asked how many social activities they were involved in planning for the past month. The average is 5 with a mode of 2 and a std.dev. of 4.99.

The next set of questions were about prompting the participants to report on their own behaviors when coordinating social activities. This data is detailed in Table 10.6 and Table 10.7 on the following page. The complete text of the questions can be found in Appendix A.1 Question 16.

Table 10.6 Questions Exploring Coordination Difficulty – Descriptive Statistics

N=84	**Planner**	**Ask others**	**Multiple Media**	**Access previous messages**
Mean	4.05	3.44	4.26	4.33
Mode	4	2	5	4
Std. Deviation	1.58	1.44	1.67	1.57
Variance	2.50	2.08	2.77	2.47

Table 10.7 Questions Exploring Coordination Difficulty – Participant Reports

N=84	**Never (1)**	**Rarely (less than 10%)**	**Occasionally (about 30% of the time)**	**Sometimes (about 50% of the time)**	**Frequently (about 70% of the time)**	**Usually (about 90% of the time)**	**Always (7)**
Planner	2.4% (n=2)	15.5% (n=13)	22.6% (n=19)	23.8% (n=20)	14.3% (n=12)	13.1% (n=11)	8.3% (n=7)
Ask others	3.6% (n=3)	28.6% (n=24)	26.2% (n=22)	16.7% (n=14)	11.9% (n=10)	13.1% (n=11)	0.0% (n=0)
Multiple Media	2.4% (n=2)	14.3% (n=12)	22.6% (n=19)	10.7% (n=9)	28.6% (n=24)	8.3% (n=7)	13.1% (n=11)
Access previous messages	1.2% (n=1)	14.3% (n=12)	11.9% (n=10)	32.1% (n=27)	15.5% (n=13)	13.1% (n=11)	11.9% (n=10)

10.3.3 What Technologies Are Used for Social Activity Coordination?

Each participant was asked about the frequency in which they use certain technologies to coordinate social activities (Appendix A.1 Q9). These technologies are: text messaging, email, phone calls, word desktop instant messaging (e.g., AIM, MSN), mobile group messaging (e.g., WhatsApp, GroupMe), Facebook chat, shared calendars, face-to-face conversations, and invite services (e.g., Facebook events, Google Invites, evites). On the next page is Table 10.8 showing the participants reports about the frequency in which they use these technologies to coordinate social activities.

Table 10.8 Technological Media Used for Social Group-Activity Coordination

N=84	**Never**	**Rarely (less than 10%)**	**Occasionally (about 30% of the time)**	**Sometimes (about 50% of the time)**	**Frequently (about 70% of the time)**	**Usually (about 90% of the time)**	**Always**
Text messaging	1.2% (n=1)	6.0% (n=5)	16.7% (n=14)	11.9% (n=10)	20.2% (n=17)	19% (n=16)	25% (n=21)
Email	7.1% (n=6)	23.8% (n=20)	23.8% (n=20)	19.0% (n=16)	14.3% (n=12)	4.8% (n=4)	7.1% (n=6)
Phone calls	1.2% (n=1)	22.6% (n=19)	15.5% (n=13)	19.0% (n=16)	21.4% (n=18)	11.9% (n=10)	8.3% (n=7)
Desktop Instant Messaging	57.1% (n=48)	25.0% (n=21)	6.0% (n=5)	6.0% (n=5)	4.8% (n=4)	0% (n=0)	1.2% (n=1)
Mobile Group Messaging	3.6% (n=3)	14.3% (n=12)	8.3% (n=7)	15.5% (n=13)	16.7% (n=14)	22.6% (n=19)	19% (n=16)
Facebook chat	17.9% (n=15)	17.9% (n=15)	11.9% (n=10)	11.9% (n=10)	17.9% (n=15)	15.5% (n=13)	7.1% (n=6)
Shared Calendars	51.2% (n=43)	21.4% (n=18)	9.5% (n=8)	8.3% (n=7)	7.1% (n=6)	1.2% (n=1)	1.2% (n=1)
Face-to-Face Conversations	0% (n=0)	8.3% (n=7)	11.9% (n=10)	20.2% (n=17)	22.6% (n=19)	17.9% (n=15)	19% (n=16)
Invite Services	28.6% (n=24)	25.0% (n=21)	15.5% (n=13)	11.9% (n=10)	9.5% (n=8)	3.6% (n=3)	6.0% (n=5)

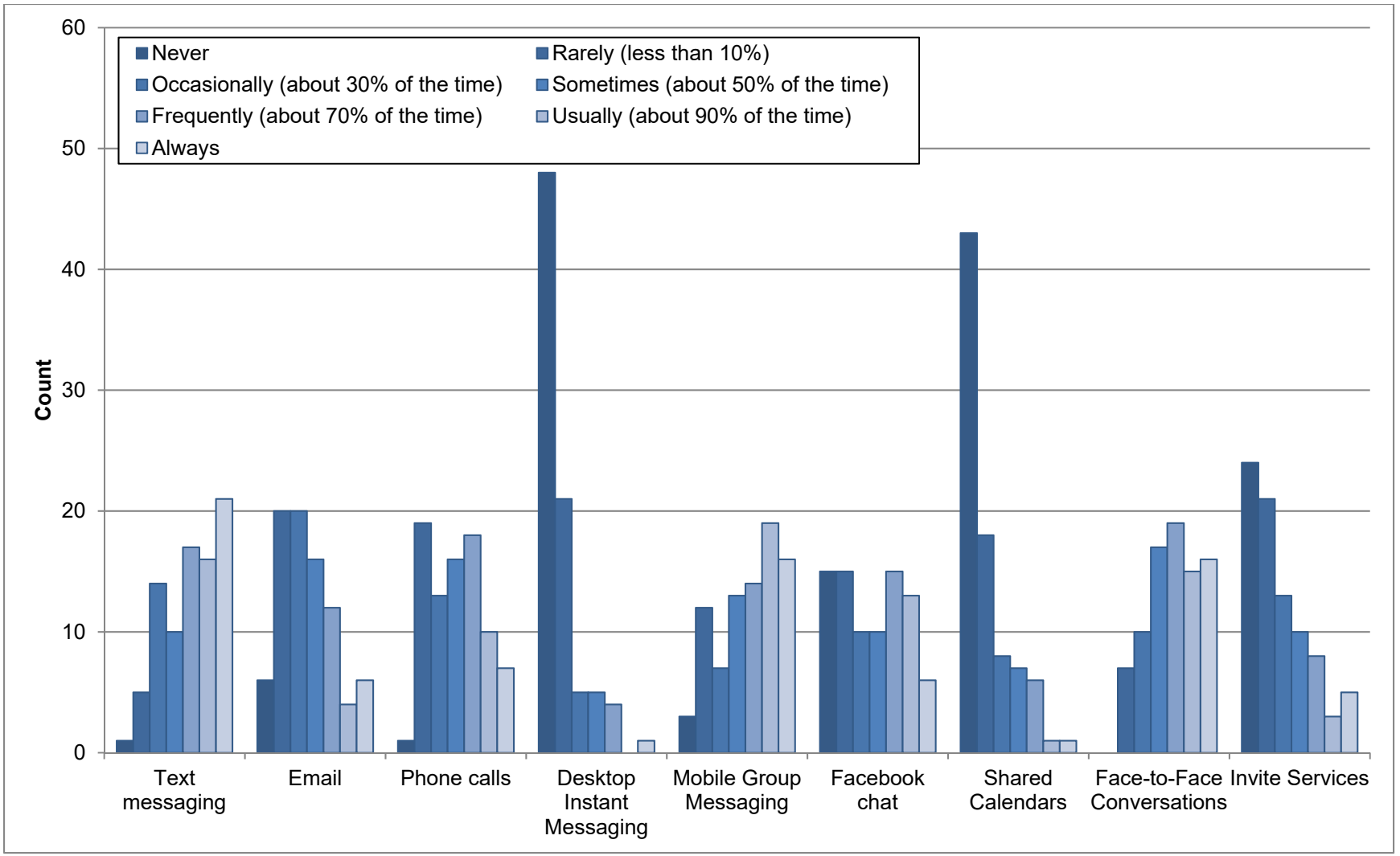

Figure 10.3 Technological media used for social group-activity coordination

The responses show that there are a large number of technological media uses to coordinate social group activities confirming the findings from Chapter 8. There is a distinct lack of use of *shared calendars, desktop instant messaging, and invite services.* Email is also very rarely used which is part of an ongoing trend noticed in previous research. The other technologies are used in similar amounts with *text messaging*, *mobile group messaging*, and *face to face conversation* showing similar distributions of reported use.

10.3.4 What Are the Preferred Technologies Regardless of Use?

The follow up to the question about the frequency of use was the preference of use, i.e., which of these technologies do the participants prefer to use to coordinate social activities (Appendix A.1 Q11). The table of responses (Table 10.9) is on the following page.

Table 10.9 Technological Preference for Social Group-Activity Coordination

N=84	**Strongly Oppose**	**Somewhat Oppose**	**Neutral**	**Somewhat Favor**	**Strongly Favor**
Text messaging	2.4% (n=2)	2.4% (n=2)	16.7% (n=14)	34.5% (n=29)	44.0% (n=37)
Email	7.1% (n=6)	23.8% (n=20)	34.5% (n=29)	21.4% (n=18)	13.1% (n=11)
Phone calls	4.8% (n=4)	9.5% (n=8)	21.4% (n=18)	32.1% (n=27)	32.1% (n=27)
Desktop Instant Messaging	32.1% (n=27)	22.6% (n=19)	33.3% (n=38)	8.3% (n=7)	3.6% (n=3)
Mobile Group Messaging	2.4% (n=2)	3.6% (n=3)	7.1% (n=6)	40.5% (n=34)	46.4% (n=39)
Facebook chat	14.3% (n=12)	10.7% (n=9)	22.6% (n=19)	32.1% (n=27)	20.2% (n=17)
Shared Calendars	38.1% (n=32)	13.1% (n=11)	26.2% (n=22)	17.9% (n=15)	4.8% (n=4)
Face-to-Face Conversations	0% (n=0)	1.2% (n=1)	16.7% (n=14)	28.6% (n=24)	53.6% (n=45)
Invite Services	20.2% (n=17)	16.7% (n=14)	17.9% (n=15)	27.4% (n=23)	17.9% (n=15)

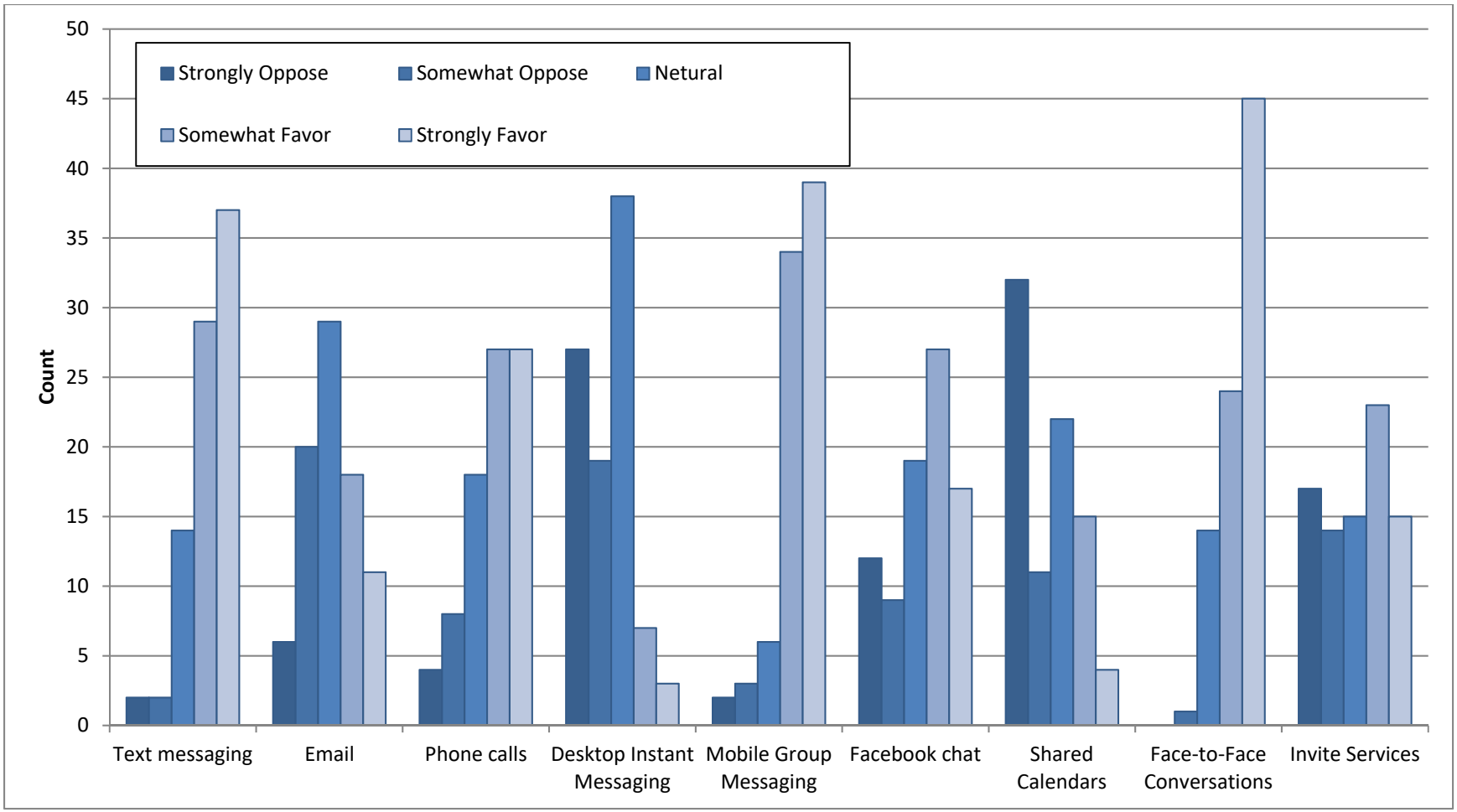

Figure 10.4 Technological preference for social group-activity coordination

The responses to these questions reinforce the findings from Chapter 8 where many people prefer *face-to-face conversation* to coordinate social group activities. Here it was reported as the most favored method. The next reported most favored method is *mobile group messaging* followed by *text messaging*.

10.4 Discussion

The overall objective of this chapter and the survey was to quantitatively assess the validity of the results presented in Chapter 8 and to also provide insight and context about the participants of the experiment presented in Chapter 11. One of the main limitations in these types of surveys is the self-reported nature of the information and while this is true of this survey as all others the questions and data attempted to be collected here was informed and inspired by previous qualitative research.

10.4.1 How Many Social Groups Do People Belong to and How Many Social Activities Have They Recently Coordinated?

The data suggests that people maintain a limited number of social groups they feel they belong to. This data is not conclusive since this question is difficult to ask due to the lack of a strong definition for what constitutes a social group. While this work has provided one definition it is not possible to assume that the participants used that same definition when responding even after being informed of it prior to completing the survey.

The participants reported that on average they participated in the coordination of five social activities, however, there were quite a few participants that reported a number well beyond the average. This indicates that for a small number of individuals the amount of social activities that they participate in the planning of is quite high. While the number of participants reporting these large numbers is too small to make any conclusive

statements this should not be dismissed. In either case this warrants future investigation. The average number of 5 social activities is consistent with the results from Chapter 8 and suggests that for most people there are not a large number of social activities that are planned per month. This provides some understanding about the lack of perceived difficulty related to planning social activities. If most people do not participant in the planning of very many activities (mode of 2) then it is understandable that they do not perceive much difficulty in their planning since the pain experienced is infrequent.

10.4.2 How Difficult Is Social Activity Coordination?

The first question presented to the participants connected to understanding the difficulty in social coordination was a question that simply asked them to report overall how easy or difficult they find planning such activities. Asking this question is not as easy as it seems. It is challenging to ask because it is multifaceted in its answer as discovered in Chapter 8. The problem stems from how the people being asked the difficulty coordinating these activities perceive difficulty when they are typically successful in achieving the goal of having a social activity. The perception of a successful outcome from the coordination (i.e., the activity is planned, scheduled, and attended) outshines the difficulties encountered during the coordination. While acknowledging that asking the question is tricky, it is still important since the collection of this data has not been attempted much in previous research.

The responses to the question are detailed in Table 10.1 and Figure 10.1. The first observation is that no participant responded that social activity coordination was “Very difficult”. The largest number of responses was for “easy” followed by “difficult” suggesting a bimodal distribution to the responses. Overall it is difficult to come to any

concrete conclusion from this overview question. However, what asking this question does show is the ambiguity that people have when assessing the difficulty of coordinating social activities when they have no reason to question their current methods.

More specific questions about coordination difficulty were asked. These questions focused on facets of social group-activity coordination that were perceived as challenges or factors that contributed to increased difficulty. The responses are detailed in Table 10.2, Table 10.3, and Table 10.4. One challenge with interpreting these numbers is the lack of prior data to compare them to. The data collected and analyzed in Chapter 8 is qualitative in nature and while it leads one to believe that this data is underreporting these challenges there is no way to conclusively say that this is the case. What it does provide is a first time measure of these data and allows for future research to have a basis for comparison.

The results show that when coordinating social group activities about half of the participants found it difficult to keep track of current agreement, suggestions, and attendance for 50% or more of the time. The difficulty for keeping everyone on the same page had about 60% of the participants reporting it difficult 50% or more of the time. It is important to note that this contrasts with the responses to the question asking about overall difficulty in coordinating social group activities where 60% of the responses were that it was at least somewhat easy. This is not remarkable when armed with the knowledge that people underreport the work involved with coordinating social activities since the actual difficulty is hidden by the success of having the activity actually occur.

10.4.3 What Technologies Are Used for Social Activity Coordination?

A research question answered by this survey was: “What technologies are used for social activity coordination?” This is an important question because it provides contextual

understanding about how the participants may perceive any intervention to support social activity coordination. Also, in a broader sense, it provides a snapshot of the current state of technological use of something that is a main part of many people's life (by many people this work is referring to those that live in highly industrial societies and it is not assumed that the majority of people alive are represented by this data).

A quick assessment of the data presented in Table 10.8 and Figure 10.3 shows a sharp contrast between the technologies that are used and those that are not. First we can see a distinct lack of current use of desktop instant messaging. This is not unexpected since the rise of the iPhone and Android devices most people have moved away from using a laptop or desktop computer as their main communication platform.

Shared calendars are also not used. It is important to note this is a lack of use of shared calendars for social activity coordination and not shared calendars in general. That being said, the lack of any substantial use of this particular technology for social activity coordination greatly diminishes any potential insight research focused on calendaring and scheduling systems can provide to those attempting to support social activity coordination. A conceit is that the participants in this survey were majority college aged individuals with little office work experience. It is possible that people who encounter calendaring systems in the workplace may then incorporate them into the social activity coordination practices; however, previous research does provide much support for this hypothesis.

Less observed from previous research but noted from the research discussed in Chapter 8 is the lack of use for invite services. These systems are predominantly useful for announcing previously decided upon activities to a large number of potential attendees. While there is a large number of responses' indicating a lack of frequent use there is

sizeable number of responses for occasional to sometimes use (30% to 50% of the time). From this data it is reasonable to assume that these services are not without any value and do provide some support to social activity coordination. What is required is a more thorough understanding of when the coordination of a social activity transition from the coordination and negotiation stage between a small group of individuals to the announcement stage and sent out to a large number of potential attendees. This is when the coordination challenge becomes tracking potential interest and attendance and less so on what, when, and where since that has already been decided by the smaller group.

The responses to the use of phone calls are counter-intuitive if viewed from a media richness perspective. If viewed from a knowledge management and conversational centric perspective, they are not. Phone calls are verbal communication, and while the transmission of the voice is now done digitally, the resulting data is ephemeral and not recorded. This greatly diminishes its utility when coordinating social activities since it is useless as an information store and unavailable for later retrieval. Additionally, even if the data was recorded its acoustic nature does not lend itself to rapid access. Also, sharing audio data is cumbersome; if one coordinating friend wishes to share some information, a text based message is much easier to share than any audio recording.

Email appears to be infrequently used. This may be counterintuitive since it is a text based media that is built into iPhone and Android devices. The responses may be due to generational affects, i.e., the participants do not use email because they did not begin communicating via email with their peers. This view is supported by previous research which shows that many individuals from this age group began their peer communication via text messaging and not email. Also, these participants have not fully entered the work

force where email use is much more prevalent and a social norm. However, emails inherent structure may also play a part in its lack of use. Email is asynchronous and there is no one shared view of the entire conversational space. A group conversation via email is also centered on a specific thread/subject/topic and requires effort on the communicating parties to maintain a coherent thread. This is in contrast to text messaging, group text messaging, and mobile group messaging, where the communication space is shared among all parties.

Text based messaging media – text messaging (SMS) or mobile group messaging – was reported as the media most used for coordinating social group activities. This is not unexpected and confirms the findings reported in Chapter 8. This suggests that there is something inherent to this media that drives this use. There are many ideas to explain this. One idea is technological inertia, people use text based media because that is what they started using and it is what those that they wish to communicate with also use. Put another way, people started using text messaging because it was similar to email, which was similar to shared terminal chat systems, which are similar to mobile group messaging systems. This would explain the similarity between the reported use patterns for text messaging and mobile group messaging as these two media share many similar attributes.

These numbers show a sharp decline in the use of desktop instant messaging services to coordinate social activities. This is in contrast to the previous studies discussed in Chapter 4, however, this result is not anomalous nor does it discount previous work. Instead it demonstrates the phenomenon that is the ever forward march of technological advance and adoption. It also highlights a decline in the use of email for this type of coordination and the continued use of text messaging with an increase in the use of mobile group messaging systems such as WhatsApp, GroupMe, and Snapchat. What is interesting

to note is lack of use of shared calendars and invite services, which is in contrast to the amount of effort and activity in researching and creating these types of systems. While these systems have their niche uses and certainly shared calendars have found their place in the workspace, at least according to some, there does not appear to be much adoption of these technologies by individuals and groups for the purposes of coordinating social activities among friends.

10.4.4 Preferred Technological Media

Participants were asked which technologies they prefer to use to coordinate social group activities. The summary of their responses are detailed in Table 10.9 and Figure 10.4. For many of the technologies the reported preference matches the reported use. Participants reported strong opposition to email, desktop instant messaging, and shared calendars.

Interestingly, there is a stronger preference to use mobile group messaging than there is of its use. This is most likely due to the fact that in order to use any one of these technologies to coordinate social activities all members of the social groups that you are coordinating with must also use the same technology. This explains higher use text messaging while it has a lower preference of use. Since it is guaranteed that if you have a mobile phone you have text messaging, which is universal, while there are multiple different and competing mobile group messaging applications.

There is a contrast between the reported use of invite services and the reported preference of use. A possible explanation for this is that the participants are unfamiliar with the intricacies of using these services to coordinate social group activities they reported a higher preference towards using them. Another explanation is that this may be another

example of social group members not all adopting the same platform for coordination and therefore the use of the technology is less than the desire to use it.

10.4.5 A Tale of Two Media

There are four standout media that the participants reported as preferred for coordinating social group activities they are, text messaging, mobile group messaging, phone calls, and face-to-face conversations. This is interesting since they represent two distinct types of media. On one hand we have text based media, text messaging, and mobile group messaging, on the other, we have phone calls and face-to-face conversations. Text messaging and mobile group messaging share very similar attributes as do phone calls and face-to-face conversations.

Phone calls as discussed earlier are much more media rich but is lacking in shared information space and the ability to easily transfer information generated during the conversation. Face-to-face conversations may be comprised of multiple people and allow for the entire group to quickly discuss and reach consensus about the activity details, however, this requires the group to be co-located and knowledge transfer to any absent members requires separate additional conversations. Both of these media are different but they share one interesting attribute in common. That attribute is that both phone calls and face-to-face conversations are social activities in of themselves. In this regard the act of coordinating a social group-activity can itself be a social activity with its own inherent motivations and benefits.

CHAPTER 11

EXPERIMENTAL STUDY OF SOCIAL GROUP-ACTIVITY COORDINATION SUPPORT

This chapter is about an evaluation of a conversationally oriented design for *social group-activity coordination* and how the various aspects and mechanisms of the design are used and help facilitate the reaching a shared understanding. The evaluation was conducted through a mixed methods laboratory study, including surveys and experiment involving the use of our social group-activity coordination support tool. The experiment compared groups of four participants performing coordination tasks using either group chat or our social activity coordination support tool (from here on referred to as the coordinator application).

11.1 Objective

The objective of this study was to understand the impact of a conversation centric design providing support for social group-activity coordination. Typical social group-activity coordination is performed using one-to-one or group based open ended communication media such as text messaging or group chat. Such tools provide limited support for consensus building, the gaining of common ground, and place considerable coordination burdens on those involved in coordinating. The coordinator application was designed to address these concerns through the provision of the following UI components:

- Current coordination state summary: This screen provides an overview of the current coordination state. The current overall state of the coordination (e.g., 'It's on'), the currently agreed upon details (date / time, place, and other), a 'peek' view into the current conversation, and the attendance state of members.

- Attendance state: The system provides the coordinating member the ability to quickly and visibly indicate their attendance state. It displays who the coordinating members are and their current attendance state (e.g., going, not going).

- Suggestions for activity details: Three coordination details are supported, date and time, place, and other. The system provides support for the creation, viewing, editing, and indication of like / dislike of these suggestions. Along with the support of separate suggestion lists for each coordination detail the suggestions are fully integrated into the conversation space.

- Conversation space: The conversation space is an enhanced group chat space that creates the view of the coordination events as a conversation. It integrates and displays all aspects of the coordination into one unified display. This space separates out the different coordination events into separate visually distant types (e.g., suggestion, attendance change, a like / dislike) that users can interact with.

The aim of this experimental study is to determine if the provision of such UI components impacts social group-activity coordination. This leads into two main research questions. RQ1) What affect, if any, does conversational support for social activity coordination have when compared to group chat and RQ2) is that conversational support desired and perceived as beneficial? These research questions are motivated by the perspective that social activity coordination difficulty can be reduced by a conversation centric design that distributes the workload across the group members and facilitates the creation of a shared information repository.

The following hypotheses are derived from the research questions.

- H1: The conversational support and shared information features are perceived as beneficial and aids social group-activity coordination.

- H2: The coordinator application reduces the cognitive load required to understand and track the coordination state.

- H3: The coordinator application increases the ability for groups to reach common ground and a shared understanding of the coordination state.

11.2 Method

This study compares two methods of coordination in a laboratory setting; throughout this chapter these methods will be referred to as treatments. In order to evaluate the coordinator application and determine its effectiveness when compared to current coordination technologies it is necessary to compare its use with what is commonly used to coordinate today. These are typically open messaging systems such as text messaging and mobile group chat.

During each study session participants completed two coordination tasks in groups of four, one coordination using an open messaging system (group-chat) and the other using the coordinator application. The two coordination tasks were selected by randomly choosing one of the four conditions for each group prior to the start of the study. These conditions were the result of counterbalancing the order of the two treatments and two scenarios. Each experimental session consists of a group of four participants coordinating two separate social activities using a different technology to coordinate going to a different place.

To reduce knowledge transfer from one coordination task to another, two different scenarios were used. If the participants were able to learn in the first task for example, where to go in NYC, then coordinating in NYC a second time would create a strong ordered effect. It was important to avoid such knowledge transfers so the two scenarios instructed the participants to coordinate similar task but in different locations. Also, it was important to limit the participants' ability to reuse coordination details, e.g., travel or meeting times, from one coordination task to another. Therefore, separate schedules for each scenario were devised to remove the ability to transfer the information about schedule availability from

one coordination task to another. This also had the added benefit of removing variability that could be introduced if the participants used their actual schedule. In addition, providing a fixed schedule for each participant reduces the participant's risk during the study and provided for a certain level of privacy.

The data were collected primarily via surveys which the participants completed at key points during each of the coordination tasks and at the conclusion of the session. Additional data were collected by recording all messaging actions made during each condition.

11.2.1 Conditions

Two treatments and two different scenarios were counterbalanced into four conditions. Each treatment is a different technological intervention and each scenario is where the groups will coordinate where they are going. The treatments: 1) group chat only and 2) coordinator application. The two scenarios: 1) Visiting New York City and 2) Visiting Philadelphia. Table 11.1 shows how they were combined into the four conditions.

Table 11.1 Counterbalanced Treatments and Scenarios

Condition 1.

Treatment – Scenario 1: Group Chat – NYC

Treatment – Scenario 2: Coordinator – Philadelphia

Condition 2.

Treatment – Scenario 1: Group Chat – Philadelphia

Treatment – Scenario 2: Coordinator – NYC

Condition 3.

Treatment – Scenario 1: Coordinator – NYC

Treatment – Scenario 2: Group Chat – Philadelphia

Condition 4.

Treatment – Scenario 1: Coordinator – Philadelphia

Treatment – Scenario 2: Group Chat – NYC

The conditions were randomly assigned for each study session by grouping the sessions in blocks of four and randomly assigning the order of conditions for each block. This allowed the study to be completed at the end of any block and maintains a balanced number of conditions completed throughout the study duration.

Each participant was provided a set daily schedule that was different across participants for each scenario. The participants were instructed to use the provided schedule in lieu of their own personal schedule. It provided them the times when they were free, in class, at work, sitting an exam, or busy. This eliminated the participants' ability to reuse prior coordination information across conditions and forced the participants to negotiate

distinct date and times for their activity and could not reuse the prior coordination in the second condition.

To provide some context for the coordination tasks, the participants were informed that NJIT is allowing students to attend and/or participate in a group cultural event / activity for a humanities course that they are all attending and that they will only be provided reimbursement for if they go as a group. In the NYC scenario the group was instructed to coordinate going to a cultural event in New York City (the 5 boroughs only). In the Philadelphia scenario, the group was instructed to coordinate going to a cultural event in the Philadelphia metropolitan area. Regardless of condition the participants are instructed that they must decide on the following: where they are going, when they are going, who is going, and when they will leave. They are also informed that they will need to coordinate any other details required to attend (e.g., if they are driving: who, if they take taking mass transit: when, where).

New York City and Philadelphia were the cities chosen for the scenarios for the following reasons. First, the two cities are the two closest major metropolitan areas with similar size near prospective participants (NYC is 30 minutes by train from NJIT and Philadelphia is approximately 1 hour and 30 minutes). Second, due to the history of these two cities they both offer a large number of cultural activities and events across a wide range of interests, availability, cost, etc., and would provide many choices for the participants during the coordination. Third, they are both easily accessible via many transportation options, from mass transit to travel by car. Fourth, they were assumed to be familiar to the participants due to their geographic proximity.

11.2.2 Procedure

The following is a high level overview of the procedure for this experiment

Table 11.2 High Level Procedure Overview

Briefing and Intake Survey	1. The participants were brought together and informed that they will be participating in coordinating social group-activities. 2. They completed the Intake Survey (discussed in chapter 10) that collects general demographic information, how often they participate in social group-activity coordination, the various technologies they use to coordinate those activities, their preferences and perceptions of the various technologies, and their overall familiarity with the other participants in their group. 3. The participants were given instruction about the technological support they will be using for each scenario / condition.
Coordination #1	4. The coordination task order was randomly assigned prior to the start of the session based on the condition. The participants were then informed what social group-activity they will be coordinating based on the randomized scenario and condition. 5. The participants then began the first coordination task.
Post Coordination Survey #1	6. At the conclusion of the coordination task the participants completed survey asking them questions about the coordination they just completed.
Coordination #2	7. The participants performed the second counterbalanced coordination task.
Post Coordination Survey #2	8. At the conclusion of the coordination task the participants completed a survey asking them questions about the coordination they just completed

Exit Survey and Debriefing	9. At the conclusion of both coordination tasks the participants completed an overall survey asking questions pertaining to the related to both coordination tasks. 10. The participants were then debriefed and were given the opportunity to discuss their participation in the study.

11.2.3 Surveys and Data Collection

As previously noted data was collected during this study primarily by surveys that the participants completed at key points. The second method of data collection is the record of each participant's actions during the study. These are the actions that are received by each group member and displayed in the coordinator application or in the group chat. These recorded actions did not include any user interface interactions. The following sections will discuss the collected the data and their purpose. All survey questions asked are located in Appendix A.

11.2.3.1 Post-coordination survey. At the conclusion of each coordination task the participants completed a survey to collect the following data.

Number of suggestions: The participants were asked for their estimation of the number of suggestions made for the activity details supported by the coordinator application and their estimation of the number of suggestions made for the activity details not supported by the coordinator application.

Shared understanding: The participants were asked to estimate their level of confidence about the shared understanding of the activity details. The questions asked about details that coordinator application supported and did not support.

Satisfaction: The participants were asked questions to determine their satisfaction with the outcome of the coordination.

Participation: The participants were asked to rank the level of participation of the other members of their coordinating group and their level of participation during that coordination task.

Level of satisfaction with the coordination outcome: Participants were asked about their level of satisfaction about the various activity details.

Perceived Cognitive Load: The participants were asked which activity details were difficult to keep track of, their confidence in how much shared understanding there was with the other group members, and the ease or difficulty there was in reaching consensus and shared understanding.

The purpose of these questions is to gather data that can be used to answer hypothesis and research questions that compare the different treatments, scenarios, and coordination tasks.

11.2.3.2 Exit Survey. At the completion of both conditions the subjects were asked to complete an exit survey about the following:

Perceived Cognitive Load: Participants were asked to compare the level of difficulty between the two conditions for keeping track of the suggestions for the activity details split between those that the coordinator application supports and does not support.

Features Facilitating Coordination: The participants were asked questions about which features of the coordinator application they felt facilitated the coordination. These questions focused on understanding the contribution each feature had individually and how the features interacted together as a whole. They were also asked questions to understand

which features (if any) they would have preferred to have had access to during the group chat condition.

Previous coordination: The subjects were asked questions to gather data about which condition they perceived to be more similar to how they typically coordinate and what activities they typically coordinate. They were also asked questions about which technological support they would prefer for future coordination (either the coordinator application or the group chat).

11.2.3.3 Coordination Conversation Data. The coordination tasks were performed using client-server software that facilitated the collection of the following data for each coordination task.

Time to complete: The time required to complete the coordination for each condition.

Number of actions: This is the number of actions performed by each participant recorded during the coordination.

Number of suggestions: The number of suggestions made in during the coordination application treatment.

Number of like / dislikes: The number of likes / dislikes / indication of agreement / acceptance or rejection of the suggestions made during the coordination application treatment.

11.2.4 Participants

In total there were 84 participants in 21 study sessions. One additional session was conducted due to incomplete surveys. Each of the 21 study sessions group of four university students. The participants were recruited via flyers placed throughout the

campus, email, the honors society, and visiting supporting instructors' classes. They were instructed to complete a pre-study survey that required them to agree to the study design and also provide information about their available times for session scheduling. Groups were created when enough participants for a particular session were available. Each participant was then instructed to report to the study session area and provided contact details in case they were delayed.

The participants' ages ranged between 18 and 27 with an average of 20 and a mode of 19. Over half (64.3%) of the participants were under the age of 20. This age range is consistent with other research performed in area and also matches those used for the previous study. The participants were queried about which country they lived / spent the longest time in (the University where this experiment was conducted has a large international population) and 71.4% (n=60) of the participants reported the United States with India at 17.9 % (n=15) being the next most popular country. The remaining reported countries were Bangladesh at 8.3% (n=7) and Pakistan at 1.2% (n=1). Undergraduates consisted of 81% (n=68) of the participants while graduate students comprised 19% (n=16). Android users were 57.1% (n=48) while iPhone users were 39.3% (n=33) of the participants with the rest using some other type of touchscreen based phone.

11.3 Results

11.3.1 Condition, Treatment, and Scenario Order Effect

As stated previously the experimental design of this study is to have a group of four participants conduct two coordination tasks comparing two treatment-scenario combinations. These combinations were counterbalanced and randomly selected prior to

the study session. This was motivated to control for and reduce the knowledge transfer from one coordination task to another. A result of this design is that each participant experienced two coordination tasks with different treatment scenario combination for each task. At the end of each coordination task the participants completed the Post Coordination survey. The responses to this survey provide data that can be examined not only within participants but also between participant grouped by scenario, treatment, and scenario treatment combinations. However, before the data can be examined it is necessary to determine if the initial assumptions of the study design holds and if not how to proceed in regards to further data analysis.

The three main assumptions of the study design are:

1) That there would be an observable difference between the two treatments.
2) That a treatment being part of the first or second coordination task would have no impact on the reported data.
3) That the two scenarios are similar and that they would not affect the participants' responses to the treatment.

To begin checking these assumptions, the data for the Post Coordination Survey was grouped by treatment scenario and for each set of questions a Kruskal-Wallis H test for differences between these groups was performed. This test determines if there is any statistically significant difference between the treatment scenario groups. This test was not used for hypothesis testing but only to determine if there was a statistical difference between treatment scenario groups and to confirm that additional analysis is required. A failure of this test to return any significant results would indicate that there were not differences in participants' reports during the study. As such, the interpretation of the

Kruskal-Wallis H test results only allows for the conclusion that the experiment affected the participants' response.

The result of the analysis is reported in Table 11.3. For all but one of the questions the null hypothesis that the mean ranks are similar is rejected. These results indicate that there is some effect between the different treatment scenario groups that affected the way the participants responded.

Table 11.3 Post-Coordination Survey Kruskal-Wallis H Test Results

	Descriptive		**Test Statistics**	
Understand when the group reached agreement about				
date and time	$\bar{x}$=5.36	sd.=1.58	H(3, N=166)=4.95,	p=0.175
place	$\bar{x}$=5.74	sd.=1.29	H(3, N=166)=14.12,	p=**0.003***
other details	$\bar{x}$=5.39	sd.=1.36	H(3, N=166)=9.16,	p=**0.027***
Difficultly to keep track of the suggestions				
date and time	$\bar{x}$=5.31	sd.=1.62	H(3, N=166)=13.44,	p=**0.004***
place	$\bar{x}$=5.64	sd.=1.33	H(3, N=166)=20.34,	p=**0.000***
other details	$\bar{x}$=5.19	sd.=1.38	H(3, N=166)=11.21,	p=**0.011***
Difficulty for the group to reach agreement				
date and time	$\bar{x}$=5.23	sd.=1.74	H(3, N=166)=9.08,	p=**0.028***
place	$\bar{x}$=5.54	sd.=1.51	H(3, N=166)=10.77,	p=**0.013***
other details	$\bar{x}$=5.40	sd.=1.39	H(3, N=166)=13.78,	p=**0.003***
Difficulty for the group to reach shared understanding				
date and time	$\bar{x}$=5.49	sd.=1.57	H(3, N=166)=9.69,	p=**0.021***
place	$\bar{x}$=5.75	sd.=1.34	H(3, N=166)=24.21,	p=**0.000***
other details	$\bar{x}$=5.54	sd.=1.40	H(3, N=166)=14.91,	p=**0.002***

Table 11.3 (cont) Post-Coordination Survey Kruskal-Wallis H Test Results

	Descriptive	**Test Statistics**
For date and time how difficult was it to		
coordinate	$\bar{x}$=2.75 sd.=1.63	H(3, N=166)=13.91, p=**0.003***
keep track of suggestions	$\bar{x}$=2.86 sd.=1.65	H(3, N=166)=18.02, p=**0.000***
keep track of who liked a suggestion	$\bar{x}$=2.75 sd.=1.65	H(3, N=166)=20.01, p=**0.000***
understand new suggestions were made	$\bar{x}$=2.31 sd.=1.28	H(3, N=166)=13.50, p=**0.004***
understand when detail was agreed	$\bar{x}$=2.25 sd.=1.26	H(3, N=166)=16.36, p=**0.001***
understand when agreed information changed	$\bar{x}$=2.45 sd.=1.39	H(3, N=166)=10.31, p=**0.016***
For date and time how difficult was it to		
coordinate	$\bar{x}$=2.31 sd.=1.40	H(3, N=166)=17.92, p=**0.000***
keep track of suggestions	$\bar{x}$=2.23 sd.=1.38	H(3, N=166)=13.60, p=**0.004***
keep track of who liked a suggestion	$\bar{x}$=2.28 sd.=1.42	H(3, N=166)=19.20, p=**0.000***
understand new suggestions were made	$\bar{x}$=2.04 sd.=1.19	H(3, N=166)=15.60, p=**0.001***
understand when detail was agreed	$\bar{x}$=2.11 sd.=1.27	H(3, N=166)=20.29, p=**0.000***
understand when agreed information changed	$\bar{x}$=2.10 sd.=1.27	H(3, N=166)=24.11, p=**0.000***
* p <= 0.05; ** p <= 0.1		

To test assumptions one and three, the data was examined across treatment and scenario. The method used was a within participant test that compares the results of the Post Coordination Survey to determine what if any aspects affect the responses. The expected result would be that there would be a significant difference in responses when comparing across treatments but not across scenarios or the main assumptions to hold. The results of the Wilcoxon signed-rank test when examining within participants' responses across scenarios found a significant difference ($p <= 0.05$) between responses for 19 out of 25 questions (see Appendix C for detailed tables). The results of the Wilcoxon signed-rank test when examining within participant responses across treatment found a significant difference ($p <= 0.05$) between responses for 7 out of the 25 questions. This result shows that the scenario affected the responses to most of the questions while the treatment did not. This implies that the scenario had a greater effect on the participants' responses to the questions than the treatment did when examining using a within participant test. As a result, to test assumption 1 and the hypothesis it is necessary to examine the effect of the treatment separately for each scenario.

To test the second assumption, the data was split by scenario and treatment and tested to see if the task order of the treatment had any effect on the responses. This test was done using the Mann-Whitney U test. The result of the test showed that the order of treatment did not impact the responses. This allows for combining data regardless of task order for the subsequent analysis.

The following sections will provide the results of testing the main hypothesis. Each section will contain subsections that briefly detail the question and response format, followed by data tables and a brief summary of the results.

11.3.2 Descriptive Statistics – Session Completion Exit Survey Question Responses

This section provides tables and figures containing the descriptive statistics from the exit survey. This survey was completed by the participants at the end of both coordination tasks and was used to collect various data comparing the coordinator application to group-chat.

11.3.2.1 Coordinator application compared to current technologies. The data presented in this section are from questions that asked the participants to report on how much better or worse they feel the coordinator application compares to various other technologies used to coordinate social group activities (Appendix A.3 Q7). The tables and figures on the following pages detail the participants' responses.

Table 11.4 Coordinator Application Compared to Current Technologies – Descriptive Statistics

N=81	**Mean**	**Mode**	**Std. Deviation**	**Variance**
Text messaging	5.26	6	1.37	1.87
Email	5.68	7	1.39	1.92
Phone calls	4.91	6	1.62	2.63
Desktop Instant Messaging (e.g., AIM, MSN)	5.58	7	1.35	1.82
Mobile Group Messaging (e.g., WhatsApp, GroupMe)	4.99	6	1.44	2.09
Facebook chat	5.46	6	1.40	1.95
Shared Calendars	5.47	6	1.34	1.80
Face-to-face conversations	4.17	4	1.78	3.17
Invite services (e.g., Facebook events, Google Invites, e-vites)	5.38	6	1.31	1.71

Table 11.5 Coordinator Application Compared to Current Technologies – Details

N=81	**Much worse (1)**	**Worse**	**Somewhat worse**	**Neither better or worse**	**Somewhat better**	**Better**	**Much better (7)**
Text	0.0% (n=0)	3.7% (n=3)	7.4% (n=6)	18.5% (n=15)	19.8% (n=16)	30.9% (n=25)	19.8% (n=16)
Email	0.0% (n=0)	3.7% (n=3)	3.7% (n=3)	16.0% (n=13)	8.6% (n=7)	33.3% (n=27)	34.6% (n=28)
Phone	2.5% (n=2)	8.6% (n=7)	7.4% (n=6)	19.8% (n=16)	16.0% (n=13)	29.6% (n=24)	16.0% (n=13)
Desktop IM	0.0% (n=0)	2.5% (n=2)	3.7% (n=3)	19.8% (n=16)	13.6% (n=11)	28.4% (n=23)	32.1% (n=26)
Mobile GM	1.2% (n=1)	7.4% (n=6)	4.9% (n=4)	19.8% (n=16)	23.5% (n=19)	30.9% (n=25)	12.3% (n=10)
Facebook chat	2.5% (n=2)	3.7% (n=3)	2.5% (n=2)	9.9% (n=8)	19.8% (n=16)	42.0% (n=34)	19.8% (n=16)
Shared Calendars	1.2% (n=1)	1.2% (n=1)	3.7% (n=3)	19.8% (n=16)	17.3% (n=14)	30.9% (n=25)	25.9% (n=21)
Face-to-face	11.1% (n=9)	6.2% (n=5)	16.0% (n=13)	24.7% (n=20)	16.0% (n=13)	14.8% (n=12)	11.1% (n=9)
Invite services	1.2% (n=1)	0.0% (n=0)	6.2% (n=5)	19.8% (n=16)	19.8% (n=16)	30.9% (n=25)	22.2% (n=18)

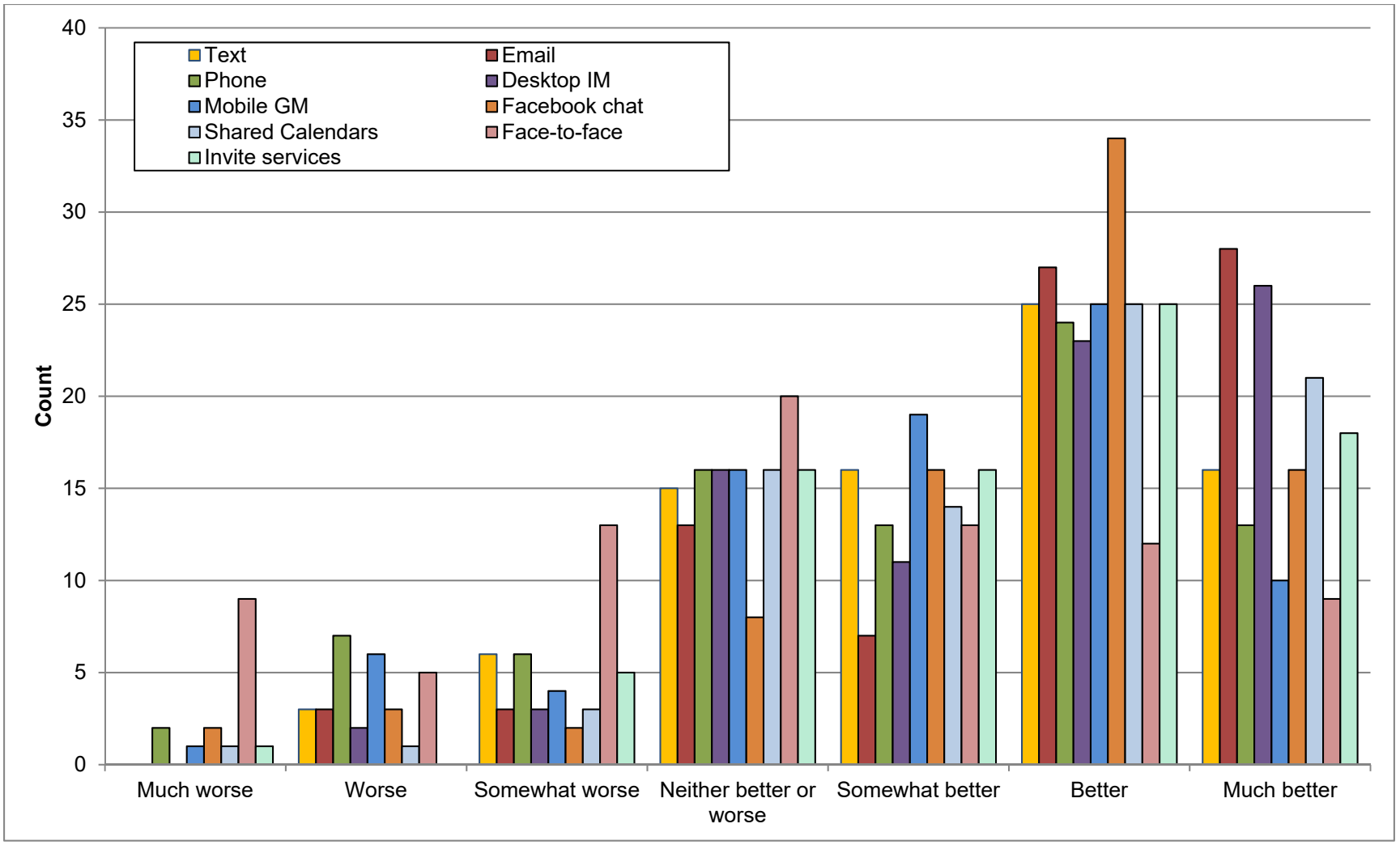

Figure 11.1 Coordinator application compared to current technologies – combined histogram.

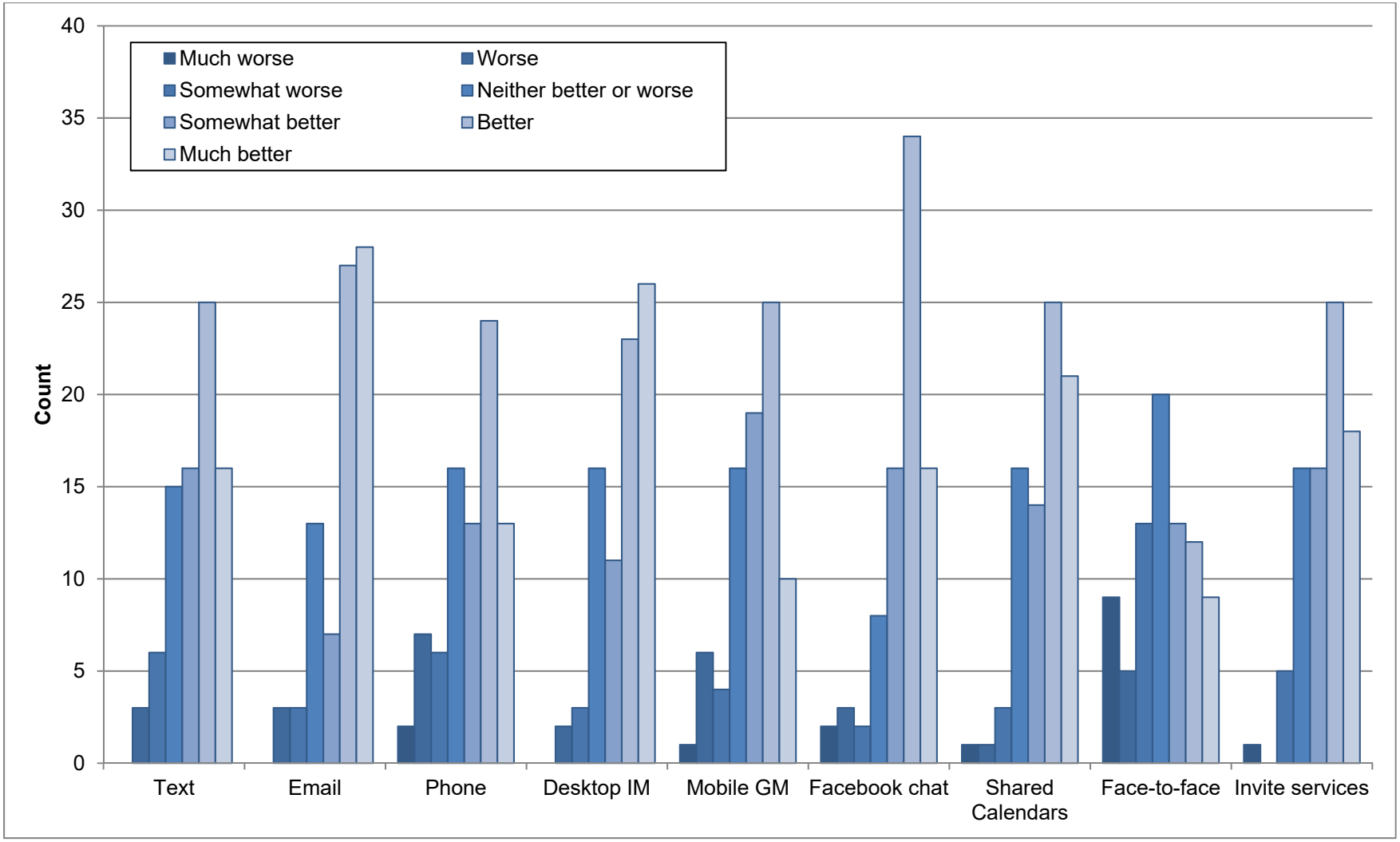

Figure 11.2 Coordinator application compared to current technologies – individual histograms.

Table 11.6 Coordinator Application Compared to Current Technologies – Sorted by Mean

	Mean (1-Much Worse; 6-Much Better)
Face-to-face conversations	4.17
Phone calls	4.91
Mobile Group Messaging (e.g., WhatsApp, GroupMe)	4.99
Text messaging	5.26
Invites services (e.g., Facebook events, Google Invites, e-vites)	5.38
Facebook chat	5.46
Shared Calendars	5.47
Desktop Instant Messaging (e.g., AIM, MSN)	5.58
Email	5.68

These results show that for all but face-to-face conversations the participants reported that the coordinator application would be better for coordinating social group activities.

11.3.2.2 Willingness to discontinue use of current technologies in favor of the coordinator application. These questions focused on asking the participants if they would give up using certain technologies for coordinating social group activities if the other people they typically coordinate with switched as well (Appendix A.3 Q8). The purpose was to reinforce the previous data and also to gather some idea about their intent of use. Intent of use probes are difficult to ask and to frame in the proper context. As previously discussed, it is possible to assume that when coordinating social activities the choice of technology is not always up to the person who initiates the coordination. For example, if a friend will only use text messaging and you want to do something with this friend and the other members of the social group then at the least you must coordinate with this friend using text messaging. The question here is framed in a context such that the participant is

asked: if they had the choice, which technologies would they give up using in favor of the coordinator application they just experienced.

Table 11.7 Use Coordinator Application Instead – Descriptive Statistics

	Mean	Mode	Std. Deviation	Variance
Text messaging	4.11	5	1.94	3.75
Email	4.88	6	1.97	3.88
Phone calls	3.99	6	2.04	4.16
Desktop Instant Messaging (e.g., AIM, MSN)	5.72	7	1.44	2.08
Mobile Group Messaging (e.g., WhatsApp, GroupMe)	4.36	6	1.82	3.31
Facebook chat	4.65	4, 6	1.82	3.30
Shared Calendars	5.40	7	1.61	2.59
Face-to-face conversations	3.38	1	1.91	3.64
Invite services (e.g., Facebook events, Google Invites, e-vites)	4.95	7	1.84	3.37

Table 11.8 Use Coordinator Application Instead – Reported Data

N=81	**Strongly disagree**	**Disagree**	**Somewhat disagree**	**Neither agree or disagree**	**Somewhat agree**	**Agree**	**Strongly agree**
Text	14.8% (n=12)	9.9% (n=8)	11.1% (n=9)	17.3% (n=14)	18.5% (n=15)	17.3% (n=14)	11.1% (n=9)
Email	8.6% (n=7)	11.1% (n=9)	6.2% (n=5)	4.9% (n=4)	18.5% (n=15)	28.4% (n=23)	22.2% (n=18)
Phone	13.6% (n=11)	16.0% (n=13)	14.8% (n=12)	16.0% (n=13)	7.4% (n=6)	17.3% (n=14)	14.8% (n=12)
Desktop IM	1.2% (n=1)	2.5% (n=2)	4.9% (n=4)	12.3% (n=10)	11.1% (n=9)	29.6% (n=24)	38.3% (n=31)
Mobile GM	7.4% (n=6)	11.1% (n=9)	14.8% (n=12)	18.5% (n=15)	13.6% (n=11)	22.2% (n=18)	12.3% (n=10)
Facebook chat	7.4% (n=6)	7.4% (n=6)	9.9% (n=8)	19.8% (n=16)	17.3% (n=14)	19.8% (n=16)	18.5% (n=15)
Shared Calendars	2.5% (n=2)	3.7% (n=3)	6.2% (n=5)	18.5% (n=15)	9.9% (n=8)	27.2% (n=22)	32.1% (n=26)
Face-to-face	24.7% (n=20)	13.6% (n=11)	14.8% (n=12)	14.8% (n=12)	13.6% (n=11)	14.8% (n=12)	3.7% (n=3)
Invite services	4.9% (n=4)	4.9% (n=4)	13.6% (n=11)	21.0% (n=17)	6.2% (n=5)	21.0% (n=17)	28.4% (n=23)

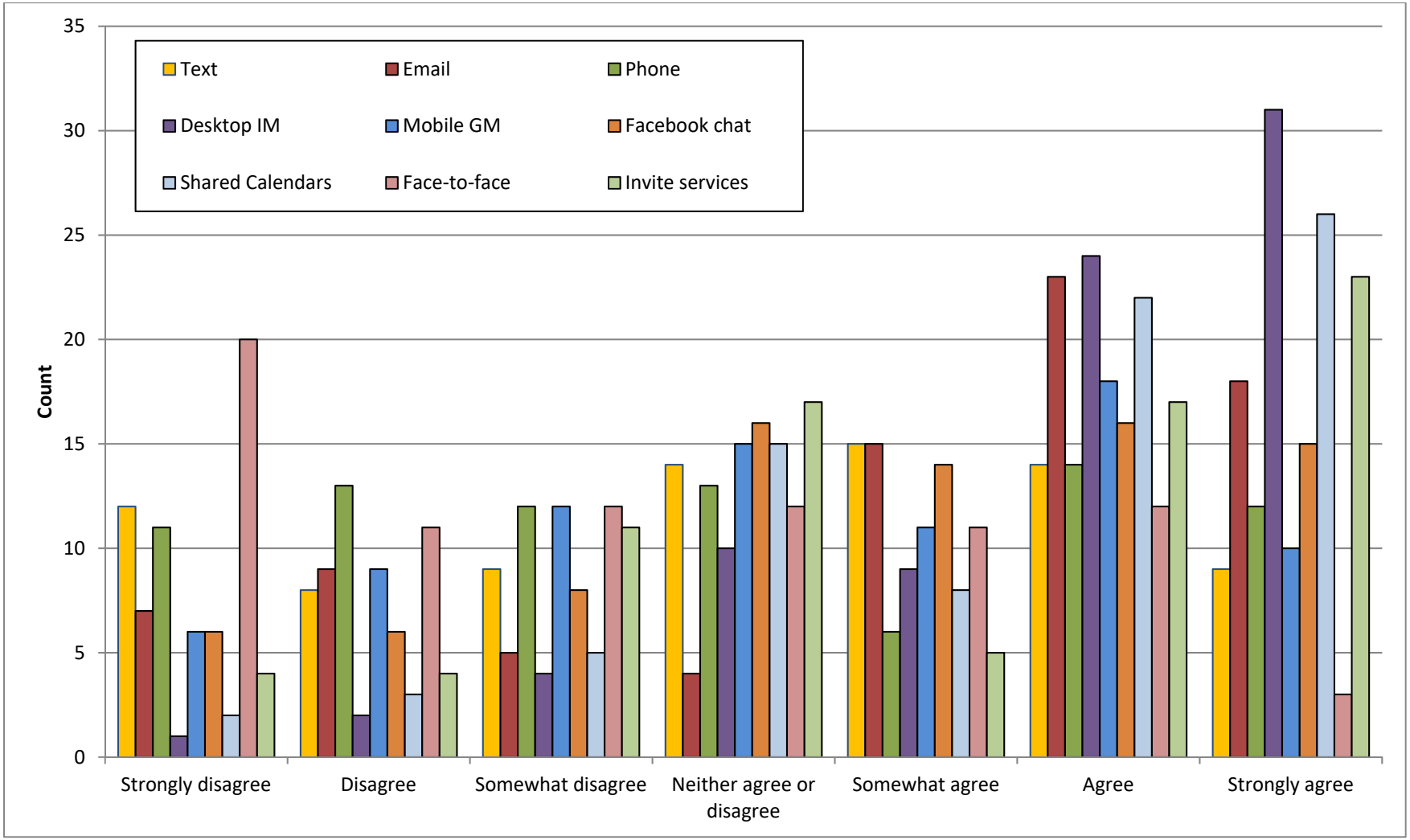

Figure 11.3 Use coordinator application instead – combined histogram.

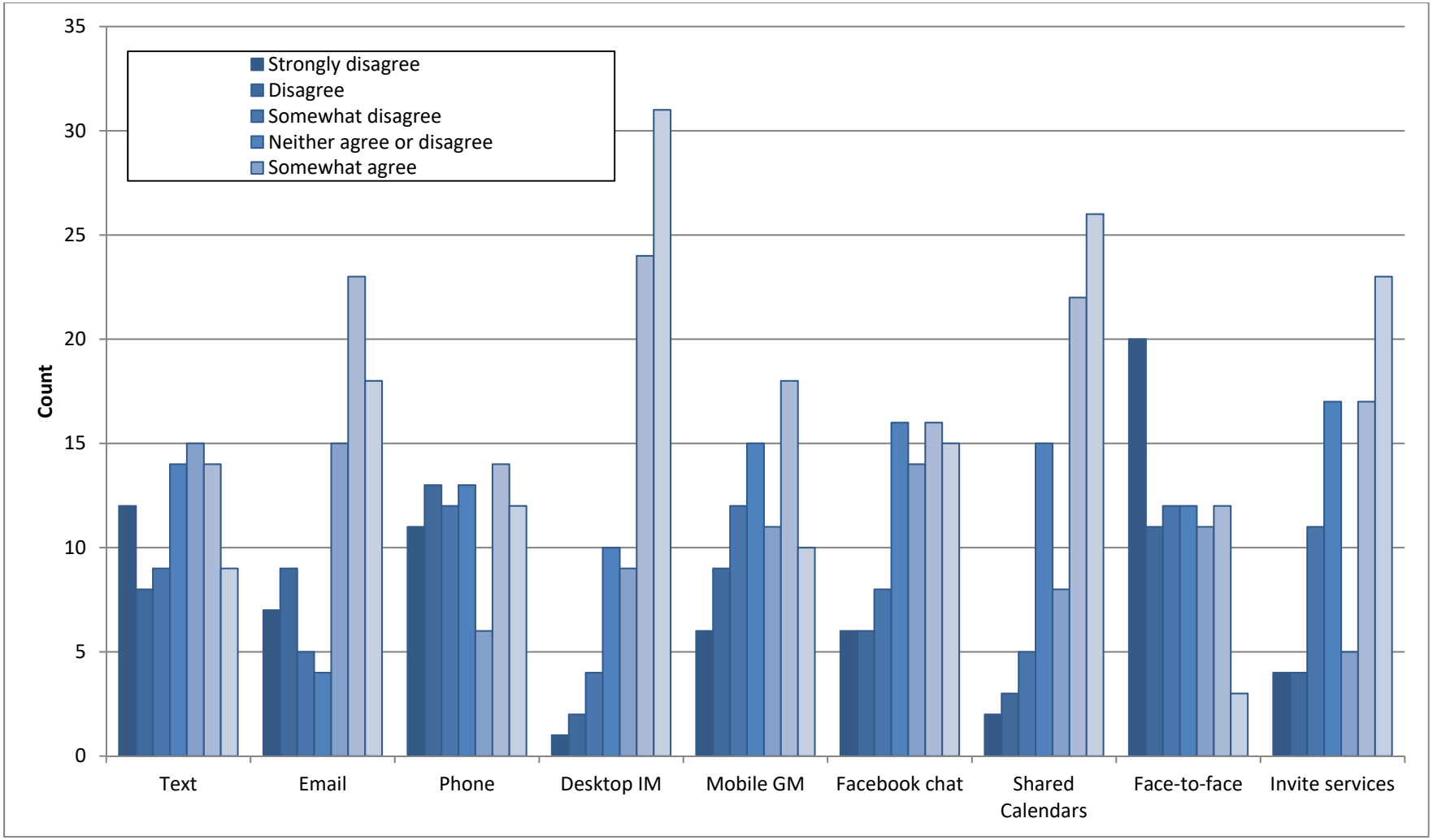

Figure 11.4 Use coordinator application instead – individual histogram.

11.3.2.3 Discontinue use of various technologies.

The last set of questions asked which technologies the participants would stop using if the other people they coordinate stopped using them as well (Appendix A.3 Q9). It was posed as a binary query to force the participants to make a decision. The reported data is in the following tables and figures.

Table 11.9 Discontinue Use If Others Do So – Descriptive Statistics

N=81	Mean	Mode	Std. Deviation	Variance
Text messaging	1.62963	2	0.485913	0.236111
Email	1.481481	1	0.50277	0.252778
Phone calls	1.604938	2	0.49191	0.241975
Desktop Instant Messaging (e.g., AIM, MSN)	1.111111	1	0.316228	0.1
Mobile Group Messaging (e.g., WhatsApp, GroupMe)	1.407407	1	0.494413	0.244444
Facebook chat	1.37037	1	0.485913	0.236111
Shared Calendars	1.209877	1	0.409758	0.167901
Face-to-face conversations	1.716049	2	0.453723	0.205864
Invites services (e.g., Facebook events, Google Invites, e-vites)	1.271605	1	0.447559	0.200309

Table 11.10 Discontinue Use If Others Do So – Reported Data

N=81	Yes (1)	No (2)
Text	37.0% (n=30)	63.0% (n=51)
Email	51.9% (n=42)	48.1% (n=39)
Phone	39.5% (n=32)	60.5% (n=49)
Desktop IM	88.9% (n=72)	11.1% (n=9)
Mobile GM	59.3% (n=48)	40.7% (n=33)
Facebook chat	63.0% (n=51)	37.0% (n=30)
Shared Calendars	79.0% (n=64)	21.0% (n=17)
Face-to-face	28.4% (n=23)	71.6% (n=58)
Invite services	72.8% (n=59)	27.2% (n=22)

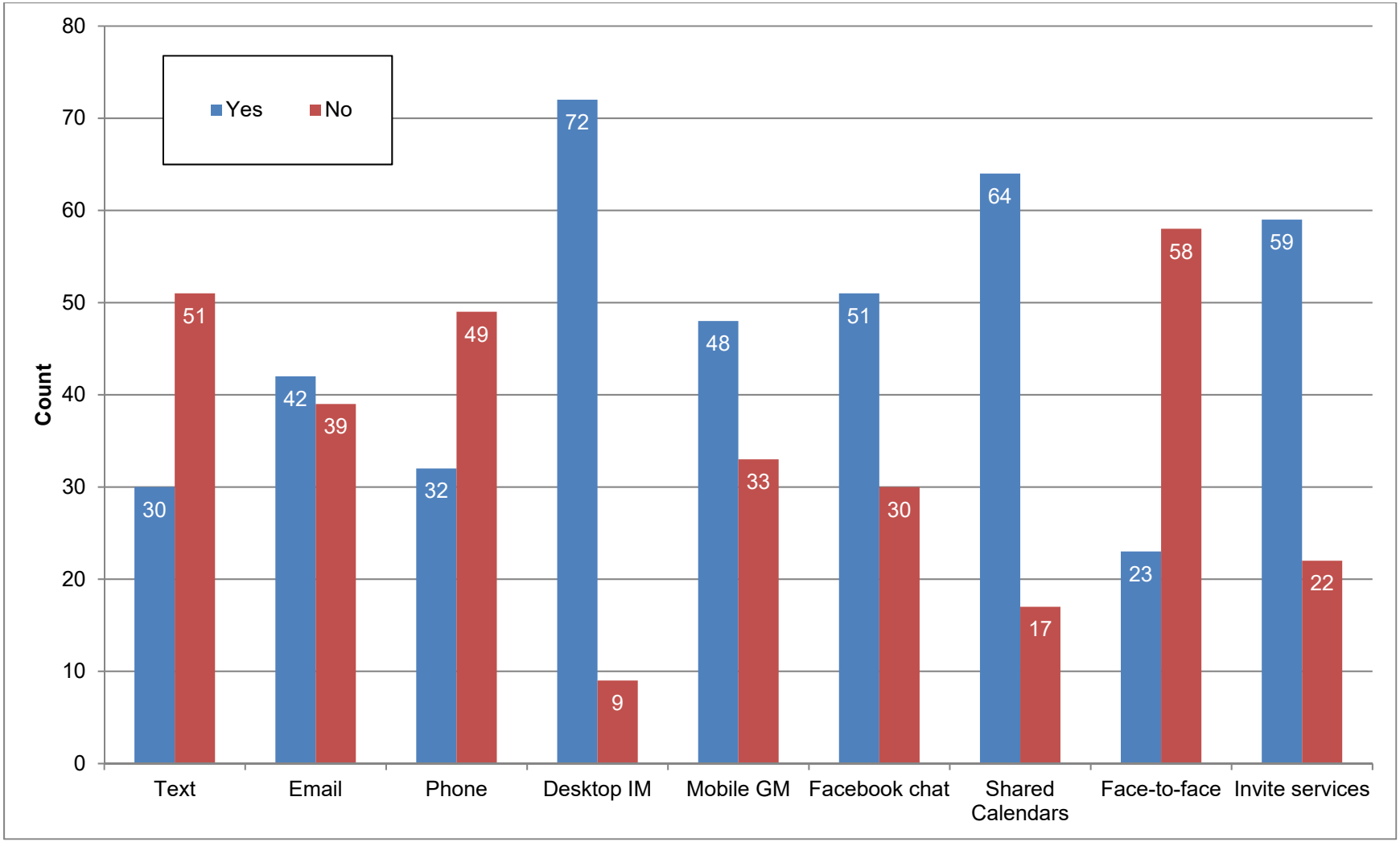

Figure 11.5 Discontinue use if others do so.

An important ordered effect between the treatment and the response to text messaging was discovered when testing for order effects.

A Kruskal-Wallis H test (non-parametric rank sum for two or more groups) was performed on this question with the category variable of the session condition (treatment x scenario) with a result: N=81, H=14.499 df=3 p=0.002 rejecting the null hypothesis that the rank sums across the conditions is the same for text messaging. The pairwise test suggested that there was an effect if the Group Chat treatment occurred first. The data was split between Group Chat treatment occurring first and this treatment occurring second. The following table and chart (Table 11.11 and Figure 11.6) show the differences in the participants' reports when the data is split.

Table 11.11 Text Messaging A.3 Q9 Split by Group Chat Treatment Order

	Yes	**No**
Group Chat Second (N=39)	17.9% (n=7)	82.1% (n=32)
Group Chat First (N=42)	54.8% (n=23)	45.2% (n=19)
Combined (N=81)	37.0% (n=30)	63.0% (n=51)

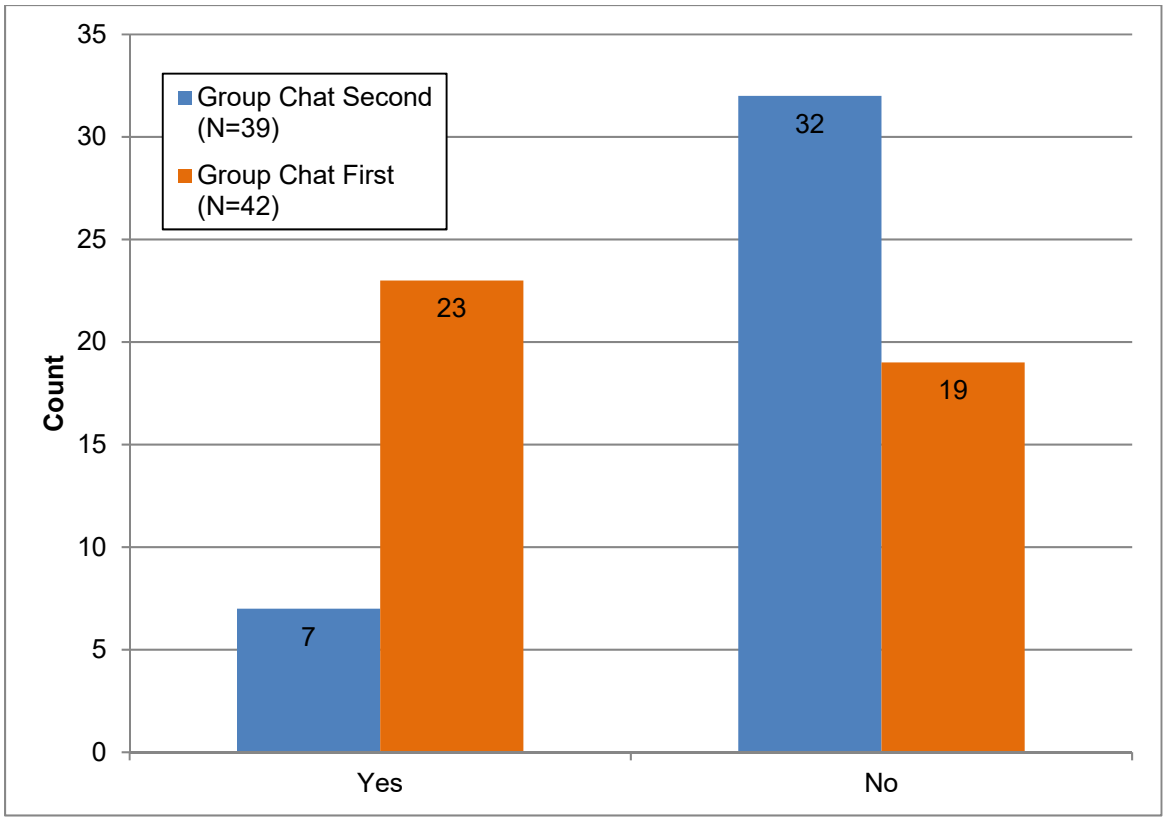

Figure 11.6 Text messaging A.3 Q9 split by group chat treatment order.

A Chi-square test was performed with $\chi^2(1, N=81) = 11.752$, $p=0.001$ showing a statistical significant difference between the reports by participants due to the order of the treatment. In summation, if the participants performed the first coordination with group chat only and then performed the second coordination with the coordinator application they are more likely to report that they would stop using text messaging for coordinating if other members of their social group stopped using it as well.

11.3.3 Descriptive Statistics – Post Coordination Task Survey Responses

This section provides tables containing the descriptive statistics from the post coordination task survey. These tables are included to be used as reference in other sections and for completeness.

11.3.3.1 Coordinating and managing information about the date and time.

This question focused on the first of the two activity details that were supported by the application, date and time.

Post Coordination Survey Question: "For the activity detail: 'date and time' that you coordinated how easy or difficult was it to do the following?"

a) Coordinate
b) Keep track of the suggestions
c) Keep track of who liked / agreed with the various suggestions
d) Understand when a suggestion was made
e) Understand when the activity detail was agreed, and
f) Understand when the agreed upon detail information was changed.

The response format was a 7 point Likert with the following choices: Very Easy (1); Easy; Somewhat easy; Neither easy or difficult; Somewhat difficult; Difficult; Very Difficult (7). For these questions, lower values for mean, median, mean rank, etc., indicate that the participants responded that they found it easier while higher values indicate that they reported more difficulty.

Table 11.12 Difficultly to do the Following for Date and Time – Descriptive Statistics

		N	Min	Max	Mean	Median	Mode	Standard Deviation
coordinate	*GC NYC*	N=43	1	7	3.23	3	3	1.688
	GC Philly	N=40	1	6	2.70	2	2	1.588
	FA NYC	N=39	1	7	3.05	2	2	1.746
	FA Philly	N=44	1	7	2.07	2	1	1.283
keep track of suggestions	*GC NYC*	N=43	1	7	3.49	3	2	1.638
	GC Philly	N=40	1	6	2.90	3	2	1.614
	FA NYC	N=39	1	7	3.05	2	2	1.849
	FA Philly	N=44	1	6	2.05	2	1	1.140
keep track of who liked a suggestion	*GC NYC*	N=43	1	7	3.47	4	5	1.791
	GC Philly	N=40	1	7	2.93	3	2	1.639
	FA NYC	N=39	1	6	2.74	2	2	1.601
	FA Philly	N=44	1	5	1.91	2	1	1.137
understand when a new suggestions was made	*GC NYC*	N=43	1	6	2.81	3	2	1.385
	GC Philly	N=40	1	5	2.35	2	2	1.272
	FA NYC	N=39	1	7	2.28	2	2	1.432
	FA Philly	N=44	1	4	1.80	2	2	0.765
understand when activity detail was agreed	*GC NYC*	N=43	1	7	2.86	3	3	1.473
	GC Philly	N=40	1	5	2.13	2	2	1.181
	FA NYC	N=39	1	7	2.23	2	2	1.266
	FA Philly	N=44	1	5	1.77	2	2	0.831
understand when agreed information changed	*GC NYC*	N=43	1	6	3.07	3	2	1.580
	GC Philly	N=40	1	6	2.38	2	2	1.353
	FA NYC	N=39	1	7	2.31	2	2	1.398
	FA Philly	N=44	1	6	2.02	2	2	0.976

11.3.3.2 Coordinating and managing information about place. This question focused on the second of the two activity details that were supported by the application, place.

Post Coordination Survey Question: "For the activity detail: 'place' that you coordinated how easy or difficult was it to do the following?"

a) Coordinate
b) Keep track of the suggestions
c) Keep track of who liked / agreed with the various suggestions
d) Understand when a suggestion was made
e) Understand when the activity detail was agreed, and
f) Understand when the agreed upon detail information was changed.

The response format was a 7 point Likert with the following choices: Very Easy (1); Easy; Somewhat easy; Neither easy or difficult; Somewhat difficult; Difficult; Very Difficult (7). For these questions, lower values for mean, median, mean rank, etc., indicate that the participants responded that they found it easier while higher values indicate that they reported more difficulty.

Table 11.13 Difficultly to Do the Following for Place – Descriptive Statistics

		N	Min	Max	Mean	Median	Mode	Standard Deviation
coordinate	*GC NYC*	N=43	1	7	3.05	3	3	1.603
	GC Philly	N=40	1	5	1.93	2	1	1.118
	FA NYC	N=39	1	6	2.23	2	2	1.266
	FA Philly	N=44	1	7	2.02	2	1	1.303
keep track of suggestions	*GC NYC*	N=43	1	6	2.84	2	2	1.557
	GC Philly	N=40	1	5	1.88	2	1	1.114
	FA NYC	N=39	1	7	2.33	2	2	1.457
	FA Philly	N=44	1	6	1.89	2	1	1.146
keep track of who liked a suggestion	*GC NYC*	N=43	1	7	2.98	3	2	1.669
	GC Philly	N=40	1	5	2.00	2	1	1.301
	FA NYC	N=39	1	6	2.38	2	2	1.350
	FA Philly	N=44	1	5	1.75	2	1	1.014
understand when a new suggestions was made	*GC NYC*	N=43	1	6	2.58	2	2	1.295
	GC Philly	N=40	1	5	1.73	1	1	0.960
	FA NYC	N=39	1	7	2.13	2	1	1.380
	FA Philly	N=44	1	4	1.73	2	1	0.872
understand when activity detail was agreed	*GC NYC*	N=43	1	6	2.79	2	2	1.424
	GC Philly	N=40	1	5	1.70	1	1	0.939
	FA NYC	N=39	1	7	2.26	2	2	1.534
	FA Philly	N=44	1	3	1.70	2	1	0.734
understand when agreed information changed	*GC NYC*	N=43	1	6	2.91	3	2	1.540
	GC Philly	N=40	1	5	1.60	1	1	0.928
	FA NYC	N=39	1	6	2.18	2	2	1.335
	FA Philly	N=44	1	3	1.70	2	1	0.701

11.3.3.3 How easy or difficult was it to keep track of the suggestions.

Post Coordination Survey Question: "How easy or difficult was it to keep track of the suggestions made for"

a) the date and time

b) the place, and

c) the other activity details.

The response format was a 7 point Likert with the following choices: Very difficult (1); Difficult; Somewhat difficult; Neither easy or difficult; Somewhat easy; Easy; Very Easy (7). For these questions, lower values for mean, median, mean rank, etc., indicate more reported difficulty while higher values indicate that the participants reported that they found it easier.

Table 11.14 How Easy or Difficult Was It to Keep Track of the Suggestions – Descriptive Statistics

		N	Min	Max	Mean	Median	Mode	Standard Deviation
date and time	*GC NYC*	N=43	2	7	4.98	5	6	1.596
	GC Philly	N=40	2	7	5.33	6	5	1.542
	FA NYC	N=39	1	7	4.87	5	5	1.880
	FA Philly	N=44	2	7	6.00	6	7	1.239
place	*GC NYC*	N=43	2	7	5.02	5	5	1.371
	GC Philly	N=40	3	7	6.03	6	6	1.000
	FA NYC	N=39	1	7	5.33	6	7	1.644
	FA Philly	N=44	4	7	6.16	6	7	0.888
other details	*GC NYC*	N=43	1	7	4.58	5	6	1.531
	GC Philly	N=40	3	7	5.30	6	6	1.324
	FA NYC	N=39	2	7	5.59	6	7	1.371
	FA Philly	N=44	3	7	5.32	6	6	1.095

11.3.3.4 Understanding group agreement. Question: "How easy or difficult was it to understand when the group reached agreement about".

a) the date and time

b) the place, and

c) the other activity details.

The response format was a 7 point Likert with the following choices: Very difficult (1); Difficult; Somewhat difficult; Neither easy or difficult; Somewhat easy; Easy; Very Easy (7). For these questions, lower values for mean, median, mean rank, etc., indicate more reported difficulty while higher values indicate that the participants reported that they found it easier.

Table 11.15 How Easy or Difficult Was It to Understand When the Group Reached Agreement About – Descriptive Statistics

		N	Min	Max	Mean	Median	Mode	Standard Deviation
date and time	*GC NYC*	N=43	2	7	5.00	5	6	1.528
	GC Philly	N=40	1	7	5.60	6	6	1.446
	FA NYC	N=39	2	7	5.26	6	7	1.874
	FA Philly	N=44	1	7	5.59	6	6	1.452
place	*GC NYC*	N=43	2	7	5.14	5	6	1.473
	GC Philly	N=40	4	7	6.25	6	6	0.809
	FA NYC	N=39	2	7	5.67	6	7	1.475
	FA Philly	N=44	3	7	5.93	6	6	1.065
other details	*GC NYC*	N=43	2	7	4.91	5	5	1.509
	GC Philly	N=40	3	7	5.53	6	6	1.377
	FA NYC	N=39	2	7	5.82	6	7	1.211
	FA Philly	N=44	2	7	5.36	6	6	1.203

11.3.3.5 Difficulty in reaching agreement. Question: "How easy or difficult was it for the group to reach agreement about"

a) the date and time

b) the place, and

c) the other activity details.

The response format was a 7 point Likert with the following choices: Very difficult (1); Difficult; Somewhat difficult; Neither easy or difficult; Somewhat easy; Easy; Very

Easy (7). For these questions, lower values for mean, median, mean rank, etc., indicate more reported difficulty while higher values indicate that the participants reported that they found it easier.

Table 11.16 Difficulty in Reaching Agreement About – Descriptive Statistics

		N	Min	Max	Mean	Median	Mode	Standard Deviation
date and time	*GC NYC*	N=43	1	7	4.77	5	6	2.022
	GC Philly	N=40	2	7	5.70	6	6	1.324
	FA NYC	N=39	1	7	4.79	5	5	1.852
	FA Philly	N=44	1	7	5.66	6	7	1.509
place	*GC NYC*	N=43	1	7	5.00	5	5	1.618
	GC Philly	N=40	4	7	6.10	6	7	0.871
	FA NYC	N=39	1	7	5.49	6	7	1.636
	FA Philly	N=44	1	7	5.61	6	7	1.588
other details	*GC NYC*	N=43	1	7	4.81	5	6	1.547
	GC Philly	N=40	3	7	5.95	6	6	1.037
	FA NYC	N=39	2	7	5.59	6	6	1.371
	FA Philly	N=44	2	7	5.30	6	6	1.322

11.3.3.6 Difficulty reaching shared understanding of activity details.

Question: "How easy or difficult was it for the group to reach a shared understanding about"

a) the date and time
b) the place, and
c) the other activity details.

The response format was a 7 point Likert with the following choices: Very difficult (1); Difficult; Somewhat difficult; Neither easy or difficult; Somewhat easy; Easy; Very Easy (7). For these questions, lower values for mean, median, mean rank, etc., indicate

more reported difficulty while higher values indicate that the participants reported that they found it easier.

Table 11.17 How Easy or Difficult Was It for the Group to Reach A Shared Understanding About – Descriptive Statistics

		N	Min	Max	Mean	Median	Mode	Standard Deviation
date and time	*GC NYC*	N=43	1	7	4.84	5	6	1.799
	GC Philly	N=40	2	7	5.78	6	7	1.368
	FA NYC	N=39	1	7	5.44	6	7	1.667
	FA Philly	N=44	2	7	5.91	6	7	1.197
place	*GC NYC*	N=43	1	7	5.00	5	5	1.480
	GC Philly	N=40	4	7	6.33	7	7	0.829
	FA NYC	N=39	1	7	5.59	6	7	1.568
	FA Philly	N=44	3	7	6.09	6	7	0.984
other details	*GC NYC*	N=43	1	7	4.77	5	6	1.730
	GC Philly	N=40	3	7	5.93	6	6	1.095
	FA NYC	N=39	3	7	5.92	6	7	1.178
	FA Philly	N=44	2	7	5.59	6	6	1.207

11.3.4 Conversational Support and Shared Information

This section contains the results of testing the hypotheses related to the overall study hypothesis H1: *The conversational support and shared information features are perceived as beneficial and aids social group-activity coordination*. Each subsection includes its own set of hypotheses. The data for testing these hypotheses is from the Exit Survey that the participants completed at the conclusion of the two coordination tasks.

11.3.4.1 Keeping track of important details. This section examines the results from Exit Survey questions that asked the participants to compare the coordinator application to the group-chat for keeping track of coordination details. (Appendix A.3 Q1)

the responses are detailed in Table 11.18 and Table 11.19, and Figure 11.7 on the following pages.

The hypothesis for these questions is as follows: H1-1: *The number of participants reporting that the coordinator application made it easier will be greater than those reporting that it made it more difficult.* This hypothesis is repeated for hypotheses H1-1a through H1-1d with the only difference being which question is being tested.

Table 11.18 Reponses Comparing the Coordinator Application Treatment to Group Chat for Keeping Track of Activity Details – Descriptive Statistics

N=81	suggestions for date and time	suggestions for the place	suggestions for other activity details	the overall state of the coordination
Mean	5.65	5.51	4.93	5.32
Std. Deviation	1.70	1.59	1.58	1.55
Variance	2.90	2.53	2.49	2.40

Table 11.19 Reponses Comparing the Coordinator Application Treatment to Group Chat for Keeping Track of Activity Details

N=81	Coordinator app was much harder	2	3	4	5	6	Coordinator app was much easier
suggestions for date and time (a)	4.9% (n=4)	3.7% (n=3)	3.7% (n=3)	4.9% (n=4)	18.5% (n=15)	19.8% (n=16)	44.4% (n=36)
suggestions for the place (b)	2.5% (n=2)	2.5% (n=2)	7.4% (n=6)	13.6% (n=11)	14.8% (n=12)	22.2% (n=18)	37.0% (n=30)
suggestions for other activity details (c)	2.5% (n=2)	3.7% (n=3)	8.6% (n=7)	33.3% (n=27)	8.6% (n=7)	22.2% (n=18)	21.0% (n=17)
the overall state of the coordination (d)	3.7% (n=3)	2.5% (n=2)	4.9% (n=4)	14.8% (n=12)	21.0% (n=17)	27.2% (n=22)	25.9% (n=21)

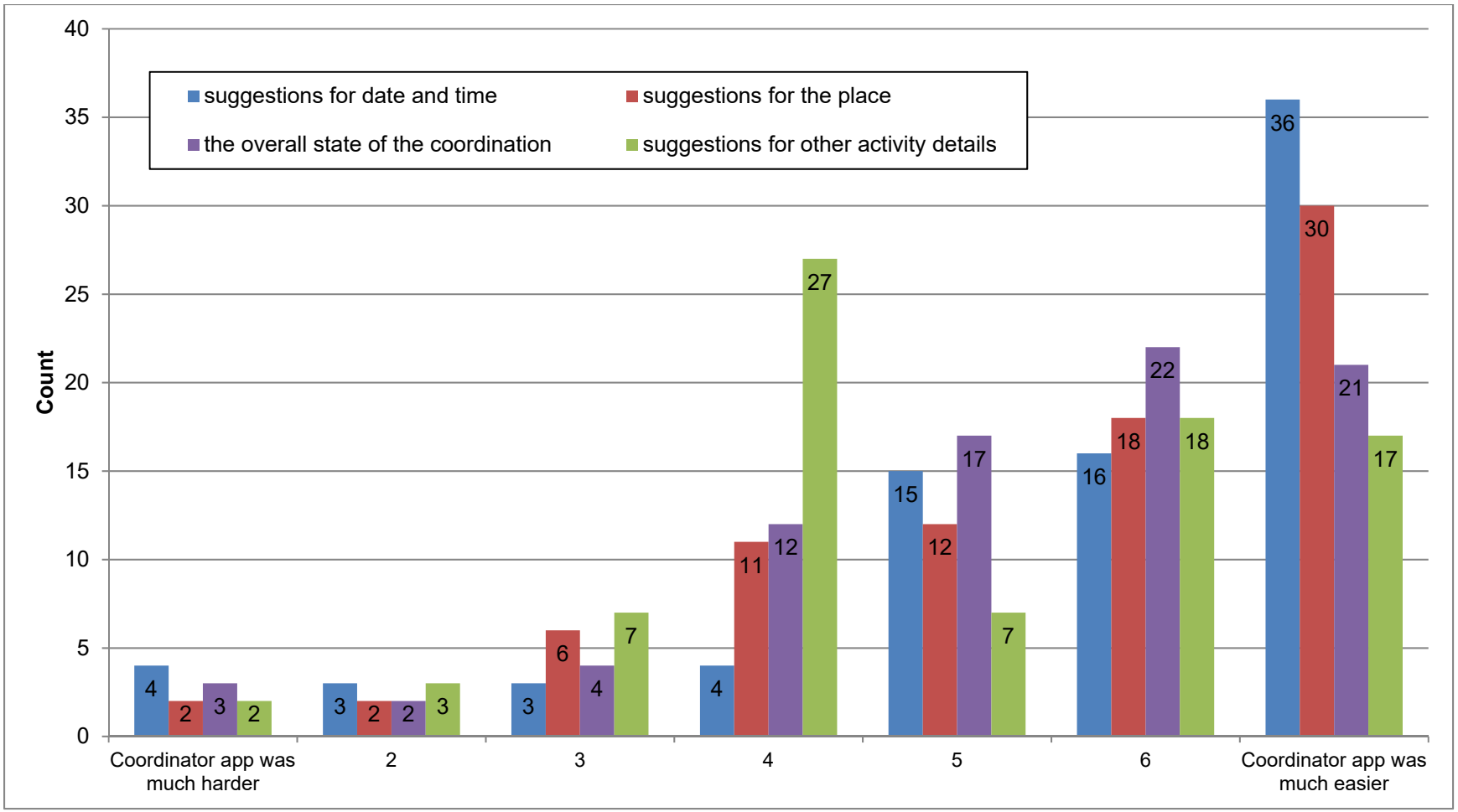

Figure 11.7 Responses comparing the coordinator application treatment to group chat for keeping track of activity details.

These tables and figures show that the participants reported that the coordinator application made it much easier for them to keep track of the suggestions for *date and time* (82.7% vs 12.3%) and *place* (74% vs 12.4%). Also the majority of participants (74.1% vs 11.1%) found the coordinator application made keeping track of *the overall state of the coordination* easier. While over half (51.8%) of the participants found that the coordinator application made keeping track of the s*uggestions for other activity details* a large amount of participants responded neutrally (33.3%).

From this data it is possible to conclude that the hypothesis H1-1 a, b, c, and d are supported for all questions.

11.3.4.2 Participation and re-engagement with the conversation. The next set of questions asked the participants how much the agreed or disagreed with various prompts about how the coordinator application facilitated participation and re-engagement with the conversation when compared to group chat (Appendix A.3 Q2).

The hypothesis for these questions is as follows:

H1-2a: *The number of participants reporting that agree that the coordinator application made it easier for them to participate in the coordination will be greater than those that disagree.*

H1-2b: *The number of participants reporting that they agreed that the coordinator application made it easier for them to figure out what they missed will be greater than those that disagreed.*

Table 11.20 Responses to Questions Examining Participation and Re-Engagement Between the Coordinator Application and Group-Chat Treatments – Descriptive Statistics

N=80	**Easier for me to participate**	**Scrolling in group chat**	**Easier to figure out what I missed**
Mean	5.36	5.66	5.28
Mode	6	6	6
Std. Deviation	1.398	1.232	1.492
Variance	1.956	1.518	2.227

Table 11.21 Responses to Questions Examining Participation and Re-Engagement Between the Coordinator Application and Group-Chat Treatments

N=80	**Strongly disagree (1)**	**Disagree**	**Somewhat disagree**	**Neither agree or disagree**	**Somewhat agree**	**Agree**	**Strongly agree (7)**
Easier for me to participate	0.0% (n=0)	3.8% (n=3)	8.8% (n=7)	13.8% (n=11)	17.5% (n=14)	33.8% (n=27)	22.5% (n=18)
Scrolling in group chat	1.3% (n=1)	1.3% (n=1)	2.5% (n=2)	8.8% (n=7)	25.0% (n=20)	33.8% (n=27)	27.5% (n=22)
Easier to figure out what I missed	0.0% (n=0)	6.3% (n=5)	11.3% (n=9)	8.8% (n=7)	16.3% (n=13)	37.5% (n=30)	20.0% (n=16)

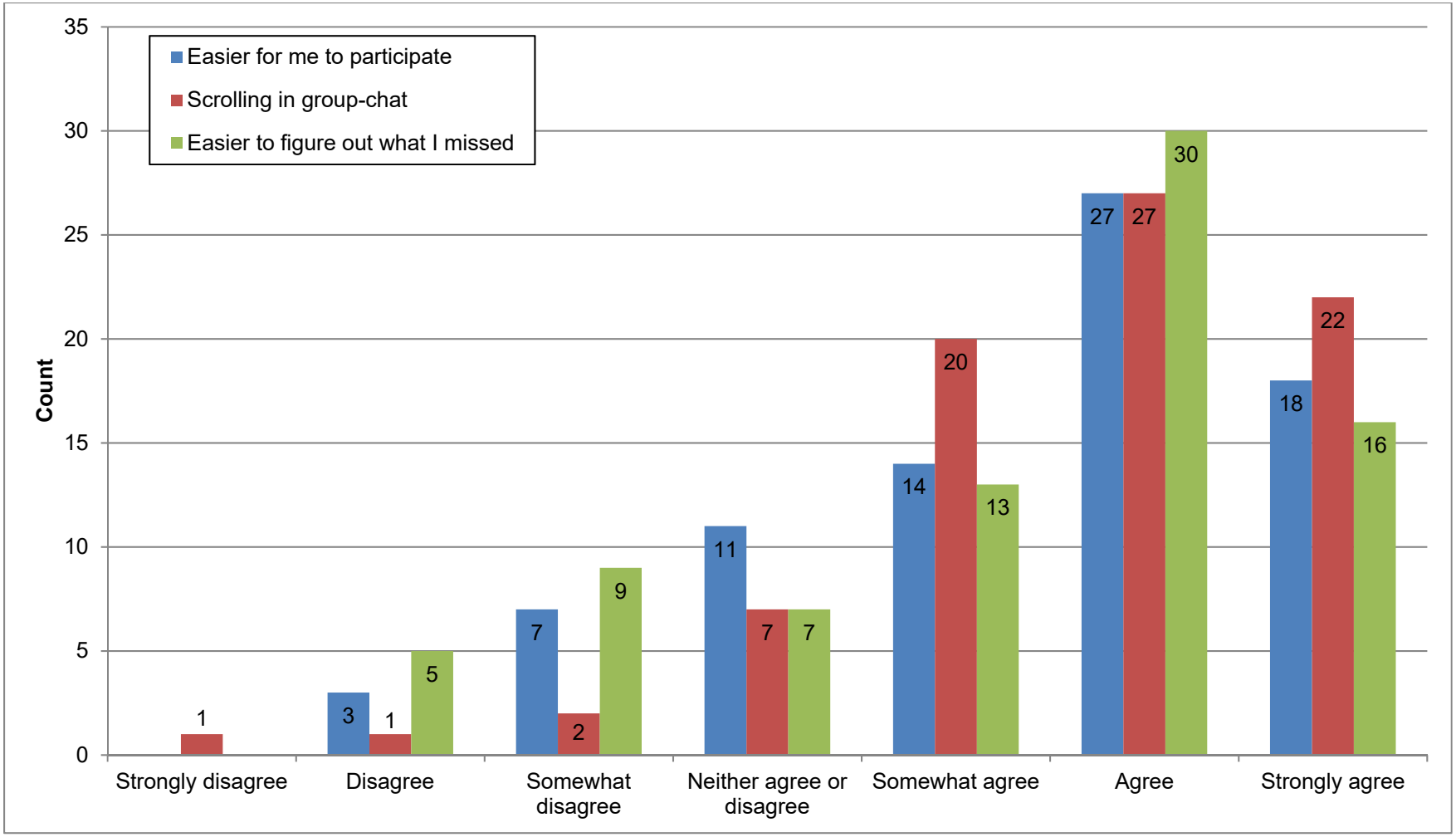

Figure 11.8 Responses to questions examining participation and re-engagement between the coordinator application and group-chat treatments

Hypothesis H1-2a is confirmed with 73.8% versus 12.6% of the participants responding that the coordinator application made it easier for them to participate.

As part of the experimental design the participants were required to put the phone down and were unable to engage in the conversation for periods during the coordination task. Hypothesis H1-2b tests if the coordinator application made reengaging in the coordination easier after this period. With 73.8% versus 17.6% this hypothesis is confirmed.

11.3.4.3 Coordinator application features desired during group chat.

The participants were asked to respond to questions about which features they would have liked to have access to during the group chat treatment (Appendix A.3 Q3). These questions were limited to a 3-point scale (Yes, Do not care, No) requiring the participants to make a clear choice for each feature. The tables and chart on the following pages details their responses and are used to test hypothesis H1-3.

Hypothesis H1-3: *More participants will respond "yes" to being asked if they would have liked this feature during the group chat treatment than "no"*. This hypothesis is repeated for hypotheses H1-3a through H1-3g with the only difference being which feature is being tested.

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Table 11.22 Coordinator Application Desired Features – Descriptive Statistics

N=81	Coordination summary view	The ability to create suggestions for date and time	The ability to create suggestions for place	The ability to like / dislike the various suggestions made	The ability to quickly identify the different types of actions in the conversation view	The Game Plan display	The suggestion lists
Mean	1.28	1.11	1.23	1.26	1.36	1.35	1.32
Mode	1	1	1	1	1	1	1
Std. Deviation	0.597	0.387	0.507	0.519	0.639	0.595	0.588
Variance	0.356	0.150	0.257	0.269	0.408	0.354	0.346

Table 11.23 Coordinator Application Desired Features

N=81	Yes (1)	Do not care (2)	No (3)
Coordination summary view (a)	79.0% (n=64)	13.6% (n=11)	7.4% (n=6)
The ability to create suggestions for date and time (b)	91.4% (n=74)	6.2% (n=5)	2.5% (n=2)
The ability to create suggestions for place (c)	80.2% (n=65)	16.0% (n=13)	3.7% (n=3)
The ability to like / dislike the various suggestions made (d)	77.8% (n=63)	18.5% (n=15)	3.7% (n=3)
The ability to quickly identify the different types of actions in the conversation view (e)	72.8% (n=59)	18.5% (n=15)	8.6% (n=7)
The Game Plan display (f)	71.6% (n=58)	22.2% (n=18)	6.2% (n=5)
The suggestion lists (g)	74.1% (n=60)	19.8% (n=16)	6.2% (n=5)

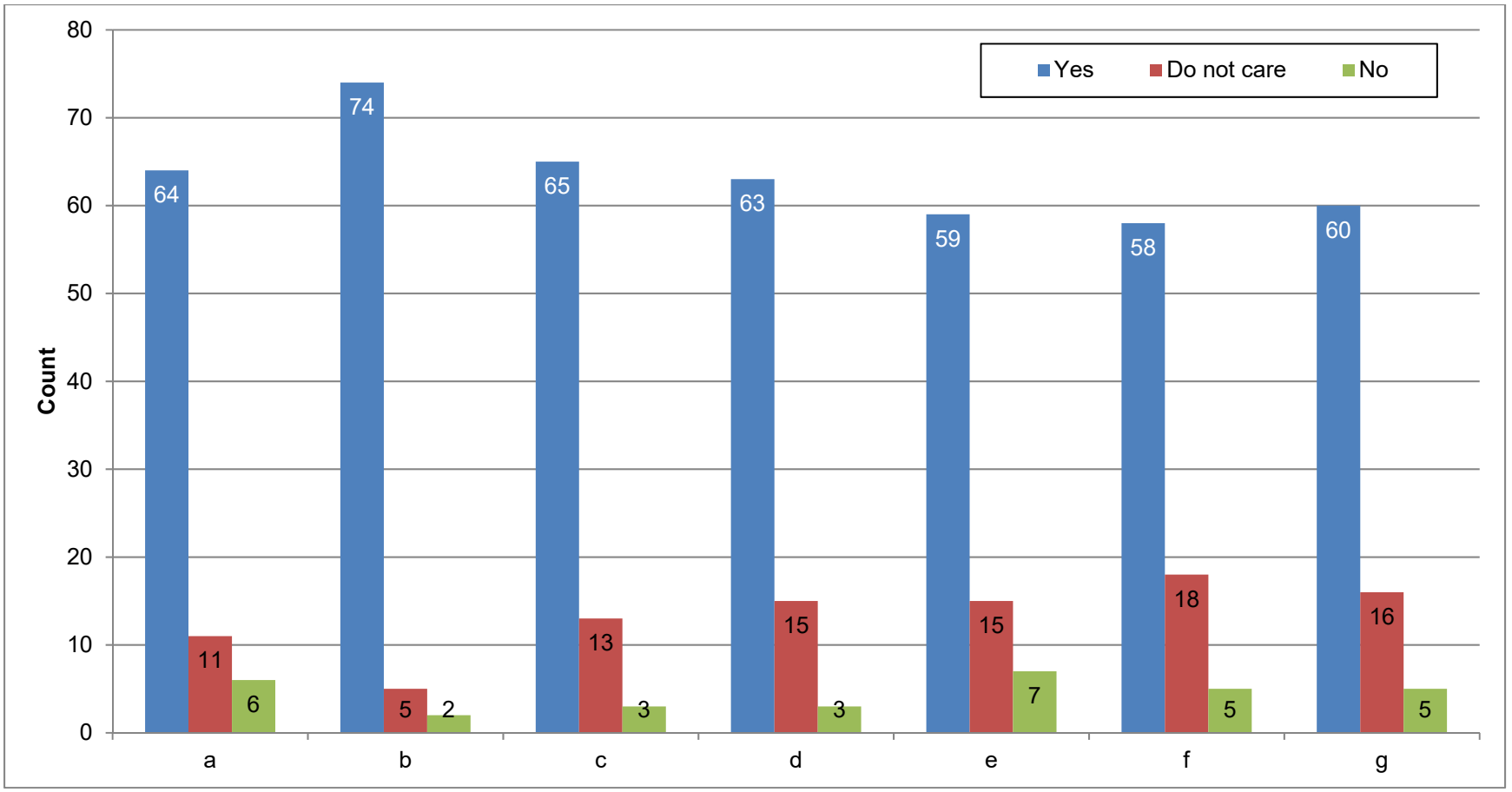

Figure 11.9 Coordinator application desired features.

These data show that all of the hypotheses (H1-3a through H1-3g) are supported.

11.3.4.4 Desire for additional detail support. The data for the next two questions (Appendix A.3 Q4) is detailed Table 11.24 and Table 11.25. These questions asked the participants: "*Would you like to have had the ability to create suggestions for other activity details, apart from date, time, place...*" during group-chat and the coordinator application tasks. The purpose of these questions was to collect data about the participants' desire to have support for coordinating other activity details beyond those provided by the coordinator application (date and time, and place).

The following hypothesis tests if the participants would have additional detail support.

H1-4: *More participants will indicate that they desired additional support for other activity details than those that did not.*

Table 11.24 Desire for Additional Activity Detail Support – Descriptive Statistics

N=81	
Mean	1.49
Median	1
Mode	1
Std. Deviation	0.69
Variance	0.48

Table 11.25 Desire for Additional Activity Detail Support

N=81	**Yes**	**Do not care**	**No**
	61.7% (n=50)	27.2% (n=22)	11.1% (n=9)

The results indicate more than half of the participants responding they would like the ability for having support for other activity details supporting hypothesis H1-4.

11.3.4.5 Summary. In this section the following hypotheses were supported:

H1-1(a though d): *The number of participants reporting that the coordinator application made it easier will be greater than those reporting that it made it more difficult*

H1-2a: *The number of participants reporting that they agreed that the coordinator application made it easier for them to participate in the coordination will be greater than those that disagreed.*

H1-2b: *The number of participants reporting that they agreed that the coordinator application made it easier for them to figure out what they missed will be greater than those that disagreed.*

H1-3(a through g): *More participants will respond "yes" to being asked if they would have liked this feature during the group chat treatment than "no".*

H1-4: *More participants will indicate that they desired additional support for other activity details than those that did not.*

Every hypothesis in this section was supported.

11.3.5 Reducing Cognitive Load

This section contains the results of testing the hypotheses related to the overall study hypothesis H2: *The coordinator application reduces the cognitive load required to understand and track the coordination state.* Each subsection includes its own set of hypotheses. The data for testing these hypotheses is from the Post Coordination Survey that the participants completed at the conclusion of each coordination task.

11.3.5.1 Coordinating and managing information – date and time.

This question focused on the first of the two activity details that were supported by the application: date and time.

The hypotheses in this subsection use the data from the following question from the Post Coordination Survey: "For the activity detail: 'date and time' that you coordinated how easy or difficult was it to do the following?" a) Coordinate, b) Keep track of the suggestions, c) Keep track of who liked / agreed with the various suggestions, d) Understand when a suggestion was made, e) Understand when the activity detail was agreed, and f) Understand when the agreed upon detail information was changed. The response format was a 7 point Likert with the following choices: Very Easy (1); Easy; Somewhat easy; Neither easy or difficult; Somewhat difficult; Difficult; Very Difficult (7). For these questions, lower values for mean, median, mean rank, etc., indicate that the participants responded that they found it easier while higher values indicate that they reported more difficulty.

The first two questions, coordinate (a), and keep track of the suggestions (b), are general overall questions. It was expected that these questions would be responded to similar to those asking about specific application features, questions (c – f).

The following hypotheses are tested in this section.

H2-1a: *The general questions coordinate (a), and keep track of the suggestions (b) will show a significant difference between the treatments when the other questions (c – f) also show significant differences for the NYC scenario*.

H2-1b: *The majority of the specific questions (c – f) related directly to the application's features will show a difference between the treatments for the NYC scenario and indicate that the coordinator application was easier than group-chat*.

Hypothesis H2-1a and H2-1b will be tested using the results of the Mann-Whitney U test from Table 11.26.

Table 11.26 Difficultly to Do the Following for Date and Time – Between Participants by Treatment Mann-Whitney U Test Results

	NYC			**Philadelphia**		
	Mean Rank Group Chat (n=43)	**Mean Rank Application (n=39)**	**Test**	**Mean Rank Group Chat (n=40)**	**Mean Rank Application (n=44)**	**Test**
coordinate (a)						
	43.26	39.56	U=763 p=0.473	47.40	38.05	U=684 *p=0.068***
keep track of suggestions (b)						
	44.87	37.78	U=693.5 p=0.170	49.35	36.27	U=606 **p=0.011***
keep track of who liked a suggestion (c)						
	45.87	36.68	U=650.5 *p=0.076***	51.13	34.66	U=535 **p=0.001***
understand when a new suggestions was made (d)						
	46.50	35.99	U=623.5 **p=0.039***	47.55	37.91	U=678 *p=0.055***
understand when activity detail was agreed (e)						
	46.85	35.60	U=608.5 **p=0.027***	45.70	39.59	U=752 p=0.215
understand when agreed information changed (f)						
	46.99	35.45	U=602.5 **p=0.024***	44.90	40.32	U=784 p=0.361
* p <= 0.05; ** p <= 0.1						

The results show that hypothesis H2-1a cannot be supported. The questions *coordinate*, and *keep track of suggestions* were not significant when the following specific questions (c – f) were.

The results also show support for hypothesis H2-1b. Three of the four questions (d, e, and f) were significantly different and indicate that the coordinator application was easier than group-chat. The question *keep track of who liked a suggestion* was marginally significant and provides some additional support for this hypothesis.

11.3.5.2 Coordinating and managing information – place. This question focused on the second of the two activity details that were supported by the application: place.

The hypotheses in this subsection use the data from the following question from the Post Coordination Survey: "For the activity detail: 'place' that you coordinated how easy or difficult was it to do the following?" a) Coordinate, b) Keep track of the suggestions, c) Keep track of who liked / agreed with the various suggestions, d) Understand when a suggestion was made, e) Understand when the activity detail was agreed, and f) Understand when the agreed upon detail information was changed. The response format was a 7 point Likert with the following choices: Very Easy (1); Easy; Somewhat easy; Neither easy or difficult; Somewhat difficult; Difficult; Very Difficult (7). For these questions, lower values for mean, median, mean rank, etc., indicate that the participants responded that they found it easier while higher values indicate that they reported more difficulty.

The first two questions, coordinate (a), and keep track of the suggestions (b), are general overall questions. It was expected that these questions would be responded to similar to those asking about specific application features, questions (c – f).

The following hypotheses are tested in this section.

H2-2a: *The general questions coordinate (a), and keep track of the suggestions (b) will show a significant difference between the treatments when the other questions (c – f) also contained significant differences for the NYC scenario*.

H2-2b: *The majority of the specific questions (c – f) related directly to the application's features will show a difference between the treatments for the NYC scenario and indicate that the coordinator application was easier than group-chat.*

Hypothesis H2-1a and H2-1b will be tested using the results of the Mann-Whitney U test from Table 11.27.

Table 11.27 Difficultly to Do the Following for Place – Between Participants by Treatment Mann-Whitney U Test Results

	NYC			**Philadelphia**		
	Mean Rank Group Chat (n=43)	**Mean Rank Application (n=39)**	**Test**	**Mean Rank Group Chat (n=40)**	**Mean Rank Application (n=44)**	**Test**
coordinate (a)						
	47.99	34.35	U=559.5 **p=0.007***	42.09	42.88	U=863.5 p=0.875
keep track of suggestions (b)						
	45.34	37.27	U=673.5 p=0.113	42.28	42.70	U=871 p=0.931
keep track of who liked a suggestion (c)						
	45.60	36.97	U=662 *p=0.090***	44.06	41.08	U=817.5 p=0.543
understand when a new suggestions was made (d)						
	46.42	36.08	U=627 **p=0.040***	42.03	42.93	U=861 p=0.852
understand when activity detail was agreed (e)						
	46.67	35.79	U=616 **p=0.032***	41.26	43.63	U=830.5 p=0.628
understand when agreed information changed (f)						
	47.13	35.29	U=596.5 **p=0.020***	39.31	45.40	U=752.5 p=0.207
* p <= 0.05; ** p <= 0.1						

The results show that hypothesis H2-2a can only be partially supported since only one question, *coordinate,* was significantly different while the second, *keep track of suggestions* was not.

The results also show support for hypothesis H2-2b. Three of the four questions (d, e, and f) were significantly different and indicate that the coordinator application was easier than group-chat. The question *keep track of who liked a suggestion* was marginally significant and provides some additional support for this hypothesis.

11.3.5.3 How easy or difficult was it to keep track of the suggestions.

The hypotheses in this subsection use the data from the following question from the Post Coordination Survey: "How easy or difficult was it to keep track of the suggestions made for" a) the date and time, b) the place, and c) the other activity details. The response format was a 7 point Likert with the following choices: Very difficult (1); Difficult; Somewhat difficult; Neither easy or difficult; Somewhat easy; Easy; Very Easy (7). For these questions, lower values for mean, median, mean rank, etc., indicate more reported difficulty while higher values indicate that the participants reported that they found it easier.

The following hypotheses are tested in this section. They are tested using the results of the Mann-Whitney U test from Table 11.28.

H2-3a: *There will be a significant difference between the responses keeping track of the suggestions for <u>date and time</u> between group-chat and coordinator application during the NYC scenario indicating that the coordination application was easier.*

H2-3b: *There will be a significant difference between the responses keeping track of the suggestions for place between group-chat and coordinator application during the NYC scenario indicating that the coordination application was easier.*

H2-3c: *There will be a significant difference between the responses keeping track of the suggestions for other activity details between group-chat and coordinator application during the NYC scenario indicating that the coordination application was easier.*

Table 11.28 How Easy or Difficult Was It to Keep Track of the Suggestions – Mann-Whitney U Test Results

	NYC			**Philadelphia**		
	Mean Rank Group Chat (n=43)	**Mean Rank Application (n=39)**	**Test**	**Mean Rank Group Chat (n=40)**	**Mean Rank Application (n=44)**	**Test**
date and time (a)	41.72	41.26	U=829 p=0.928	36.48	47.98	U=639 **p=0.025***
place (b)	38.24	45.09	U=698.5 p=0.182	41.10	43.77	U=824 p=0.593
other details (c)	34.00	49.77	U=516 **p=0.002***	42.83	42.20	U=867 p=0.904
* p <= 0.05; ** p <= 0.1						

The results from Table 11.28 show support for hypothesis H2-3c and no support for hypotheses H2-3a and H2-3b.

11.3.5.4 Summary.

Supported Hypotheses:

H2-1b: *The majority of the specific questions (c – f) related directly to the application's features will show a difference between the treatments for the NYC scenario and indicate that the coordinator application was easier than group-chat.*

H2-2b: *The majority of the specific questions (c – f) related directly to the application's features will show a difference between the treatments for the NYC scenario and indicate that the coordinator application was easier than group-chat.*

H2-3c: *There will be a significant difference between the responses keeping track of the suggestions for other activity details between group-chat and coordinator application during the NYC scenario indicating that the coordination application was easier.*

Partially Supported:

H2-2a: *The general questions coordinate (a), and keep track of the suggestions (b) will show a significant difference between the treatments when the other questions (c – f) also contained significant differences for the NYC scenario*.

Not Supported:

H2-1a: *The general questions coordinate (a), and keep track of the suggestions (b) will show a significant difference between the treatments when the other questions (c – f) also contained significant differences for the NYC scenario*.

11.3.6 Common Ground and Shared Understanding

This section contains the results of testing the hypotheses related to the overall study hypothesis H3: *The coordinator application increases the ability for groups to reach common ground and a shared understanding of the coordination state.* Each subsection includes its own set of hypotheses. The data for testing these hypotheses is from the Post

Coordination Survey that the participants completed at the conclusion of each coordination task.

11.3.6.1 Understanding group agreement. The hypotheses in this subsection use the data from the following question from the Post Coordination Survey: "How easy or difficult was it to understand when the group reached agreement about" a) the date and time, b) the place, and c) the other activity details. The response format was a 7 point Likert with the following choices: Very difficult (1); Difficult; Somewhat difficult; Neither easy or difficult; Somewhat easy; Easy; Very Easy (7). For these questions, lower values for mean, median, mean rank, etc., indicate more reported difficulty while higher values indicate that the participants reported that they found it easier.

Using this data the following hypotheses are tested.

H3-1a: *The participants will report it was easier to understand when agreement was reached about the date and time during the coordinator application treatment when compared to the group chat treatment.*

H3-1b: *The participants will report it was easier to understand when agreement was reached about the place during the coordinator application treatment when compared to the group chat treatment.*

H3-1c: *The participants will report it was easier to understand when agreement was reached about the other activity details during the coordinator application treatment when compared to the group chat treatment.*

These hypotheses will be supported if there is a statistically significant difference in the Mann-Whitney U test for the NYC scenario.

Table 11.29 How Easy or Difficult Was It to Understand When the Group Reached Agreement About – Between Participants by Treatment – Mann-Whitney U Test Results

	NYC			Philadelphia		
	Mean Rank Group Chat (n=43)	**Mean Rank Application (n=39)**	**Test**	**Mean Rank Group Chat (n=40)**	**Mean Rank Application (n=44)**	**Test**
date and time (a)	38.63	44.67	U=715 p=0.241	42.35	42.64	U=874 p=0.955
Place (b)	37.12	46.33	U=650 *p=0.072***	45.96	39.35	U=741.5 p=0.180
other details (c)	34.65	49.05	U=544 **p=0.005***	44.83	40.39	U=787 p=0.389
* p <= 0.05; ** p <= 0.1						

The result of the Mann-Whitney U test of *other details* shows a statistically significant difference in the mean ranks when comparing the two treatments for the NYC scenario and a moderately significant difference for *place.* There is no statistically significant difference for *date and time*. Hypothesis H3-1c is supported and H3-1a and b are not supported.

11.3.6.2 Difficulty in reaching agreement. The hypotheses in this subsection use the data from the following question from the Post Coordination Survey: "How easy or difficult was it for the group to reach agreement about" a) the date and time, b) the place, and c) the other activity details. The response format was a 7 point Likert with the following choices: Very difficult (1); Difficult; Somewhat difficult; Neither easy or difficult; Somewhat easy; Easy; Very Easy (7). For these questions, lower values for mean, median, mean rank, etc., indicate more reported difficulty while higher values indicate that the participants reported that they found it easier.

Using this data the following hypotheses are tested.

H3-2a: *The participants will report it was easier to reach agreement about the date and time during the coordinator application treatment when compared to the group chat treatment.*

H3-2b: *The participants will report it was easier to reach agreement about the place during the coordinator application treatment when compared to the group chat treatment.*

H3-2c: *The participants will report it was easier to reach agreement about the other activity details during the coordinator application treatment when compared to the group chat treatment.*

These hypotheses will be supported if there is a statistically significant difference in the Mann-Whitney U test for the NYC scenario.

Table 11.30 How Easy or Difficult Was It for the Group to Reach Agreement About – Mann-Whitney U Test Results

	NYC			**Philadelphia**		
	Mean Rank Group Chat (n=43)	**Mean Rank Application (n=39)**	**Test**	**Mean Rank Group Chat (n=40)**	**Mean Rank Application (n=44)**	**Test**
date and time (a)	41.59	41.40	U=834.5 p=0.970	41.65	43.27	U=846 p=0.750
Place (b)	37.52	45.88	U=667.5 p=0.102	44.66	40.53	U=793.5 p=0.415
other details (c)	35.78	47.81	U=592.5 **p=0.019***	48.79	36.78	U=628.5 **p=0.019***
* p <= 0.05; ** p <= 0.1						

The Mann-Whitney U test between participants test comparing treatments across the scenarios shows that *other details* was significantly different. The participants reported that for the NYC scenario the coordinator application treatment was easier. This supports hypothesis H3-2c. Hypotheses H3-2a and b were not supported.

11.3.6.3 Difficulty reaching shared understanding of activity details.

The hypotheses in this subsection use the data from the following question from the Post Coordination Survey: "How easy or difficult was it for the group to reach a shared understanding about" a) the date and time, b) the place, and c) the other activity details. The response format was a 7 point Likert with the following choices: Very difficult (1); Difficult; Somewhat difficult; Neither easy or difficult; Somewhat easy; Easy; Very Easy (7). For these questions, lower values for mean, median, mean rank, etc., indicate more reported difficulty while higher values indicate that the participants reported that they found it easier.

Using this data the following hypotheses are tested.

H3-3a: *The participants will report it was easier to reach a shared understanding about the date and time during the coordinator application treatment when compared to the group chat treatment.*

H3-3b: *The participants will report it was easier to reach a shared understanding about the place during the coordinator application treatment when compared to the group chat treatment.*

H3-3c: *The participants will report it was easier to reach a shared understanding about the other activity details during the coordinator application treatment when compared to the group chat treatment.*

These hypotheses will be supported if there is a statistically significant difference in the Mann-Whitney U test for the NYC scenario.

Table 11.31 How Easy or Difficult Was It for the Group to Reach a Shared Understanding About – Mann-Whitney U Test Results

	NYC			Philadelphia		
	Mean Rank Group Chat (n=43)	**Mean Rank Application (n=39)**	**Test**	**Mean Rank Group Chat (n=40)**	**Mean Rank Application (n=44)**	**Test**
date and time (a)	37.53	45.87	U=668 p=0.105	41.74	43.19	U=849.5 p=0.775
place (b)	36.22	47.32	U=611.5 **p=0.031***	45.34	39.92	U=766.5 p=0.272
other details (c)	33.73	50.06	U=504.5 **p=0.001***	46.13	39.20	U=735 p=0.172
* p <= 0.05; ** p <= 0.1						

The Mann-Whitney U between participants test comparing treatments across the scenarios shows a highly significant difference for *place* and *other details* for the NYC scenario. The data indicates that the participants found the coordinator application made it easier to reach a shared understanding for both *place* and *other details* and supports hypotheses H3-3b and c. Hypothesis H3-3a was not supported.

11.3.6.4 Summary. The following are the lists of hypotheses supporting or not supporting the overall hypothesis overall study hypothesis H3: *The conversational support and shared information features are perceived as beneficial and aids social group-activity coordination.*

Supported:

H3-1c: *The participants will report it was easier to understand when agreement was reached about the other activity details during the coordinator application treatment when compared to the group chat treatment.*

H3-2c: *The participants will report it was easier to reach agreement about the other activity details during the coordinator application treatment when compared to the group chat treatment.*

H3-3b: *The participants will report it was easier to reach a shared understanding about the place during the coordinator application treatment when compared to the group chat treatment.*

H3-3c: *The participants will report it was easier to reach a shared understanding about the other activity details during the coordinator application treatment when compared to the group chat treatment.*

Not Supported:

H3-1a: *The participants will report it was easier to understand when agreement was reached about the date and time during the coordinator application treatment when compared to the group chat treatment.*

H3-1b: *The participants will report it was easier to understand when agreement was reached about the place during the coordinator application treatment when compared to the group chat treatment.*

H3-2a: *The participants will report it was easier to reach agreement about the date and time during the coordinator application treatment when compared to the group chat treatment.*

H3-2b: *The participants will report it was easier to reach agreement about the place during the coordinator application treatment when compared to the group chat treatment.*

H3-3a: *The participants will report it was easier to reach a shared understanding about the date and time during the coordinator application treatment when compared to the group chat treatment.*

These results show that the participants reported that the coordinator application made it easier to reach common ground and a shared understanding for the other activities details.

11.4 Discussion

This study had a group of four randomly selected participants conduct two coordination tasks. The coordination tasks were assigned based on the randomly assigned conditions setup at the start of the study. The coordination tasks comprised of a treatment-scenario pair where the treatment represented a technological intervention (either the coordinator application or group-chat) and the scenario the place where the group would coordinate going. It was found that the treatment order had no effect on the participants' response to the survey questions. The scenario did have an effect on the participants' responses and it was found that the New York City scenario had a much stronger response to the treatment than the Philadelphia scenario (an examination of the reasons for this is in Appendix D). The main observed reason for this is that participants reported that they had to perform more work for the NYC scenario (regardless of treatment) vs the Philadelphia scenario (see Table D.1 Table D.2). This is most likely due to the natural affect that since the participants were closer to and likely have been to NYC more frequently which therefore made them more familiar with NYC and its various locales and transportation options than with Philadelphia. This effect led to splitting the data analysis between the two scenarios.

It was found that overall the conversation centric design of the coordinator application reported by the participants to aid in the coordination of the assigned social group-activities when compared to group chat and the three main hypotheses were supported by the results. The following sections contain detailed discussions related to the hypotheses and research questions of this study.

11.4.1 Information Overload

One of the main aims of this study was to determine if the coordinator application can reduce the cognitive load required to coordinate social group activities. One way this was evaluated by asking the participants about how difficult they found coordinating the different activity details.

The results reported in Section 11.3.5 are about having the participants' responses to probes relating to the difficulty in coordinating the various activity details. The questions were focused on understanding the participants' level of perceived difficulty. For the activity details supported by the application (*date and time* and *place*) and the third (*other details*), a group of questions were asked about the difficulty of understanding when various aspects of these details were changed, added, updated, etc.

The participant responses to the question about the difficulty in understanding when new suggestions were made, when activity details were agreed, and when previously agreed information was changed for both the *date and time* and *place* were found to have a statistically significant difference between treatments for the NYC scenario.

For *date and time*, participants responded that the following was easier during the coordinator application task: understanding when a new suggestion was made (U=650.5, n_1=43, n_2=39, $p < 0.039$), understanding when an activity detail was agreed (U=608.5,

n_1=43, n_2=39, $p < 0.027$), and understanding when previously agreed information was changed (U=602.5, n_1=43, n_2=39, $p < 0.024$).

For *place*, the participants responded that the following was easier during the coordinator application task: understanding when a new suggestion was made (U=627, n_1=43, n_2=39, $p < 0.040$), understanding when an activity detail was agreed (U=616, n_1=43, n_2=39, $p < 0.032$), and understanding when previously agreed information was changed (U=596.5, n_1=43, n_2=39, $p < 0.020$).

What these results show is that by directly supporting the coordination of *date and time* and *place* the coordinator application reduced the cognitive load required to coordinate this information when compared to group-chat. In addition, the participants responded that the coordinator application made it easier to keep track of the suggestions of the *other activity details* not directly supported by the application (U=516, n_1=43, n_2=39, $p < 0.002$).

During the exit survey at the conclusion of the two coordination tasks, the participants were asked to compare various aspects of the coordinator application to group-chat. Two sets of questions from this survey are related to information overload.

The first set of questions is detailed in Figure 11.7. These questions ask the participants to compare the coordinator application to group-chat for keeping track of the suggestions for *date and time, place, and other details* along with the overall state of the coordination. This data shows a very large majority of the participants responded that the coordinator application made it easier to keep track of the suggestions for the *date and time* (82.7% vs 12.3%), *place* (74% vs 12.4%), and also keep track of the overall state of the coordination (74.1% vs 11.1%). Also of interest in Figure 11.7 is the large spike of neutral

responses to the questions about the coordinator application making it easier or more difficult to keep track of suggestions for the other activity details.

The participants were also asked to report if the coordinator application made it easier for them to participate in the coordination task and if it also made it easier for them to figure out what they missed when they had to put the phone down. The results show that for these two questions 73.8% (see Figure 11.8) of the participants responded that the coordinator application made those aspects easier.

The design used by the participants provided support for only *date and time* and *place*. Important aspects of any group activity but far from being the only ones required for an activity to occur. An important result of this study is that supporting only some aspects of social group-activity coordination made it easier to coordinate and reduced the information load of the non-supported aspects as well. This finding is important because it demonstrates that an application does not need to tackle the intricacies of every type of social activity coordination. Simply supporting this very minimal set can be of substantial benefit in reducing cognitive load and information overload.

When these results are combined, they provide a clear indication that the coordinator application did reduce the information overload experienced by the participants. This allows us to conclude that the shared information state, suggestion lists, and ability to quickly ascertain different messages in the conversation view aided the coordination and hypothesis H1: *The conversational support and shared information features are perceived as beneficial and aids social group-activity coordination,* is supported.

11.4.2 Supporting Consensus Building and Common Ground

The previous section discussed a tangible aspect of the coordinator application: can it help make important aspects of coordinating social group activities easier. It does and this is important. Following that is the concept of something a bit less tangible and motivated more from the theoretical perspective previously discussed. Would making certain things easier improve common ground and shared understanding of the coordination state? The largest difficulty with evaluating this is how to best collect data and pose the questions to the participants. Asking a participant if feature A, B and C made things easier is grounded in the coordination task they just experienced. Asking a participant to evaluate the level of common ground and shared understanding achieved by using feature A, B, and C is more difficult.

Section 11.3.6 contains the results and analysis of questions about consensus building and supporting common ground. In an attempt to overcome the difficulty asking these questions the participants were probed using three separate questions using different language for concepts closely related to common ground and consensus building. They were asked about the perceived difficulty in understanding when the group reached agreement, the actual perceived difficulty in reaching agreement, and the difficulty in reaching shared understanding.

When the study was designed and the questions developed, it was expected that if the participants reported that if the coordinator application made things easier they would also report that it facilitated consensus building. Specifically, if they found that the coordinator application made it easier to coordinate various aspects of *date and time* and

place, it was expected they would report similarly for consensus building. These expectations were wrong and this is not what occurred.

The participants were asked three questions: How easy or difficult was it 1) to understand when the group reached agreement; 2) for the group to reach agreement; and 3) for the group to reach a shared understanding. For each question they were asked to respond for *date and time*, *place,* and *other details.*

What was observed was that for the NYC scenario the *other details* was significantly different for the three questions (Q1: (U=544, n_1=43, n_2=39, $p < 0.005$), Q2: (U=592, n_1=43, n_2=39, $p < 0.019$), Q3: (U=504.5, n_1=43, n_2=39, $p < 0.001$)). *Place* was found statistically significant for Q3 (U=611.5, n_1=43, n_2=39, $p < 0.031$). In each case the direction of difference shows that the participants reported it was easier during the coordinator application treatment vs the group-chat treatment.

What is interesting is that the two activity details directly supported by the coordinator application (*date and time,* and *place)* were not found to have a statistically significant difference (minus the one exception for *place*) while all the other details were found to be easier. At face-value one might conclude that coordinator application failed at providing support for consensus building and common ground, however, a more nuanced look provides a better interpretation.

It is important to consider that none of the features provided by the coordinator application were used in isolation. Every feature interacted with each other to create a whole and they were used holistically during the coordination task. This is an important consideration because while there was only a difference for *other details* how did this difference arise?

The *other details* showed an improvement because the coordinator application directly supported *date and time* and *place* which allowed the participants to more easily communicate about *other details*. The supported details were organized in separate lists, visually identified separately from regular chat messages, and in the case of *date and time* provided specifically tailored means for user input. All of these aspects combined separated the *date and time* and *place* messages and activity from the *other details.* The result is that consensus building and achieving common ground about *other details* was easier because it was easier for *date and time* and *place*.

It is difficult to determine why the *date and time* and *place* were not reported as easier for these questions. The responses from the Exit Survey detailed in Figure 11.7 and Figure 11.9 show an overwhelming positive response to the features supporting the coordination of these details. Taken as a whole the results presented here support the hypothesis H3: *The coordinator application increases the ability for groups to reach common ground and a shared understanding of the coordination state.*

Overall, two things were learned: 1) that the coordinator application supports consensus building and common ground and 2) that it is difficult to probe people about this aspect of coordination. Only by asking different questions related to the points of interest was a complete picture assembled. This indicates that additional research is required to further our understanding about how to better investigate similar factors in the future.

11.4.3 Coordinator Application Features Desired During Group Chat

An important aspect of this study was to provide an evaluation about the provided features and if the participants viewed them as beneficial. Initial pilot studies asked the participants to evaluate each feature and to provide a response about how beneficial they perceived it.

This proved problematic since it lacked clarity for the participants. To overcome these problems for this study, it was decided to ground these probes by forcing a comparison between the group-chat treatment and the coordinator application treatment reducing the ambiguity for the participants. The questions were also limited to a 3-point scale to more forcefully prompt the participants to make a decision about each feature.

One set of these questions focused on asking the participants about which coordinator application features they would have desired during the group-chat coordination task.

Figure 11.9 and related tables provide the detailed data from this set of questions. From these data, it is notable that all of the features were desired for group-chat by a large margin. This suggests that the participants found value in having access to these features during the coordinator application treatment and would have preferred the same access during the group-chat treatment.

The two most desired features were the ability to make suggestions for the *date and time* (91.4% desired; 6.2% do not care; 2.5% not desired) and *place* (80.2% desired; 16% do not care, 2.5% not desired). This reinforces the previous findings where the participants reported that the coordinator application made it easier to keep track for the suggestions for the *date and time* and *place*. It also provides additional support for the interpretation surrounding the results of the consensus building and common ground questions.

Even the least desired feature, the Game Plan display, had a very favorable response (71.6% desired; 22.2% do not care; 6.2% not desired).

In addition to asking about provided features, the participants were also asked if they would have liked additional activity details to be supported beyond *date and time* and *place.* The majority of the participants responded that they would (61.7% yes; 27.2% do

not care; 11.1% no). This is an encouraging response since it reinforces the view that the participants found benefit to the coordinator application.

Hypothesis H1 proposed that: *the conversational support and shared information features are perceived as beneficial and aids social group-activity coordination.* What these results show is conclusive support for this hypothesis. Not only did the participants find the coordinator application easier to use but they also desired the features provided by the application in preference to group-chat.

11.4.4 Coordinator Application Compared to Current Technologies

In the Exit Survey a set of questions asked the participants to compare their experience with the coordinator application with current technologies used to coordinate social activities. These technologies are the same as asked about during the Intake Survey discussed in Chapter 10 (see Figure 11.1 and Figure 11.2 and related tables for detailed responses to these questions).

When comparing the coordinator application to current technologies many of the participants responded favorably and indicated that the coordinator application was better.

Surprisingly, the participants did not find the coordinator application much better or worse than face-to-face conversations (42% application; 24.7% neutral; 33.3% f-t-f). Conventional wisdom would expect face-to-face conversations to be considered better than the coordinator application since it is much faster to discuss and coordinate a social activity in person. However, this is only applicable to coordination that is conducted in one face-to-face conversation. We know that this is typically not the case. The diary study in Chapter 8 tells us that will rarely happen except for routine and common activities.

The shared calendars (74.1% application; 19.8% neutral; 6.2% shared calendars) and invite services (72.8% application; 19.8% neutral; 7.4% invite services) were favored more than expected. However, these responses require additional context to be properly evaluated. Over half of the participants (53.6%) reported they never or rarely used invite services while more than two-thirds (72.6%) reported they never or rarely used shared calendars. This lack of experience with these technologies most likely impaired their ability to compare them to the coordinator application.

Email and desktop instant messaging were reported to be comparably worse than the coordinator application. The participant responses show that when comparing the application to email 76.5% agreed that the coordinator application was better, 16% were neutral, and 7.4% found email better. Desktop instant messaging responses were similar with 74.1% of the participants finding the coordinator application better, 19.8% neutral, and 6.2% finding the application worse. However, these were some of the least used technologies. Unlike shared calendars and invite services we know from the information gained in the diary study in Chapter 8 that people have tried to and used email and instant messaging to coordinate social activities. This data can be interpreted as a response to their experience using these technologies and finding them lacking.

The results comparing text messaging to the coordinator application are quite surprising. The intake survey tells us that 76.1% of the participants reported that they use text messaging at least 50% of the time when coordinating social group activities. This indicates that the large majority of participants have a lot of experience using text messaging to coordinate their social activities. The responses in the exit survey show that 70.4% of participants found the coordinator application at least somewhat better than text

messaging, with 18.5% neutral, and 11.1% reporting that the coordinator application is worse.

The next most used technology is mobile group messaging with 73.8% of the participants reporting that they use it at least 50% of the time. So they have a similar level of experience with this technology as they do with text messaging. It is not surprising then that the reported favorability when comparing mobile group messaging to the coordinator application is similar (66.7% coordinator better; 19.8% neutral; 13.6% mobile group messaging better).

The intake survey responses show that 60.6% of the participants use phone calls at least 50% of the time and is almost as frequently used as text messaging and mobile group messaging. The difference in media is quite stark however. The participants' responses indicate some difference when comparing phone calls to the coordinator application with 61.7% finding the coordinator application better, 19.8% neutral, and 18.5% preferring phone calls.

These results are very positive for the coordinator application. They show that for most participants the coordinator application was better than either text messaging or mobile group messaging. These are two technologies that are used every day and in many different scenarios so having results indicating that the coordinator application is better than them shows that while they are very good at supporting unstructured messaging they can be improved upon. Also, these results show that any burden imposed on the participants by the coordinator application was offset by the benefits.

The result of text messaging and mobile group messaging being similar to phone calls in favorability is interesting. First, there is a great difference in the two forms of

media. Text messaging and mobile group messaging allows users to go back through old messages to find and lookup information they have missed. Phone calls do not provide this; however, they provide high bandwidth synchronous communication. Phone calls are typically followed up with text or mobile group messages in order to relay decided upon information to the other group members resulting in this information being retained and captured. So one interpretation is that participants view phone calls as more favorable because they use it as a rich media to discuss coordination details and then use text messaging or mobile group messaging to convey the information to the other members. The coordinator application provides a more robust and meaningful method to convey important social activity coordination details when compared to messaging technologies.

Another possibility for the mixed responses to these questions is what kind of social activity was conceptualized by the participants when responding to the question. From the diary study, we know that different types of social activities are coordinated in different ways and different groups use different media. We know that phone calls and face-to-face conversations are generally preferred and used when the activities are common / routine, require little negotiation over details, coordinating members are frequently co-located, and are conducted between a small number of people typically two to three individuals. Text messaging and mobile group messaging is typically employed when those cases are not met with lack of frequent co-location and larger number of coordinating individuals being the primary motivations for use. An interpretation of the results from this point of view requires us to first assume that when comparing the technology to the coordinator application the participants were also comparing the types of activities they coordinate with those technologies. Then it follows that for routine activities, between a very small number

of people that do not require much coordination of details, the coordinator application is not perceived as much of a benefit. However, when the coordinated activities are between more people, less common, and require more details to be coordinated the benefits of the coordinator application are perceived when compared to text messaging and mobile group messaging.

Overall, the participants reported that the coordinator application is better than these technologies and the results provide additional support for hypothesis H1. At the very least, it tells us that there is a strong desire innovation in this space and we must move beyond what these technologies currently offer.

11.4.5 What Technologies Would Participants Stop Using?

An attempt to collect information about intent to use was made (Appendix A.3 Q8). However, in this context this type of question is more problematic than normal. One of the things discovered about coordinating social activities by the work discussed in Chapter 8 is that the choice of technology is not always up to the person who initiates the coordination. If one's friend will only use text messaging and one desires to do something with this friend and the other members of the social group, then at the least one must coordinate with this friend using text messaging. Armed with this knowledge the questions here are framed in a context such that the participant is asked: if they had the choice, which technologies would they give up using in favor of the coordinator application they just experienced if those in their social groups were using it as well.

The reported data must be interpreted carefully and through the lens of how participants previously reported on their technological use. This is because some of these questions could be asking participants to compare the coordinator application to a

technology that they are unfamiliar with. Table 10.8 contains the data about the participants' technological use for social activity coordination and within this table we can see that the participants reported the most use for text messaging, face-to-face conversations, mobile group messaging, and phone calls. The participants reported the least use for invite services, email, shared calendars, and desktop instant messaging. Therefore, it is important to take care when evaluating these data. Responses to questions about technologies that are not frequently used by the participants would be impacted by the lack of use. Another thing to consider is that the protocol for this study was to conduct the coordination of two social activities from beginning to end in one sitting. This is rarely how actual social activities are coordinated so it is possible that the participants were evaluating how technologies compare with the coordinator application with that particular situation in mind. This does not invalidate this data but only provides another factor to consider during its interpretation

Figure 11.4 and the other related tables and figures contain the responses to this set of questions. Notable but not unsurprising is that the same technologies reported as the least frequently used were also reported as having the greatest number of responses indicating a desire to discontinue use. Desktop IM had 12% of the participants reporting they use it 50% or more of the time, shared calendars 17.8%, and invite services 31%. When asked about technologies they would discontinue use of in favor of the coordinator application 79% responded they would discontinue using desktop instant messaging, with 8.6% neutral, and 12.3% reporting they would continue it using over the coordinator application. The responses to invite services were 55.6%, 23.5%, and 21% and shared calendars responses were 69.1%, 12.3%, 18.5%.

These results are expected since if someone is not using a particular technology frequently that person would logically be willing to take advantage of the opportunity to further remove it from their coordination practices.

The response to participants' willingness to give up face-to-face conversations or phone calls in favor of the coordinator application is not surprising despite the fact they are only more effective in specific coordination contexts. Face-to-face conversations responses were 32.1% in favor of using the coordinator application, 53.1% neutral, and 14.8% in favor of continued use. The responses to phone calls were similar at 39.5%, 44.4% and 16.0%. The participants reported they found the coordinator application better when compared to these technologies while here they are not willing to completely give them up. This likely because coordinating a social activity is in itself a social endeavor and phone calls and face-to-face conversations are arguably more socially engaging.

When examining the two most comparable technologies to the coordinator application (text messaging and mobile group messaging), the responses are quite favorable. These data shows that nearly half (46.9%) of participants responded favorably to switching to the coordinator application from text messaging (35.8% neutral; 17.3% remain). Also, a similarly 48.1% of participants responded favorably to switching from mobile group messaging (33.3% neutral, 18.5% remain). These responses are quite promising considering how entrenched these two technologies are in peoples every day social activity coordination practices.

Figure 11.5 shows the participant responses when asked (yes or no) if they would discontinue using a communication technology to coordinate social activities if the other people they coordinate stopped using it as well. Unlike the previous question, this question

does not compare the technologies to the coordinator application and instead attempt to examine overall desire to continue using these technologies.

The results here are not too unexpected and follow the previous discussion. More than half of the participants reported that they would stop using mobile group messaging to coordinate social activities if others in their social groups would as well. This suggests that when forced to choose the participants would prefer not to use this technology. The participants' reports show that their choice to continue using text messaging is much higher than mobile group messaging. The findings in Chapter 8 help us to understand this result. We know that text messaging apps are primarily limited to one-to-one communication despite various attempts to mediate this by clever application tricks. This would seem to be a limitation that mobile group messaging overcomes and is therefore an advantage of that media. However, what was learned in Chapter 8 is that mobile group chats frequently become derailed from the task of coordinating the social activity and devolve into random conversation about unrelated subjects. This frequently frustrated the participants in that study. Knowing this it is understandable that the participants in this study would prefer to discontinue using mobile group messaging in preference to text messaging.

When examining the responses for any ordered effect, only one was discovered. The responses to the question about discontinuing the use of text messages had a statistically significant result when comparing the order of the group chat treatment ($\chi^2(1, N=81) = 11.752$, $p=0.001$). Participants that used group chat as the first treatment had a much higher response that they would discontinue use of text messaging (23 yes; 19 no) than those who used group chat as the second treatment (7 yes; 32 no) (see: Figure 11.6). This is an unexpected finding. One possible explanation for this difference is that the group

chat coordination treatment primed the participants into facing all the aspects of social-group coordination that they dislike, such as, missing important information, needing to scroll through message history, unclear responses to suggestions, etc., and that the coordinator application introduced them to an alternative where these frustrations are reduced and/or removed. Also, the responses when using group chat first are more aligned with those for the mobile group chat question. This suggests that in the future straight forward comparisons of coordination technologies may not be adequate and more sophisticated methods, such as this study, are required.

11.4.6 Summary

The goal of the research presented in this chapter was to understand how conversational support for social activity coordination compares to group-chat and if that support is desired and favored over group-chat. The results and subsequent discussion show that conversational support is beneficial over group-chat and show that the three main hypotheses are supported. The coordinator application not only made social group-activity coordination easier it also reduced the amount of work required and facilitated consensus building.

The results also validated and supported the conversation centric design perspective that the coordinator application represents. The concepts of providing a shared and persistent conversation space, structuring and supporting the coordination of key activity details while not imposing process, providing semi-structured and specifically tailored user input mechanisms, focus on the minimizing the disparity of work, and supporting conversation first have all been supported.

This study also generated some important unexpected results due to the differences between the scenarios. Appendix D is devoted to providing a potential explanation for this. While unexpected, these results show that there needs to be additional research and thought surrounding how these types of systems are tested and evaluated. The disparity between the two scenarios appears somewhat obvious in hindsight but this is only because of the illuminating aspect of the data collected from this study providing said hindsight. Future research is required to provide additional understanding about how familiarity impacts the evaluation of similar systems. Also, researchers in the future need to be much more aware and careful when comparing systems, groups, activities, and scenarios when attempting to understand and support coordination.

CHAPTER 12

SUMMARY AND CONTRIBUTION

Everyday people get together with their friends, family, co-workers, etc., to do things together. Most of the work that is required to achieve this goes unnoticed and when it is noticed excused as just working things out. The effort involved by many as acceptable because the outcome, doing something with others, is seen as so favorable. In the workplace the time and effort involved in communicating and coordinating is seen as something to be minimized and optimized away. Prior researchers have devoted many years and pages towards advancing out understanding of how best to mitigate these coordination and communication efforts. Yet, when it comes to understanding and supporting coordinating and communicating for social reasons, going to the movies with your friends, there is still a large expanse of knowledge and understanding left to be uncovered. The entirety of the work presented in this document has been in the pursuit of narrowing that expanse by a small amount. While this work has narrowed the expanse it has also shown that the area of social group-activity and coordination is very likely much larger in scope than the work here has covered.

The guiding motivation that underpinned this work was the notion if one is left lacking with what currently is then what is currently known is also. The means of coordinating social group activities was and is lacking, therefore, our understanding about how to do so is as well. This work was guided and informed by prior research and work and drew upon many different areas for inspiration and foundation it did not blindly adhere to any one theory or premise. Due in part because of the acceptance that there was

knowledge missing but also because if one does not accept that the world can be improved then there is little point in the pursuit of improving it.

What we have now is a greater definition and exploration of the area of social group-activity coordination is and a starting point to further refine our concept of social activities. The definitions and explanations in Chapter 2 draw upon and extend previous research. It also shows how limited our current understanding is and why there is need for more work to be done in this area.

The review of prior research in Chapter 3 and Chapter 4 provide a clearer picture of the current state of research in social group-activity coordination and CSCW as a whole as it relates to coordination and communication. There is currently a large gap between the theories related to group communication and supporting the design and implementation of systems that support group communication. Currently, the broad CSCW and calendaring and scheduling research have focused heavily on the process and system perspective that has been overly biased towards understanding work groups and facilitating workplace performance of these groups. Researchers theorizing about group communication are mostly external to the larger CSCW and CHI communities as a whole and are not primarily motivated towards constructing theories that are prescriptive for design. The research into systems and technological use have focused on single technologies limiting our view and understanding about how different technologies are used for the same purpose, e.g., coordinating a social activity. What this work as attempted is to highlight this as an issue while also drawing upon all these different areas for inspiration and assistance in understanding and supporting social group-activity coordination.

The result of gathering these various concepts, theories, frameworks, design implications, etc., was described in Chapter 5 and Chapter 6. In these chapters, conversation centric perspective and design principles for understanding and supporting social group-activity coordination were created. This drew upon many different types of research with very different motivations. The following design principles were formulated from this review: facilitate natural language actions, designs should support unforeseen interdependencies, support consensus building via shared artifacts, design for unanticipated use and reduce specific encoding of process, minimize the disparity of work, and do not focus on achieving optimal coordination and instead support the natural process of reaching a good enough solution. These principles were conceived as a starting point not only for the research contained in this dissertation but for future researchers. What this work has found through the various studies is that the conversation centric design approach allows for the creation of successful designs supporting social group-activity coordination.

The diary study presented in Chapter 8 found many interesting things about social group-activity coordination by focusing on understanding the problem space and not just one specific technology. It was found that there are two main ways the coordination conversation of social group activities begin, group-centric or activity-centric. This is an important finding since the manner in which the conversation begins influences what is initially discussed and the evolution of the conversation. It also shows that it is critical to design with assumptions about how this type of coordination begins. This study highlighted the manner in which critical details about the activity is coordinated moving from generic suggestions to more specific to finally a finalized and accepted understanding. It was also discovered that many of these details are discussed simultaneously and each one could be

in a different place on the path to finalization. Most critical and influential to the resulting design work was discovering the issue with information overload and disparity that occurs when coordinating social group activities. There are typically only one or two leaders that do most of the work and also hold most of groups' knowledge about the coordination. This results in these leaders being overburdened with work and knowledge while other group members are typically left with an incomplete and out of date understanding about the current state of the coordination.

It took years and numerous design iterations to finally realize a design that users found useful and useable. In this document the design work is presented after the diary study chapter and both after the design perspective chapters. However, it was some of the earliest work initiated in this entire process and helped inform much of the other work in this document. Exploring a problem space by working towards a solution is a challenging prospect. One of the hardest requirements is to continuously reevaluate where you are going from where you were and if that is the correct direction. At every step, the next is influenced and guided by all those that came before. The temptation is to continue along a straight path and never explore any turns or deviations, to never question assumptions or concepts. It was important that as the design iterated so too did the conversation centric design perspective and theoretical frameworks used to establish it. This was only enabled by having the two endeavors feedback into each other; which the research through design approach supported The presented design represents a culmination of the learning that occurred over the course of this work, both in respect to achieving the design itself but also on the reflection of what space this work inhabits in the wider field. It was not until many

different and disconnected areas were examined and joined together did a design that promised to overcome the challenges unearthed in the diary study was finally realized.

One of the main goals of this research was to understand and explore current social group-activity coordination practices. The primary method this was performed was via the diary study discussed previously. The findings from that study stand on their own; however, the laboratory study provided an opportunity to collect additional information and confirm those findings quantitatively. The participants were asked about how difficult they find planning social activities, how many social groups they belong to, what technologies they use, and what technologies they prefer to use. The results corroborate with those from the diary study. It was found that the typical number of social groups people reported as belonging to was five. Text messaging and mobile group messaging were the most used and most preferred technologies to coordinate social group activities. Also, there was an evident lack of use of shared calendars and invite systems. Notably, there was a bimodal response to the question about how easy or difficult they find planning social activities. More of the participants reported that it was at least somewhat easy (60.7%) vs difficult (25%). However, when asked about specific difficulties, e.g., keeping track of suggestions, half of the participants reported that for 50% or more of the time they have difficulty doing this. This struggle in collecting general reports about coordination difficulty was also found during the diary study. It is not enough to rely on probing for overall assessment of difficulty in this space. This is true for many design spaces but here it seems much more so because of the integral part coordinating these activities play in our daily lives. It is hard to perceive the negatives in something that we do every day without any thought.

The final phase of research and presented last in this document was the evaluation an instantiation of the presented design and an evaluation with the goal of determining if it provided any benefit to people coordinating a social group-activity. This study was informed by the usability studies that occurred during the design process and by pilot studies. There were three main hypothesis: H1: *the conversational support and shared information features are perceived as beneficial and aids social group-activity coordination*; H2: *the coordinator application reduces the cognitive load required to understand and track the coordination state;* and H3: *The coordinator application increases the ability for groups to reach common ground and a shared understanding of the coordination state.* Each of these hypotheses were supported by the results of this study and together provide confirmation that the conversation centric design perspective presented in this dissertation has merit.

The participants responded very positively to the coordinator application and when they compared its features to group-chat 91.4% desired the ability to make suggestions for *date and time* and 80.2% desired that ability for *place*. In addition, 61.7% of the participants responded that they would have liked to have support for coordinating additional activity details beyond *date and time* and *place*. The large percentage of positive responses to the coordinator application indicates that the participants preferred the tool and its various features much more than group-chat alone. It was also found that the coordinator application reduced information overload and supported consensus building. The participants found coordinating the activity detail *date and time* was easier when using the coordinator application than when using group-chat (understanding when a new suggestion was made (U=650.5, n_1=43, n_2=39, $p < 0.039$), understanding when an activity detail was

agreed (U=608.5, n_1=43, n_2=39, $p < 0.027$), and understanding when previously agreed information was changed (U=602.5, n_1=43, n_2=39, $p < 0.024$) with similar results for *place*.

Not only did the participants find the coordinator application better than group chat they responded that they found it better or at least comparable to text messaging and mobile group messaging systems. Seventy percent of the participants responded that the coordinator application is at least somewhat better than text messaging and two-thirds responded that it is better compared to mobile group messaging systems.

The conclusive result of this study was that the coordinator application and the conversation centric design perspective that it represents does in fact provide a positive benefit to social group-activity coordination. Not only did the participants indicate that it was useful as a whole but they found many of the features that represent the different aspects of the design perspective useful as well.

Overall, this work represents a need to shift the perspective how research and support social activities coordination and communication is accomplished. It is necessary for CSCW and CHI researchers to move beyond a workplace only perspective in regards to coordination and communication. Not only that, but it is imperative that there is a reevaluation and shift from the process and systems oriented perspective that is currently so prolific in this space and transition to a more conversation centric perspective. Also, there needs to be more work done to provide prescriptive theories and frameworks to inform and assist with the design of such systems. Future work should not be required to draw upon and attempt to meld so many disparate pieces in the attempt to work in this area. It is with hope that the work entailed herein aids future researchers in their attempts at

overcoming these challenges and they achieve greater things and provide us with even greater understanding.

APPENDIX A

SURVEY QUESTIONS FOR THE LABORATORY STUDY

Scales will be chosen and modified as appropriate using (http://www.clemson.edu/centers-institutes/tourism/documents/sample-scales.pdf) as a reference.

A.1 Intake Survey

1. Full Name
2. In what year were you born? (enter 4-digit birth year; for example, 1976)
3. I identify my gender as:
    a. Male
    b. Female
    c. Prefer not to answer
    d. Other (please specify)
4. In what country did you spend the majority of your childhood?
5. In what country have you lived the longest?
6. In what language do you speak most often?
7. Which are you?
    a. Undergraduate Student
    b. Graduate Student
    c. Other (please specify)
8. What is your primary mobile device? Android, iPhone, Windows Phone, or Blackberry?
9. How frequently do you use the following technologies to plan social activities with your friends, co-workers, classmates, etc.?
   Scale: 7 point Likert: Never; Rarely (less than 10%); Occasionally (about 30% of the time); Sometimes (50% of the time); Frequently (about 70% of the time); Usually (About 90% of the time); Always.
    a. Text messaging
    b. Email
    c. Phone call

d. Desktop Instant Message (e.g.,AIM, MSN)
e. Mobile Group Messaging (e.g., WhatsApp, GroupMe)
f. Facebook chat
g. Shared calendars
h. Face-to-face conversations
i. Invite Services (e.g., Facebook events, Goog;e Invites, evites)

10. List the top three technologies you use to plan social activities with your friends, co-workers, classmates, etc. The first being the most used.
11. Which of the following technologies do you prefer to use for planning social activities with your friends? (Tell us about your preference, not your frequency of use). Scale: 5 point Likert: Strongly Oppose; Somewhat Oppose; Neutral; Somewhat Favor; Strongly Favor
    a. Text messaging
    b. Email
    c. Phone call
    d. Desktop Instant Message (e.g.,AIM, MSN)
    e. Mobile Group Messaging (e.g., WhatsApp, GroupMe)
    f. Facebook chat
    g. Shared calendars
    h. Face-to-face conversations
    i. Invite Services (e.g., Facebook events, Google Invites, evites)
12. List the top three technologies you prefer to use to plan social activities with your friends, co-workers, classmates, etc., The first being the most preferred.
13. I find that planning social activities is… Scale: 7 point Likert: Very easy; Easy; Somewhat easy; Not easy or difficult; Somewhat difficult; Difficult; Very difficult.
14. How many social groups do you belong to? (Please provide a number)
15. How many times in the last month were you involved in planning a social activity? (including those that do not end up happening).
16. When planning social activities how frequently do you find yourself… Scale: 7 point Likert: Never; Rarely (less than 10%); Occasionally (about 30% of the time); Sometimes (50% of the time); Frequently (about 70% of the time); Usually (About 90% of the time); Always.
    a. …being the main person responsible for the planning?
    b. …needing to ask the other people important details that you've forgot or cannot find anymore?
    c. …coordinating the same activity using different technologies (e.g., using a mix of email and text messaging)?

d. …needing to go through old messages or emails to find important details about the activity you are coordinating?

17. When planning social activities how frequently do you find it difficult to… Scale: 7 point Likert: Never; Rarely (less than 10%); Occasionally (about 30% of the time); Sometimes (50% of the time); Frequently (about 70% of the time); Usually (About 90% of the time); Always.
    a. …keep track of the currently agreed upon details?
    b. …keep track of the different suggestions made during the coordination?
    c. …keep track of who said they were going or not?
    d. …keep everyone on the same page?
    e. …keep track of who agrees on the activity details (e.g., when, where)?
18. Please indicate how much you agree or disagree with the following statements: Scale: 7 point Likert: Strongly disagree; Disagree; Somewhat disagree; Neither agree or disagree; Somewhat agree; Agree; Strongly Agree.
    a. When planning social activities I find that the more people involved in the planning the more difficult it is to coordinate.
    b. I find that the more difficult the coordination is the less I participate.
    c. I prefer to wait until most of the coordination is done and then just let the group know if I am going or not.

A.2 Post Coordination Survey

1. Estimate (to the best of your ability) the total number of suggestions made during the coordination for…
    a. The date and time
    b. The place
2. How satisfied are you with the agreed upon activity details? Scale: 7 point Likert: Completely dissatisfied; Mostly dissatisfied; Somewhat dissatisfied; Neither satisfied or dissatisfied; Somewhat satisfied; Mostly satisfied; Completely satisfied.
3. How easy or difficult was it to understand when the group reached agreement about… Scale: 7 point Likert: Very difficult; Difficult; Somewhat difficult; Neither easy or difficult; Somewhat easy; Easy; Very Easy.
    a. ...the date and time?
    b. …the place?
    c. …the other activity details?
4. How easy or difficult was it to keep track of the suggestions made for… Scale: 7 point Likert: Very difficult; Difficult; Somewhat difficult; Neither easy or difficult; Somewhat easy; Easy; Very Easy.

a. ...the date and time?

b. …the place?

c. …the other activity details?

5. How easy or difficult was it for the group to reach agreement about… Scale: 7 point Likert: Very difficult; Difficult; Somewhat difficult; Neither easy or difficult; Somewhat easy; Easy; Very Easy.

   a. ...the date and time?

   b. …the place?

   c. …the other activity details?

6. How easy or difficult was it for the group to reach a shared understanding about… Scale: 7 point Likert: Very difficult; Difficult; Somewhat difficult; Neither easy or difficult; Somewhat easy; Easy; Very Easy.

   a. ...the date and time?

   b. …the place?

   c. …the other activity details?

7. List the top 5 import activity details that needed to be coordinated for the activity to occur. Exclude the date / time and place in the list. (Please answer at least 1 and if you feel there were no other important details indicate with N/A)

8. For the activity detail: "date and time" that you coordinated how easy or difficult was it to do the following?
   Scale: 7 point Likert: Very Easy; Easy; Somewhat easy; Neither easy or difficult; Somewhat difficult; Difficult; Very Difficult

   a. Coordinate

   b. Keep track of the suggestions

   c. Keep track of who liked / agreed with the various suggestions

   d. Understand when a suggestion was made

   e. Understand when the activity detail was agreed

   f. Understand when the agreed upon detail information was changed

9. For the activity detail: "place" that you coordinated how easy or difficult was it to do the following?
   Scale: 7 point Likert: Very Easy; Easy; Somewhat easy; Neither easy or difficult; Somewhat difficult; Difficult; Very Difficult

   a. Coordinate

   b. Keep track of the suggestions

   c. Keep track of who liked / agreed with the various suggestions

   d. Understand when a suggestion was made

   e. Understand when the activity detail was agreed

f. Understand when the agreed upon detail information was changed

10. For the activity detail: "[TOP #1]" that you coordinated how easy or difficult was it to do the following?
Scale: 7 point Likert: Very Easy; Easy; Somewhat easy; Neither easy or difficult; Somewhat difficult; Difficult; Very Difficult
    a. Coordinate
    b. Keep track of the suggestions
    c. Keep track of who liked / agreed with the various suggestions
    d. Understand when a suggestion was made
    e. Understand when the activity detail was agreed
    f. Understand when the agreed upon detail information was changed
11. For the activity detail: "[TOP #2]" that you coordinated how easy or difficult was it to do the following?
Scale: 7 point Likert: Very Easy; Easy; Somewhat easy; Neither easy or difficult; Somewhat difficult; Difficult; Very Difficult
    a. Coordinate
    b. Keep track of the suggestions
    c. Keep track of who liked / agreed with the various suggestions
    d. Understand when a suggestion was made
    e. Understand when the activity detail was agreed
    f. Understand when the agreed upon detail information was changed
12. For the activity detail: "[TOP #3]" that you coordinated how easy or difficult was it to do the following?
Scale: 7 point Likert: Very Easy; Easy; Somewhat easy; Neither easy or difficult; Somewhat difficult; Difficult; Very Difficult
    a. Coordinate
    b. Keep track of the suggestions
    c. Keep track of who liked / agreed with the various suggestions
    d. Understand when a suggestion was made
    e. Understand when the activity detail was agreed
    f. Understand when the agreed upon detail information was changed
13. For the activity detail: "[TOP #4]" that you coordinated how easy or difficult was it to do the following?
Scale: 7 point Likert: Very Easy; Easy; Somewhat easy; Neither easy or difficult; Somewhat difficult; Difficult; Very Difficult
    a. Coordinate
    b. Keep track of the suggestions

c. Keep track of who liked / agreed with the various suggestions
d. Understand when a suggestion was made
e. Understand when the activity detail was agreed
f. Understand when the agreed upon detail information was changed

14. For the activity detail: "[TOP #5]" that you coordinated how easy or difficult was it to do the following?
Scale: 7 point Likert: Very Easy; Easy; Somewhat easy; Neither easy or difficult; Somewhat difficult; Difficult; Very Difficult
    a. Coordinate
    b. Keep track of the suggestions
    c. Keep track of who liked / agreed with the various suggestions
    d. Understand when a suggestion was made
    e. Understand when the activity detail was agreed
    f. Understand when the agreed upon detail information was changed
15. Please indicate how much you agree or disagree with the following statements:
Scale: 7 point Likert: Strongly disagree; Disagree; Somewhat disagree; Neither agree or disagree; Somewhat agree; Agree; Strongly Agree.
    a. During the coordination I found it difficult to keep track of who was going and who was not going.
    b. When I plan social activities with my friends, family, co-workers, etc., the amount I participate in the coordination is similar to the amount I participated during this coordination.
    c. The person assigned as the organizer acted in that role.
16. Who do you think was the main leader during the coordinate?
17. Rank in order from the person who participated the most in the coordination to the people who participated the least, including yourself.

A.3 Exit Survey

1. How did the coordinator application compare to the group chat only for keeping track of…
Scale: 7 point Likert: Coordinator app was much harder; 2; 3; 4; 5; 6; Coordinator app was much easier.
    a. …suggestions for date and time
    b. …suggestions for the place
    c. …suggestions group chat for the other activity details
    d. …the overall state of the coordination

2. Please state how much you agree / disagree with the following statements:
   Scale: 7 point Likert: Strongly disagree; Disagree; Somewhat disagree; Neither agree or disagree; Somewhat agree; Agree; Strongly Agree.
   a. The coordinator app made it easier for me to participate in the coordination compared to group chat only.
   b. When using the group chat only I found myself needing to scroll back through the conversation a lot to find out details that I missed.
   c. When compared to group chat only the coordinator application made it easier to figure out what I missed during the coordination.
3. Of the following Coordinator app features which ones would you liked to have had access to while using group chat only?
   Scale: 3 point Likert: Yes; Do not care; No.
   a. Coordination summary view
   b. The ability to create suggestions for date and time
   c. The ability to create suggestions for place
   d. The ability to like / dislike the various suggestions made
   e. The ability to quickly identify the different types of actions in the conversation view
   f. The Game Plan display
   g. The suggestion lists
4. Would you like to have had the ability to create suggestions for other activity details, apart from date, time, place…
   Scale: 3 point Likert; Yes; Do not care; No
   a. …when using the group chat only?
   b. …when using the coordinator app?
5. The activity that was coordinated using group chat only is something that I typically do.
   Scale: 7 point Likert: Strongly disagree; Disagree; Somewhat disagree; Neither agree or disagree; Somewhat agree; Agree; Strongly Agree.
6. The activity that was coordinated using the coordinator application is something that I typically do.
   Scale: 7 point Likert: Strongly disagree; Disagree; Somewhat disagree; Neither agree or disagree; Somewhat agree; Agree; Strongly Agree.
7. How much better or worse do you feel the coordinator application is for coordinating social-group activities compared to the following technologies?
   Scale: 7 point Likert: Much worse; Worse; Somewhat worse; Neither better or worse; Somewhat better; Better; Much better
   a. Text messaging
   b. Email

c. Phone call
d. Desktop Instant Message (e.g.,AIM, MSN)
e. Mobile Group Messaging (e.g., WhatsApp, GroupMe)
f. Facebook chat
g. Shared calendars
h. Face-to-face conversations
i. Invite Services (e.g., Facebook events, Goog;e Invites, evites)

8. I would be willing to give up using the following technologies to coordinate social group-activities in favor of the coordinator application if those in my social groups were using it as well.
Scale: 7 point Likert: Strongly disagree; Disagree; Somewhat disagree; Neither agree or disagree; Somewhat agree; Agree; Strongly Agree.
    a. Text messaging
    b. Email
    c. Phone call
    d. Desktop Instant Message (e.g.,AIM, MSN)
    e. Mobile Group Messaging (e.g., WhatsApp, GroupMe)
    f. Facebook chat
    g. Shared calendars
    h. Face-to-face conversations
    i. Invite Services (e.g., Facebook events, Goog;e Invites, evites)
9. If people in my social groups stopped using the following to coordinate social activities I would as well.
Scale: Binary: Yes; No.
    a. Text messaging
    b. Email
    c. Phone call
    d. Desktop Instant Message (e.g.,AIM, MSN)
    e. Mobile Group Messaging (e.g., WhatsApp, GroupMe)
    f. Facebook chat
    g. Shared calendars
    h. Face-to-face conversations
    i. Invite Services (e.g., Facebook events, Goog;e Invites, evites)

APPENDIX B

SCENARIOS FOR LABORATORY STUDY

The scenario text is as follows:

We want you to coordinate going to a cultural event as a group. This can be any activity that involves attending something that increases your cultural knowledge. This can mean going to a play, a museum, taking a tour of a historical site, etc. You are not limited to attending only one event but NJIT will only be paying for the attendance of a single event. We want you to plan which event you will be attending, how you are going to get there, what other activities you may participate in, and how you are going to get back. For this part of the study we want you to coordinate going to a cultural event in <New York City / Philadelphia>.

APPENDIX C

POST COORDINATION SURVEY – WILCOXON SIGNED RANK TEST RESULTS

This appendix contains tables that detail the Wilcoxon signed rank test results that were discussed in Chapter 11.3.1.

Post Coordination Survey Q.3: "How easy or difficult was it to understand when the group reached agreement about"

Table C.1 How Easy or Difficult Was It to Understand When the Group Reached Agreement About – Wilcoxon Signed Rank Test Results

	Group Chat vs Coordinator Application				**NYC vs Philadelphia**			
	Negative Mean Ranks	**Positive Mean Ranks**	**Ties**	**Test**	**Negative Mean Ranks**	**Positive Mean Ranks**	**Ties**	**Test**
date and time	28.236 (n=36)	34.980 (n=25)	21	Z=-0.515 p=0.607	30.565 (n=23)	31.263 (n=38)	21	Z=-1.758 *p=0.079***
place	28.063 (n=32)	30.200 (n=25)	25	Z=-0.577 p=0.564	22.684 (n=19)	32.158 (n=38)	25	Z=-3.193 **p=0.001***
other details	31.400 (n=40)	33.043 (n=23)	19	Z=-1.724 *p=0.085***	31.550 (n=30)	32.409 (n=33)	19	Z=-0.427 p=0.669
* p <= 0.05; ** p <= 0.1								

Post Coordination Survey Q.4: "How easy or difficult was it to keep track of the suggestions made for"

Table C.2 How Easy or Difficult Was It to Keep Track of the Suggestions – Wilcoxon Signed Rank Test Results

	Group Chat vs Coordinator Application				**NYC vs Philadelphia**			
	Negative Mean Ranks	**Positive Mean Ranks**	**Ties**	**Test**	**Negative Mean Ranks**	**Positive Mean Ranks**	**Ties**	**Test**
date and time	30.976 (n=42)	36.696 (n=23)	17	Z=-1.513 p=0.130	30.690 (n=21)	34.102 (n=44)	17	Z=-2.833 **p=0.005***
place	30.711 (n=38)	31.478 (n=23)	21	Z=-1.619 p=0.105	24.033 (n=15)	33.272 (n=46)	21	Z=-4.276 **p=0.000***
other details	34.221 (n=43)	32.152 (n=23)	16	Z=-2.376 **p=0.017***	34.196 (n=28)	32.987 (n=38)	16	Z=-0.961 p=0.337
* p <= 0.05; ** p <= 0.1								

Post Coordination Survey Q.5: "How easy or difficult was it for the group to reach agreement about"

Table C.3 How Easy or Difficult Was It for the Group to Reach Agreement – Wilcoxon Signed Rank Test Results

	Group Chat vs Coordinator Application				**NYC vs Philadelphia**			
	Negative Mean Ranks	**Positive Mean Ranks**	**Ties**	**Test**	**Negative Mean Ranks**	**Positive Mean Ranks**	**Ties**	**Test**
date and time	32.288 (n=33)	33.734 (n=32)	17	Z=-0.046 p=0.963	30.150 (n=20)	34.267 (n=45)	17	Z=-3.095 **p=0.002***
place	28.288 (n=33)	33.204 (n=27)	22	Z=-0.138 p=0.890	27.429 (n=21)	32.154 (n=39)	22	Z=-2.536 **p=0.011***
other details	27.662 (n=34)	34.212 (n=26)	22	Z=-0.191 p=0.849	30.130 (n=23)	30.730 (n=37)	22	Z=-1.659 *p=0.097***
* p <= 0.05; ** p <= 0.1								

Post Coordination Survey Q.6: “How easy or difficult was it for the group to reach a shared understanding about”

Table C.4 How Easy or Difficult Was It for the Group to Reach a Shared Understanding About – Wilcoxon Signed Rank Test Results

	Group Chat vs Coordinator Application				**NYC vs Philadelphia**			
	Negative Mean Ranks	**Positive Mean Ranks**	**Ties**	**Test**	**Negative Mean Ranks**	**Positive Mean Ranks**	**Ties**	**Test**
date and time	30.211 (n=38)	32.304 (n=23)	21	Z=-1.475 p=0.140	26.571 (n=21)	33.325 (n=40)	21	Z=-2.822 p=0.005*
place	28.094 (n=32)	27.870 (n=23)	27	Z=-1.098 p=0.272	21.077 (n=13)	30.143 (n=42)	27	Z=-4.22 p=0.000*
other details	35.232 (n=41)	32.058 (n=26)	15	Z=-1.95 p=0.051**	30.069 (n=29)	37.000 (n=38)	15	Z=-1.704 p=0.088**
* p <= 0.05; ** p <= 0.1								

Post Coordination Survey Q.8 “For the activity detail: ‘date and time’ that you coordinated how easy or difficult was it to do the following?”

Table C.5 Difficultly to Do the Following for Date and Time – Wilcoxon Signed Rank Test Results

	Group Chat vs Coordinator Application				**NYC vs Philadelphia**			
	Negative Mean Ranks	**Positive Mean Ranks**	**Ties**	**Test**	**Negative Mean Ranks**	**Positive Mean Ranks**	**Ties**	**Test**
coordinate (a)								
	27.190 (n=21)	29.286 (n=35)	26	Z=-1.872 *p=0.061***	28.619 (n=42)	28.143 (n=14)	26	Z=-3.332 **p=0.001***
keep track of suggestions (b)								
	34.750 (n=20)	33.681 (n=47)	15	Z=-2.81 **p=0.005***	36.217 (n=46)	29.143 (n=21)	15	Z=-3.335 **p=0.001***
keep track of who liked a suggestion (c)								
	25.563 (n=16)	31.000 (n=42)	24	Z=-3.482 **p=0.000***	30.756 (n=39)	26.921 (n=19)	24	Z=-2.683 **p=0.007***
understand when a new suggestions was made (d)								
	26.559 (n=17)	29.346 (n=39)	26	Z=-2.882 **p=0.004***	30.514 (n=36)	24.875 (n=20)	26	Z=-2.499 **p=0.012***
understand when activity detail was agreed (e)								
	22.079 (n=19)	30.443 (n=35)	28	Z=-2.833 **p=0.005***	30.417 (n=36)	21.667 (n=18)	28	Z=-3.091 **p=0.002***
understand when agreed information changed (f)								
	23.294 (n=17)	30.769 (n=39)	26	Z=-3.34 **p=0.001***	31.068 (n=37)	23.500 (n=19)	26	Z=-2.921 **p=0.003***
* p <= 0.05; ** p <= 0.1								

Post Coordination Survey Q.9: "For the activity detail: 'place' that you coordinated how easy or difficult was it to do the following?"

Table C.6 Difficultly to Do the Following for Place – Wilcoxon Signed Rank Test Results

	Group Chat vs Coordinator Application				**NYC vs Philadelphia**			
	Negative Mean Ranks	**Positive Mean Ranks**	**Ties**	**Test**	**Negative Mean Ranks**	**Positive Mean Ranks**	**Ties**	**Test**
coordinate (a)								
	24.604 (n=24)	32.197 (n=33)	25	Z=-1.912 *p=0.056***	30.400 (n=40)	25.706 (n=17)	25	Z=-3.156 **p=0.002***
keep track of suggestions (b)								
	25.000 (n=20)	25.833 (n=30)	32	Z=-1.355 p=0.175	26.351 (n=37)	23.077 (n=13)	32	Z=-3.326 **p=0.001***
keep track of who liked a suggestion (c)								
	27.068 (n=22)	31.743 (n=37)	23	Z=-2.229 **p=0.026***	30.622 (n=45)	28.000 (n=14)	23	Z=-3.796 **p=0.000***
understand when a new suggestions was made (d)								
	25.326 (n=23)	29.922 (n=32)	27	Z=-1.629 p=0.103	28.841 (n=41)	25.536 (n=14)	27	Z=-3.583 **p=0.000***
understand when activity detail was agreed (e)								
	24.525 (n=20)	27.734 (n=32)	30	Z=-1.853 *p=0.064***	28.638 (n=40)	19.375 (n=12)	30	Z=-4.262 **p=0.000***
understand when agreed information changed (f)								
	23.952 (n=21)	28.226 (n=31)	30	Z=-1.733 *p=0.083***	28.951 (n=41)	17.364 (n=11)	30	Z=-4.639 **p=0.000***
* p <= 0.05; ** p <= 0.1								

APPENDIX D

POST-HOC ANALYSIS OF THE SCENARIO EFFECT

As noted at the beginning of the results section in Chapter 11, analysis indicated that the scenario had a significant effect on the participant responses (see Appendix C). Overall, the participants reported much less favorable reports for the application during the Philadelphia scenario. When the data was split by scenario and examined between participants, then the results are very much favorable for the coordinator application treatment. The purpose of this appendix is to provide a post-hoc analysis that examines and interprets data to help explain this difference between the scenarios.

The first explanation as why there was a difference between the two scenarios comes directly from the participants self-reports. What was observed is that the participants found it much more difficult to coordinate important activity details *date and time* and *place* during the New York City scenario versus the Philadelphia scenario. Tables Table D.1 and Table D.2 show the results of a Wilcoxon signed rank test providing these observations.

Table D.1 Difficultly to Do the Following for Date and Time – Wilcoxon Signed Rank Test Results

	Group Chat vs Coordinator Application				NYC vs Philadelphia			
	Negative Mean Ranks	**Positive Mean Ranks**	**Ties**	**Test**	**Negative Mean Ranks**	**Positive Mean Ranks**	**Ties**	**Test**
coordinate (a)								
	27.190 (n=21)	29.286 (n=35)	26	Z=-1.872 *p=0.061***	28.619 (n=42)	28.143 (n=14)	26	Z=-3.332 **p=0.001***
keep track of suggestions (b)								
	34.750 (n=20)	33.681 (n=47)	15	Z=-2.81 **p=0.005***	36.217 (n=46)	29.143 (n=21)	15	Z=-3.335 **p=0.001***
keep track of who liked a suggestion (c)								
	25.563 (n=16)	31.000 (n=42)	24	Z=-3.482 **p=0.000***	30.756 (n=39)	26.921 (n=19)	24	Z=-2.683 **p=0.007***
understand when a new suggestions was made (d)								
	26.559 (n=17)	29.346 (n=39)	26	Z=-2.882 **p=0.004***	30.514 (n=36)	24.875 (n=20)	26	Z=-2.499 **p=0.012***
understand when activity detail was agreed (e)								
	22.079 (n=19)	30.443 (n=35)	28	Z=-2.833 **p=0.005***	30.417 (n=36)	21.667 (n=18)	28	Z=-3.091 **p=0.002***
understand when agreed information changed (f)								
	23.294 (n=17)	30.769 (n=39)	26	Z=-3.34 **p=0.001***	31.068 (n=37)	23.500 (n=19)	26	Z=-2.921 **p=0.003***
* p <= 0.05; ** p <= 0.1								

Table D.2 Difficultly to Do the Following for Place – Wilcoxon Signed Rank Test Results

	Group Chat vs Coordinator Application				NYC vs Philadelphia			
	Negative Mean Ranks	**Positive Mean Ranks**	**Ties**	**Test**	**Negative Mean Ranks**	**Positive Mean Ranks**	**Ties**	**Test**
coordinate (a)								
	24.604 (n=24)	32.197 (n=33)	25	Z=-1.912 *p=0.056***	30.400 (n=40)	25.706 (n=17)	25	Z=-3.156 **p=0.002***
keep track of suggestions (b)								
	25.000 (n=20)	25.833 (n=30)	32	Z=-1.355 p=0.175	26.351 (n=37)	23.077 (n=13)	32	Z=-3.326 **p=0.001***
keep track of who liked a suggestion (c)								
	27.068 (n=22)	31.743 (n=37)	23	Z=-2.229 **p=0.026***	30.622 (n=45)	28.000 (n=14)	23	Z=-3.796 **p=0.000***
understand when a new suggestions was made (d)								
	25.326 (n=23)	29.922 (n=32)	27	Z=-1.629 p=0.103	28.841 (n=41)	25.536 (n=14)	27	Z=-3.583 **p=0.000***
understand when activity detail was agreed (e)								
	24.525 (n=20)	27.734 (n=32)	30	Z=-1.853 *p=0.064***	28.638 (n=40)	19.375 (n=12)	30	Z=-4.262 **p=0.000***
understand when agreed information changed (f)								
	23.952 (n=21)	28.226 (n=31)	30	Z=-1.733 *p=0.083***	28.951 (n=41)	17.364 (n=11)	30	Z=-4.639 **p=0.000***
* p <= 0.05; ** p <= 0.1								

While the participants reported a difference in difficulty this does not help explain why there was a difference in difficulty. Additional investigation is required.

The first data to look at concerns the number of suggestions made during the coordination task. There are two sources of data for this. One is self-reported by the participants during the Post-Scenario survey. These questions (Appendix A.2 Q1a, and Q2b) asked the participants to estimate the total number of suggestions made for the date and time and place during the coordination task. The second source of data is the number of suggestions made during the coordinator application treatment. This number only records the suggestions made during this treatment via the in-app support, it does not count any suggestions made via the group chat mechanism. These two sources of data cannot be compared via statistics due to the differing natures in which they were collected but also

due to the fact that they represent two different types of data. While we cannot directly compare these data statistically, they are both useful for providing insight into coordination tasks.

Table D.3 Post Coordination Survey Q1 (A & B) Number of Reported Suggestions for Treatment x Scenario

Treatment x Scenario	Question	N	Minimum	Maximum	Mean	Std. Deviation	Variance
Group Chat NYC	Date and time	40	1	9	3.53	1.948	3.794
	Place	41	1	5	2.15	1.062	1.128
Group Chat Philadelphia	Date and time	37	1	7	2.49	1.304	1.701
	Place	39	1	4	2.00	0.889	0.789
Full App NYC	Date and time	34	1	7	3.38	1.457	2.122
	Place	35	1	5	2.49	0.742	0.551
Full App Philadelphia	Date and time	42	1	5	2.67	1.408	1.984
	Place	40	1	4	1.98	0.891	0.794
Zero reports and outliers were removed.							

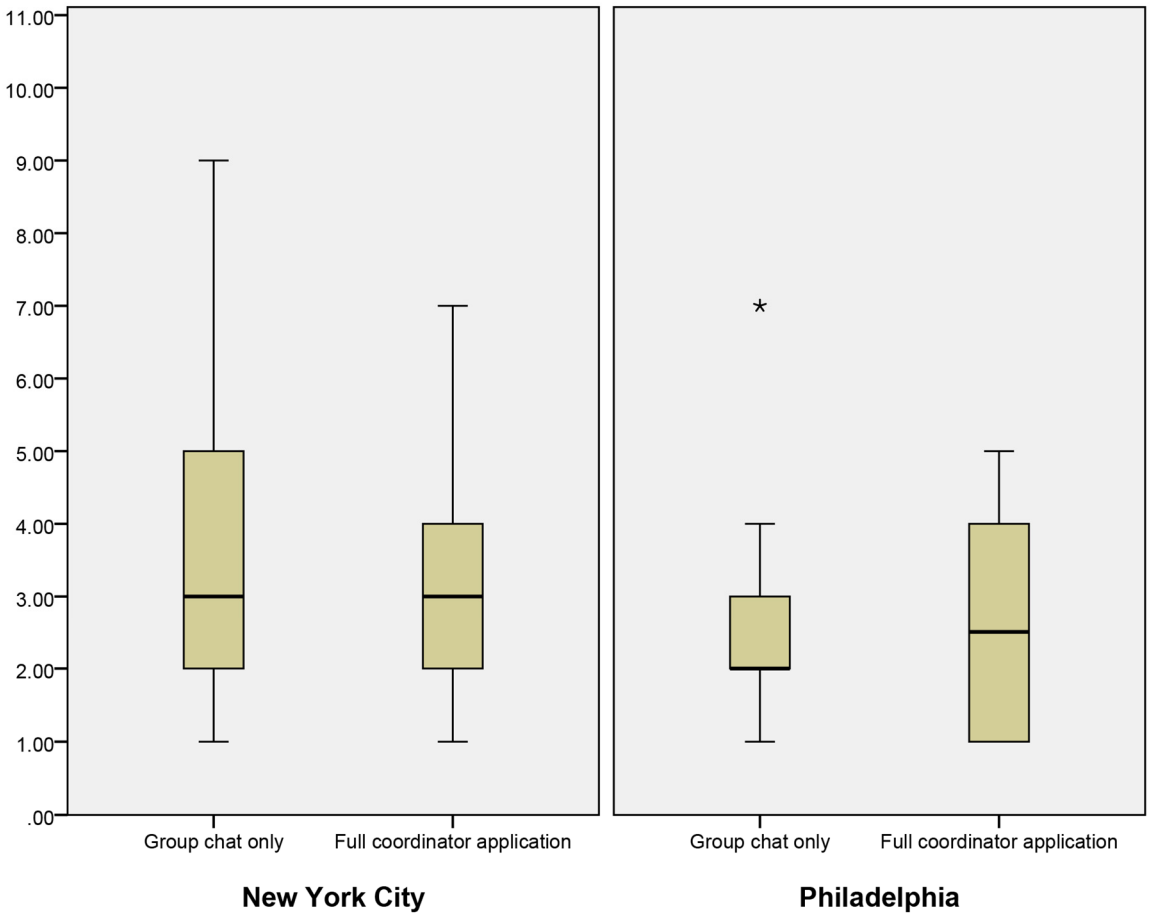

Figure D.1 Box-plot of Post coordination survey Q1a date and time (treatment by scenario).

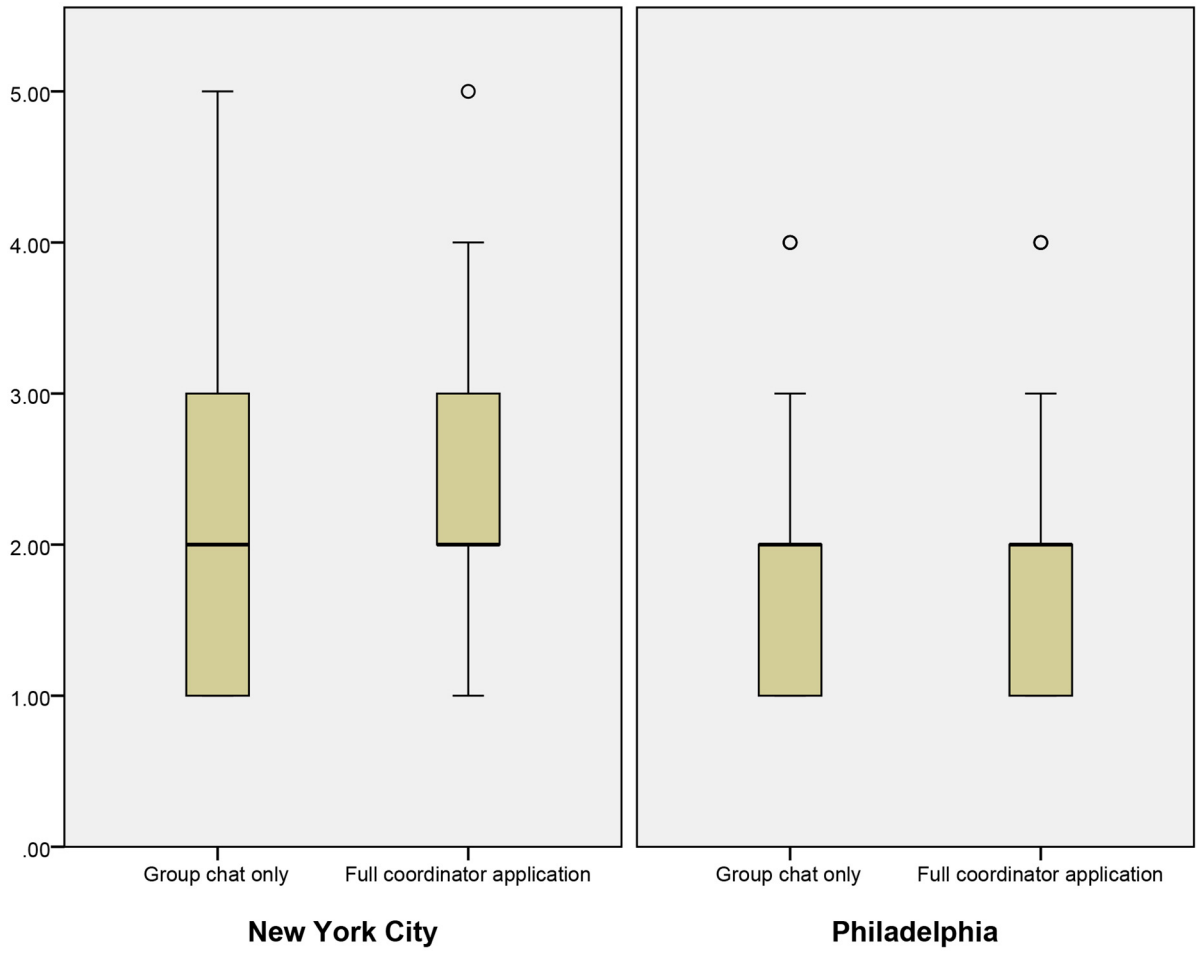

Figure D.2 Box-plot of Post coordination survey Q1b place (treatment by scenario).

Table D.4 Coordinator Application Treatment Descriptive Statistics for Number of Suggestions Made Using In App Support

Scenario		N	Min	Max	Mean	Std. Deviation	Variance
New York City	*date and time*	10	1	5	2.80	1.398	1.956
	place	10	1	8	4.50	2.224	4.944
Philadelphia	*date and time*	11	1	4	2.18	1.079	1.164
	place	11	1	8	3.73	1.902	3.618

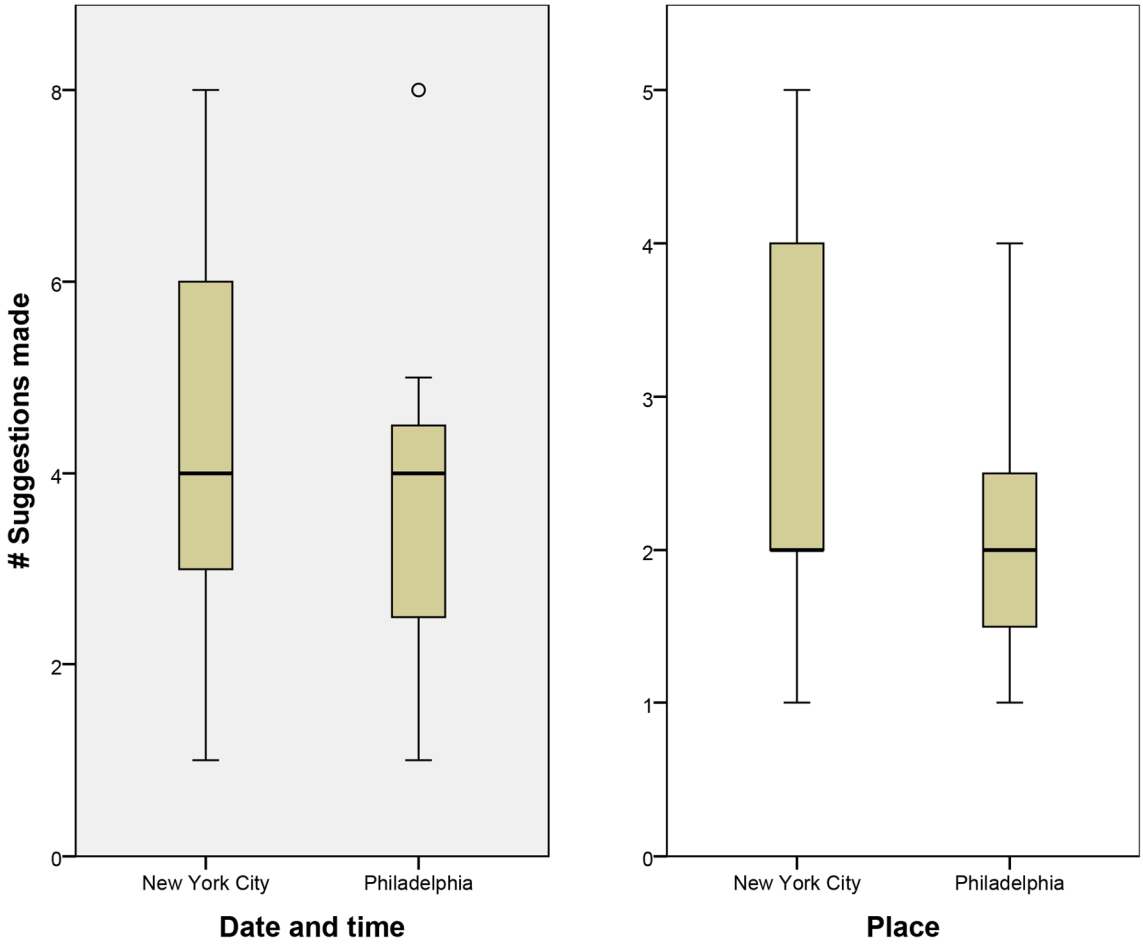

Figure D.3 Number of suggestions made for both date and time and place using in-app support during the coordinator application treatment (by scenario).

Examination of this data reveals an important finding; regardless of the treatment the participants reported fewer suggestions made during the Philadelphia scenario for both date and time and place. These are the number of suggestions made for the two activity details supported by the application that they remember during the coordination. Since the participants reported fewer suggestions we can infer that there was more discussion about the activity details supported by the application for the New York City scenario and less for the Philadelphia scenario. The inference from the reported number of suggestions is supported by examining the data about the number of suggestions made using in-app

support during the coordinator application treatment (Figure D.3 and Table D.4). These two sets of data provide one insight as to the difference between the two scenarios.

The time to completion for each coordination task is also interesting.

Table D.5 Descriptive Statistics for Duration in Minutes of Each Coordination Task Split by Treatment and Scenario

Treatment by Scenario	N	Minimum	Maximum	Mean	Std. Deviation
Group Chat NYC	11	12.42	44.62	26.73	10.91
GC Philadelphia	10	10.50	37.93	22.75	9.07
Full App NYC	10	19.28	48.75	28.37	9.87
FA Philadelphia	11	19.49	40.13	26.34	7.08

Table D.6 Descriptive Statistics for Duration in Minutes of Each Coordination Task Split by Scenario

Scenario	N	Minimum	Maximum	Mean	Std. Deviation
New York City	21	12.42	48.75	27.51	10.20
Philadelphia	21	10.50	40.13	24.63	8.09

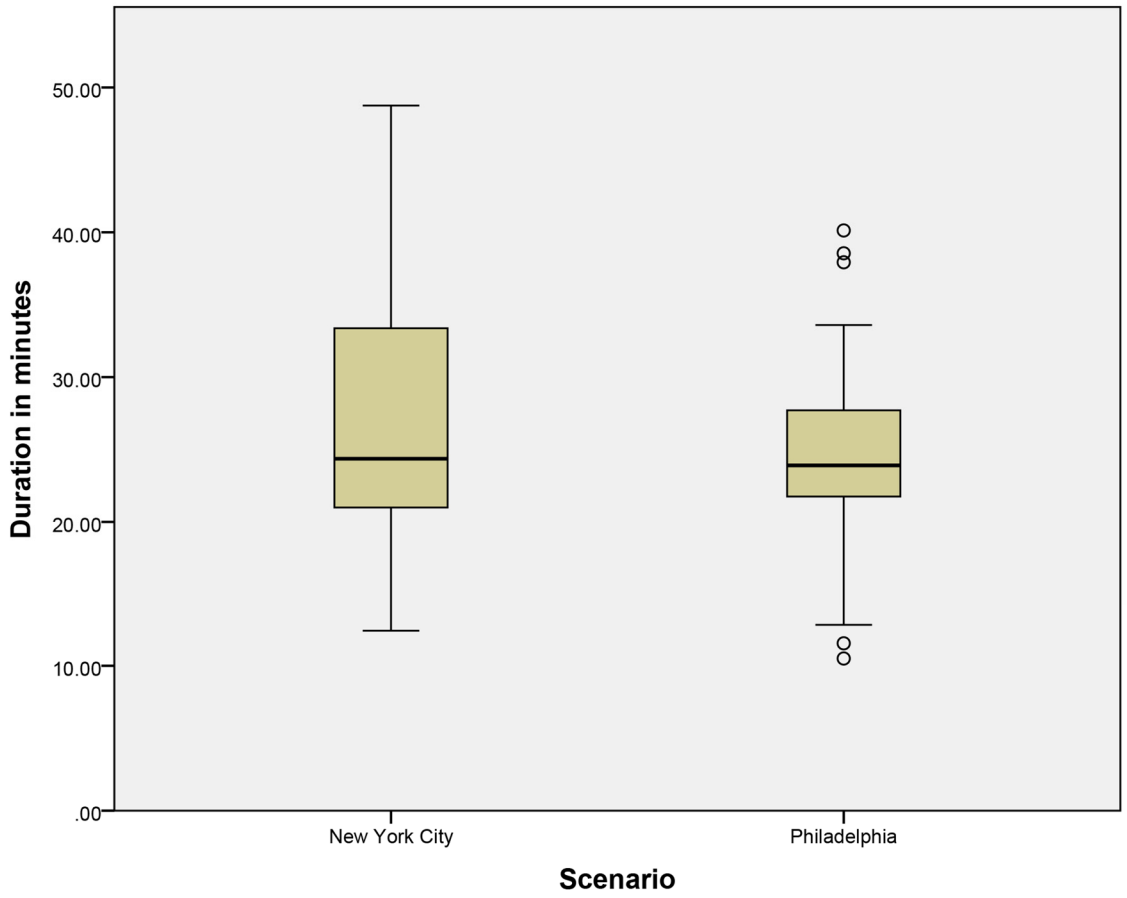

Figure D.4 Box-plot of duration in minutes by scenario.

The data shows that the coordination tasks took less time on average for the NYC scenarios than for the Philadelphia scenarios. However, this is not the full story. When this data is examined for any effect, the order of the coordination task on the scenario (i.e., if the scenario was the first or second coordination task) then some differences emerge.

Table D.7 Descriptive Statistics of Duration in Minutes by Coordination Task Order (First, or Second Task) and Scenario

Task order by scenario	N	Minimum	Maximum	Mean	Std. Deviation
First - NYC	11	20.99627	48.75036	30.84879	10.3794
Second - NYC	10	12.42179	38.39084	23.83257	9.099105
First - Philadelphia	10	22.39746	40.12752	30.5498	6.466512
Second - Philadelphia	11	10.50385	24.71568	19.24909	5.125228

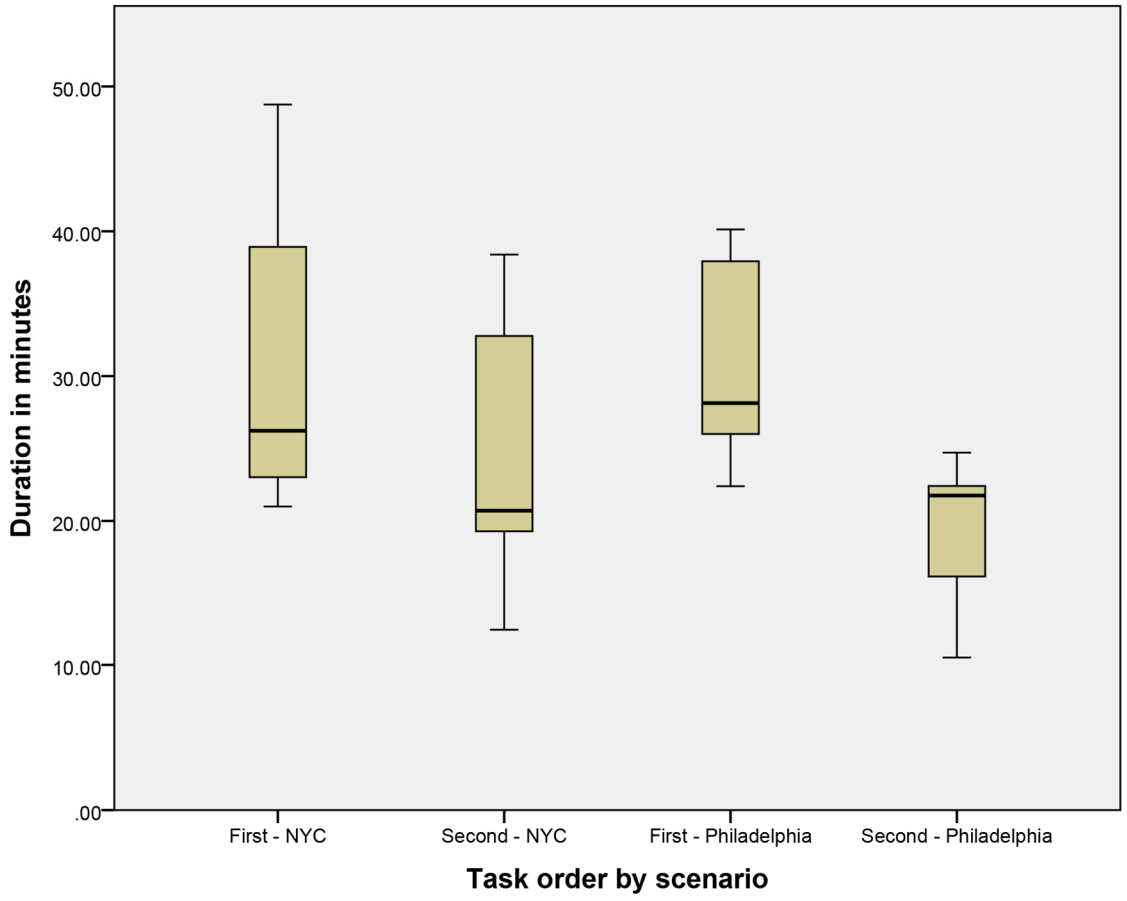

Figure D.5 Box-plot of duration in minutes split by coordination task order (first, or second task) and scenario.

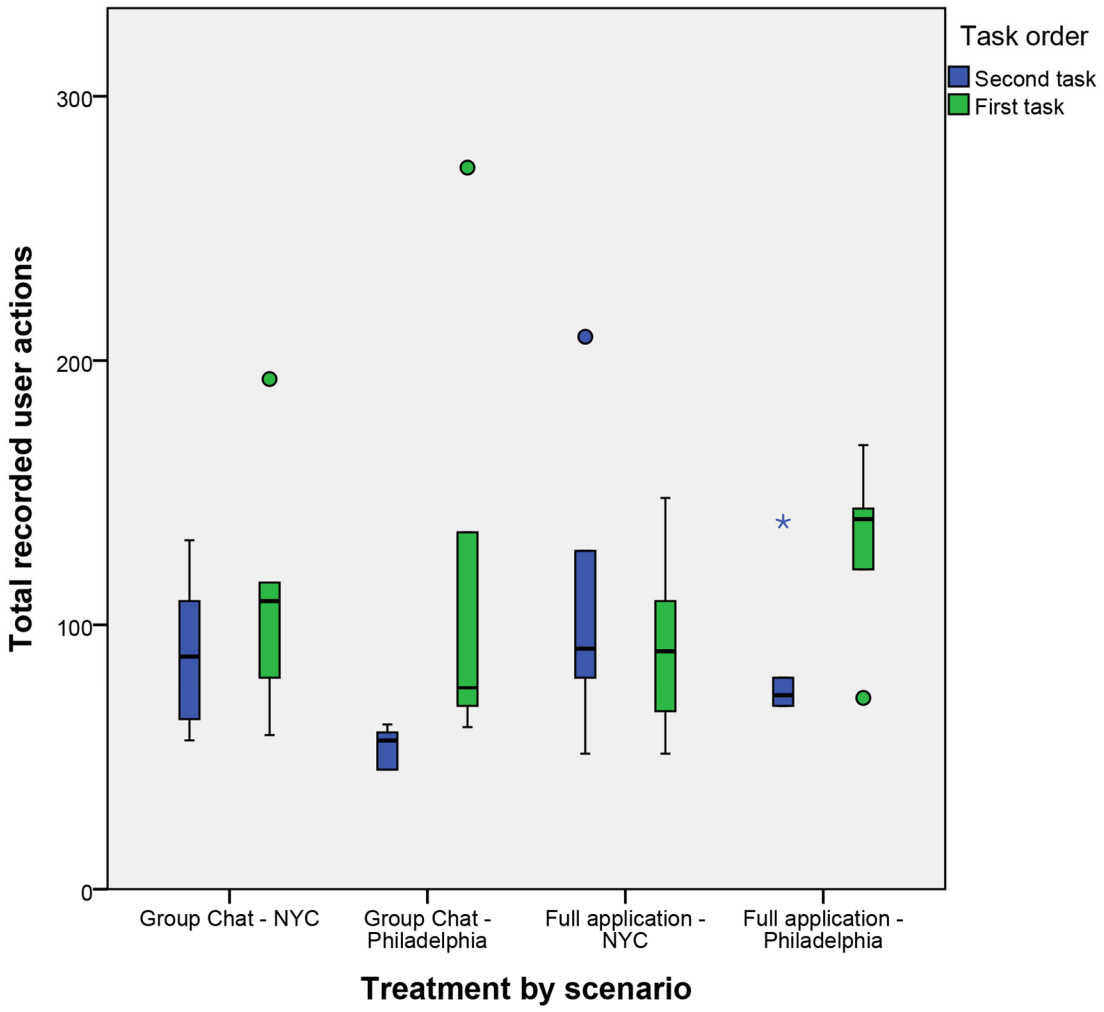

Figure D.6 Box-plot of total user actions grouped by task order and split by treatment and scenario.

There is an obvious difference in the data for the duration of the coordination task. The second coordination task has a lower duration regardless of the scenario with the second Philadelphia task having a much lower duration on average than the others. A box-plot of the total number of user actions split by the coordination task order then by the treatment and scenario (Figure D.6) demonstrates that total number of user actions is only different across the Philadelphia scenario when coordination task order is considered. The

New York City scenario does not display any obvious difference between the task order and number of user actions.

The shorter duration for the Philadelphia scenario, especially as the second task, combined with the lower number of user actions for the second task may explain some of the participants' less favorable perception of the coordinator application over the group chat. However, the second task took less time regardless of the scenario so another interpretation of this discrepancy is required.

This difference in duration due to task order could be the result a few factors, one is: fatigue of the participants; the participants could have wanted to end the session early and attempted to rush to completion. This interpretation disputed by the number of user actions for the NYC scenario not being affected by the task order. Another factor could be explained by a learning effect, i.e., over the course of the study the participants could have become more comfortable with the phone and application they were using during the coordination tasks. This explains the shorter duration for the second task during the NYC scenario while maintaining a similar number of user actions; however, this does not stand for the Philadelphia scenarios. These are very surface level and obvious and do not adequately explain the data observed, something else is happening.

During the Post-coordination survey the participants were asked to identify the top five 5 import details needed to be coordinated other than date and time and place for the activity to occur (Appendix A.2 Q8). The responses for this data was examined and coded into 5 categories: Transportation (relating to how to get to the place), Meeting place (relating to where / if the group would meet up together), Budget, Extra activates (other things the group would do beyond the activity for the coordination task), and Other

(anything not fitting one of those categories). There were responses that were not included in the coding due to missing data, intelligibility, or they reported date and time or place in lieu of the instructions. The following data tables and charts provide the result of this coding for the first and second reported top activity details.

Table D.8 First Top Activity Detail Frequency and Percentages

Scenario	Activity detail code	Frequency	Percent
New York City (n=57)	*Transportation*	36	63
	Meeting place	2	4
	Budget	13	23
	Extra activities	1	2
	Other	5	9
Philadelphia (n=60)	*Transportation*	39	65
	Meeting place	5	8
	Budget	9	15
	Extra activities	1	2
	Other	6	10

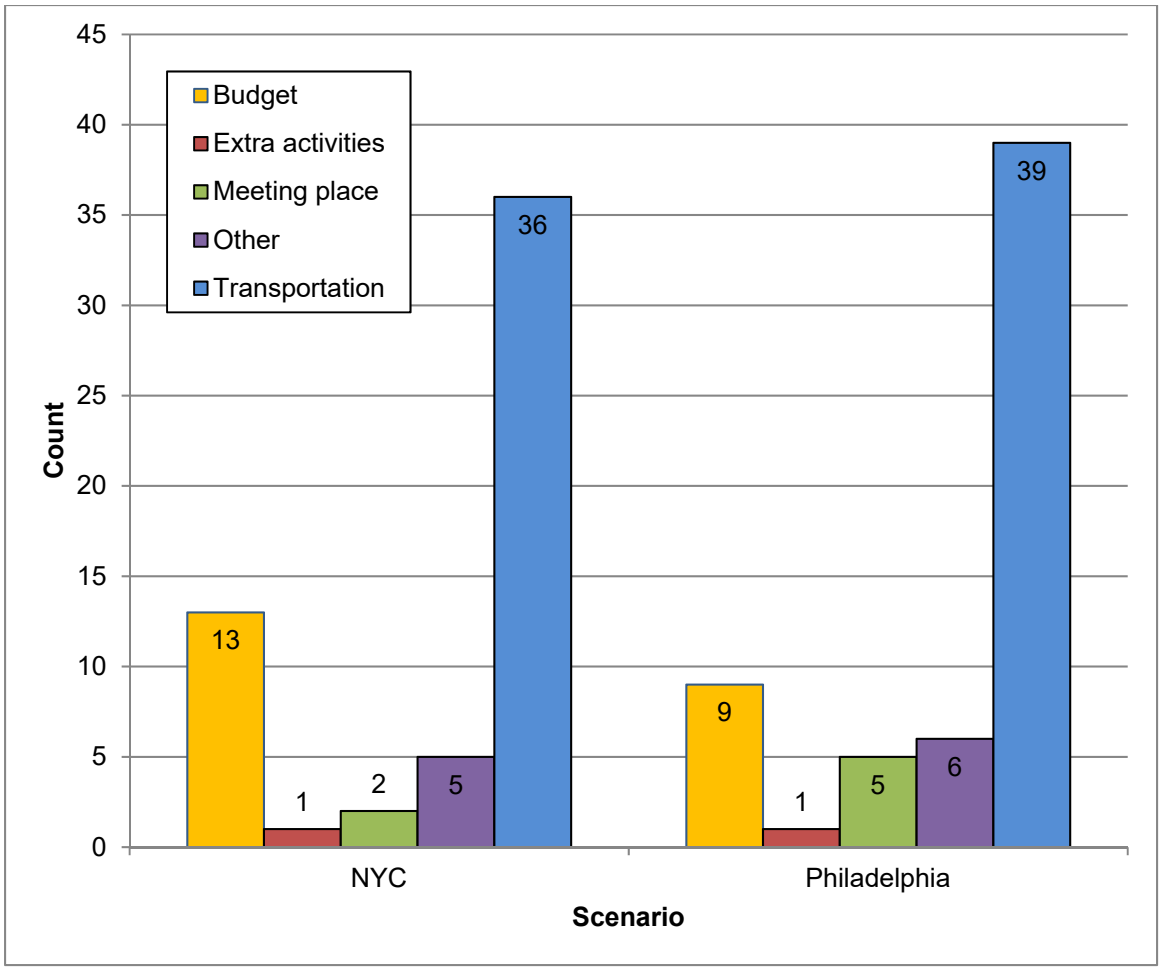

Figure D.7 First top activity detail frequency graph by scenario.

Table D.9 Second Top Activity Detail Frequency and Percentages

Scenario	Activity detail code	Frequency	Percent
New York City (n=49)	*Transportation*	16	33
	Meeting place	5	10
	Budget	12	24
	Extra activities	11	22
	Other	5	10
Philadelphia (n=55)	*Transportation*	19	35
	Meeting place	6	11
	Budget	15	27
	Extra activities	10	18
	Other	5	9

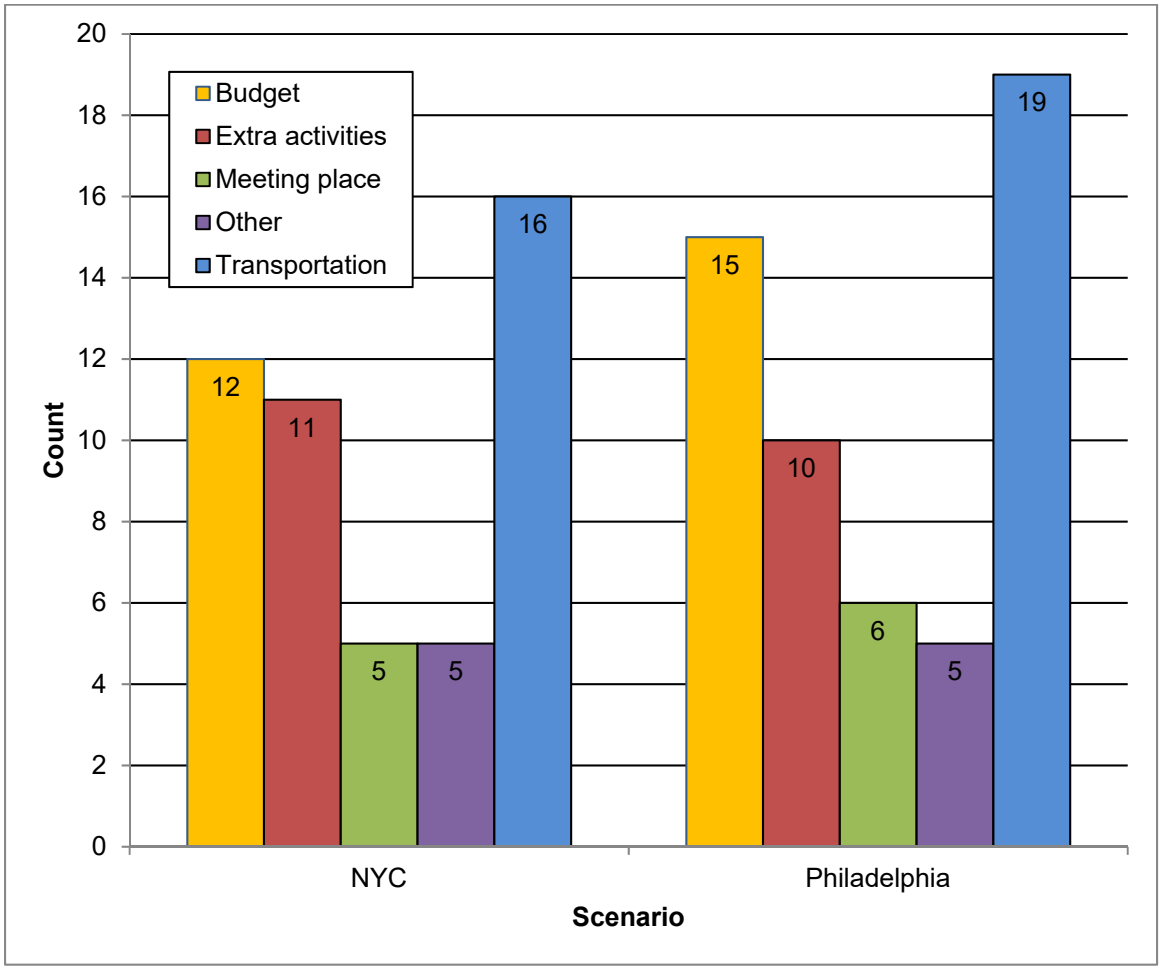

Figure D.8 Second top activity detail frequency graph by scenario.

The data shows that the highest reported first or second top detail was about Transportation with the second being Budget. This is important because it helps us to understand more about the difference between the scenarios. However, to do this we first must review some of the study design and scenario construction.

During the initial design of this study, there was discussion about how closely related the scenarios should be. It was decided that they should be as closely related as possible while removing the possibility for the participants to reuse the previous

coordination task's details. As a result the two scenarios only differ in which city the group was tasked with finding a cultural event in to attend. The location of NJIT made the construction of the scenarios advantageous since it is located near multiple large cities. The initial choice for New York as one of the cities was obvious since it has many places and events that the participants could choose for their cultural activity. Once it was decided that limiting the duplication of activity details between scenarios was paramount another city was now required for the second scenario. After some discussion, the city of Philadelphia was selected since it too has many sites that are culturally significant and is within same-day traveling distance for students both during the week and weekends depending on scheduling. During pilots and follow-up discussion about the study design, there was little questioning about these two choices. It was not expected that there would be a difference, or if any, it would be small. Fortunately, due to the additional insight into social coordination, there was a difference.

What we can surmise is that for the Philadelphia scenario there was more discussion about the transportation requirements and the budget required for the group's transportation. From northern New Jersey where NJIT is located traveling to New York is relatively easy via mass transit and is generally something most people in this area is familiar with doing. Traveling to Philadelphia is a bit more challenging without a car. It is possible and not difficult to travel to Philadelphia via mass transit as well, however, the difference is likely the familiarity with the method and destination of travel. It is not unreasonable to assume that the participants were much more familiar with traveling to NYC and various destinations there. As a result, there was more discussion about where they wanted to go and less about how they were going to get there. This contrasts with the

Philadelphia scenario, where we can once again reasonably assume that the participants were much less familiar with traveling there and also with that city in general so they required more discussion about how they were getting there which likely curtailed discussion about additional places.

We can assume this since we know from the diary study that much social activity coordination is more about first best choice, i.e., groups do not attempt to optimize for the best possible choice but mainly default to the first most reasonable one. There is a great deal of effort required to arrange unfamiliar travel details and these details get inexorably linked to place and date and time. This helps explain why there were fewer suggestions about those activity details during the Philadelphia scenario when compared to the NYC scenario. Also, travel details were not supported by the application only date and time and place was so the participants would have fallen back to using group chat to discuss anything related to travel. As a result, the group chat interface would have become more familiar faster and they may have defaulted to using it rather than the in-app features for date and time and place.

The fortunate aspect of the scenario affect was mentioned earlier. Some may believe that discovering unexpected results from a study is problematic and is a consequence of poor study design. This view is not shared here. Unexpected results drive discovery and understanding and without anything unexpected preconceptions will not be challenged and deeper interpretation of data will not be perused. There are important aspects about coordination and coordination study design that can be learned from the differences from these two scenarios which is important for this study and for other research in this area.

First, specific to this study is the fact that participants found the coordinator application slightly more favorable or comparable to the group chat during the Philadelphia scenario. This is not a failure of the coordinator application but instead it is a success. This is because the coordinator application did not detract from the participants' ability to coordinate via conversation specifically due to the design philosophy of supporting conversation before process. This is unlike every other tool that has attempted to support coordination. Practically every tool besides chat based systems are not used and when used perceived to be a detriment to the coordination overall. Instead we found that when the application could not fully support all aspects of the coordination required the participants were able to fall back to using group chat and therefore the application was at least comparable. When the application supports more of the coordination aspects, then the participants reported that it was better than group chat as we saw in the NYC scenario. So, by rejecting the idea to impose our own coordination process and instead augmenting coordination by building support on top of conversation we were able to successfully provide additional benefit to the participants without hindering them if that additional support was not adequate.

Second, the manner in which research of coordination and coordination support systems requires much more nuance than previously thought. Some of this was hinted during the research through design study where we routinely found that groups of friends would have much more favorable impressions of various iterations of the application than random groups of strangers. It was thought that this was due to the familiarity those groups had with each other and the prior experience with the difficulty of coordinating activities together that made for more positive impressions. However, this study provides an

additional interpretation. While it is true that groups of friends are familiar with each other and their prior coordination experience they are also familiar with what they do, where they go, what times are possible, etc., which provided many more potential choices and variables which is what the application helps groups coordinate. This suggests that studies attempting to evaluate and understand coordination need to focus on coordination tasks that provide some level familiarity in order to increase the potential choices to be evaluated and decided upon. Also, differing tasks (in this specific case destination) alone is not enough, as found between the NYC and Philadelphia scenarios, if the tasks do not adequately provide complementary familiarity and choice potentials.

Third, and much needed, is an understanding of familiarity vis-à-vis coordination. A method of formulating, describing, measuring, and evaluating different aspects of familiarity is required if we are to adequately support coordination. This not limited to just the coordination tasks, groups, scenarios, etc., but also to the technological media used.

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