IMPACT OF SIMULTANEOUS COLLABORATIVE MULTITASKING ON COMMUNICATION PERFORMANCE AND EXPERIENCE

DISSERTATION

Presented in Partial Fulfillment of the Requirements for the Degree Doctor of Philosophy in the Graduate School of the Ohio State University

By

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2008

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ABSTRACT

Media multitasking has become more popular with the proliferation of multi function devices and the belief that multitasking can increase productivity. The trend is especially true among youth today. On the other hand, scientific researchers in different areas have shown that the human brain cannot process information simultaneously and constantly switching between tasks may reduce performance. This study is the first attempt to examine task performance under multitasking conditions through a controlled experiment.

In this study, subjects were asked to work with one or two partners through online communication tools like Instant Messaging (IM) and Skype. The results show that there is deterioration on performance from single task to multitask. Although actors in multitask conditions think they performed well, their partners give a lower rating on actors’ performance. Therefore, when people are multitasking, they may not perform as well as when they only focus on one thing.

Other than perceived performance by self and others, we also looked at the number of questions answered as an indicator of actors’ performance. There is a significant difference between single task and multitask on the number of questions answered during the experiment. This indicated that when doing more than one thing at the same time, people slowed down with their work; therefore, there is no improved
productivity as commonly assumed.

This study is a first attempt to study the multitasking behavior in an environment simulating real life online communication experience. Although numerous survey studies have provided evidence about the prevalence of media multitasking among youth and other generations, this study provide more insights about the discrepancy between self and others’ perception and experience during the multitasking process. Since we used an experiment design in this study, the results cannot be applicable to the general population. However, future study may use our findings to further investigate the multitasking communication process on a broader basis.
Dedicated to my parents
ACKNOWLEDGMENT

I want to thank my advisor Dr. Prabu David for his continuous guidance through all these years. Without his encouragement and help, I would not be able to finish this study.

I want to thank my committee Dr. Dimmick and Dr. Kosicki for their valuable insights and advice during the whole process.

I also want to thank my husband and children, who have been the most dedicated supporters for my pursuit. Your patience and love enabled me to finish this dissertation.

Lance Oditt and Heath Rittler also helped me with the experiment design and data collection. I really appreciate their contributions to this study.
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CHAPTER 1

INTRODUCTION

Multitasking, a term indicative of doing, or trying to do, more than one task in a short or limited period of time, has become cemented into the lives of many individuals. Such behavior, reportedly utilized for generations in an individual’s workplace and at his/her home, occurs when people do multiple activities, such as doing chores while listening to music; eating when watching TV; and talking on the telephone while writing notes. Multitasking may be described as the ability to accomplish “multiple task goals in the same general time period by engaging in frequent switches between individual tasks” (Delbridge, 2000, p.1). Other definitions have been advanced as well, including “the ability to handle the demands of multiple tasks simultaneously” (Lee & Taatgen, 2002, p. 573) or just simply as doing several things at once (Pew & Mavor, 1998).

From a cognitive modeling perspective, multitasking has been defined as “the ability to integrate, interleave, and perform multiple tasks and/or component subtasks of a larger complex task” (Salvucci, 2005 p. 458). Multitasking may refer to a situation “where a person has to complete multiple tasks, but cannot execute them sequentially (due to time limitations) or simultaneously (due to physical or cognitive limitations). As a result, tasks are interleaved with one another, each being suspended and then resumed.
after appropriate intervals.” (Burgess, 2000, p. 848).

1.1 Media multitasking

As media continue to play an increasingly vital role in human life from all perspectives, the time individuals invest in activities involving use of some type of media occupies a large portion of their waking hours. The Census Bureau's annual Statistical Abstract of the United States estimates that Americans spend more than 9.5 hours a day with media (U.S. Census Bureau, 2006). Hours spent using more than one type of media simultaneously, such as watching TV and using the Internet, talking on the phone while listening to music, were counted twice; nevertheless, this number indicates media multitasking occurs at significant rates in everyday life. However, most media multitasking is not inherently coupled or coordinated, except by the user.

Emerging digital technology offers users the capability to use even more media simultaneously, a technological advance which gives rise to the phenomenon of “media multi-tasking.” Media multitasking, a term that involves both use of media and multitasking, includes common behaviors in which people engage daily, such as talking on the phone while searching for information on the Internet, listening to the radio while reading a newspaper, and/or chatting with friend online while talking over the phone.

With regard to hardware, a desktop or notebook computer now routinely runs multiple applications simultaneously. Other advances in digital technology, along with the increasing miniaturization of components and converging functions, continue to change the landscape of consumer technology. Notebook computers can be used as audio
and video players, and video game graphics are increasing in density and complexity. Cell phones are converging with digital cameras, while new generations of MP3 players also play recently released video clips and movies.

Thanks to rapidly evolving technologies, a person can increasingly utilize information resources and perform technology-supported tasks with a diverse set of multifunction tools such as the computer, an ideal media multitasking station that can currently perform numerous functions also served by other traditional devices, including, but not limited to, radios, telephones, CD/DVD players, and televisions. In addition, devices with customizable interfaces, often mobile, may be utilized online in a variety of contexts. As new technology enables an individual to customize the tools he/she uses online, it becomes vital that he/she understands as much as possible, not only about the interaction between individual characteristics and technology, but also recognizes countering components and potential compromises related to online multitasking.

College students, as well as professionals and parents, particularly moms, have practiced multitasking for eons before the Internet came into their lives, as individuals attempt to gain more from their valuable time. One study, The Internet Goes to College, by Pew Internet Projects (Jones, 2002), suggests the multitasking behavior contemporary students currently practice online is not new, but rather a supplementary method reproducing types of multiple interactions students previously performed offline. Contemporary examples of domestic multitasking include cooking and shopping. Multitasking constitutes an integral component of many jobs, including, but not limited to management (Seshadri & Shapira, 2001) or emergency medicine, as well as rescue efforts.
(Chisholm, Collison, Nelson, & Cordell, 2000). However, it is the youth who are perhaps most affected by the communication multitasking.

1.2 Generation Y and Multitasking

Young Americans, or those between the ages of 18 and 25 (born between 1983 and 1990), maintain myriad labels, including “Generation Y” or “Generation Next.” These individuals constitute the cohort of young adults growing up with personal computers, cell phones and the Internet, who currently claim their place in a world where, some contend, rapid changes qualify as the primary constant (Pew Research Center, 2007).

Experiencing constant changes, this generation reportedly realizes they qualify as the most avid multitaskers in both online and offline activities. Studies examining media multitasking have focused on this generation. These include two Middletown Media Studies (Papper, Holmes, and Popovich, 2004; Papper, Holmes, Popovich, and Bloxham, 2005), Kaiser Family Foundation Studies on American Youth Media Exposure (Kaiser Family Foundation, 2005), along with a number of Pew Internet & American Life Project Studies.

In today’s expansive realm of multiple media use, individuals routinely utilize particular types of media more often in conjunction with other forms. For example, an individual may frequently use instant messaging (IM) along with talking on the telephone and/or reading a newspaper, in addition to other media forms. The Kaiser Family Foundation’s study, which explored the full pattern of media use among a representative
sample of U.S. youth, reveals U.S. youngsters are reportedly immersed in media. During 1999, the average youth devoted 6.75 hours to media. With concurrent use of multiple media (i.e., media multitasking), however, this increased his/her exposure to 8 hours.

As scores of youth frequently utilize two or more media simultaneously, they appear to engage in media multitasking at least one fourth of their media exposure time. Even though overall media exposure time increased from 1999 to 2004 by more than an hour, media use actually increased by only two minutes. In other words, although media exposure increased, time invested in media multitasking simultaneously increased. For this reason, the actual amount of time youth committed to media use basically remained the same (Kaiser Family Foundation, 2005).

A primary impetus for this study evolves from the fact that despite the increasing popularity of media multitasking, a dearth of literature exists on the performance of such behavior during communication between human beings and its impact on the communication experience. While some studies, having emerged in the past few years, focus on the phenomena of growing popularities of media multitasking behavior, more information is needed on the underlying psychological and interpersonal communication process.

Following reviews of the findings of nationwide surveys on multitasking behavior, I review theoretical models and frameworks that are relevant to this study. Based on the limitation of human capacity when processing messages, I use the limited capacity model as the theoretical framework to examine multitasking performance. A number of other potential predictors of multitasking performance such as attention, working memory, and
personality are also reviewed and their application to this current experiment design discussed.

Since the experiment conducted for this study employs both self and partner perceptions to evaluate task performance and communication experience, theories related to the causes of difference between self impression and others’ observation, which include co-orientation theory of communication and studies about ego-centric biases and systematic divergence in the assessments of self versus others, are also reviewed.

1.3 Statement of Problem

Contrary to the popularity of media multitasking among younger generations, findings from human communication research and cognitive psychology suggest that humans possess limited simultaneous processing skills in some areas, whereas they are proficient in multitasking in other domains. Kahneman (1973) argues that when auditory and visual channels complement one another, they create a super ordinate [semantic] structure basically constituting a semantic blend of message channels that blend as an intact semantic unit based on the viewer’s perceptions.

Human behavior constantly changes from one second to the next, contributing to the fact that human behavior, and consequently human cognition, constitutes a phenomenal, dynamic process (Thelen and Smith, 1994). Communication, also a constant interactive process, serves as the overtime interaction between humans (Geiger and Reeves, 1993; Lang, 2000; Rafaeli, 1988).

Media multitasking involves simultaneous experiences or exposure to content
from diverse media. As an individual possesses only a limited number of cognitive resources, he/she will not, however, be able to process information at the same level of efficiency while multitasking as when single-tasking. As a result of the continuing shifting attention in multitasking, an individual who engages in this practice experiences less effective retrieval of information, as well as less effective encoding and storing information.

On a practical level, although there have been many studies on human multitasking with several tasks (e.g., Knutson, Wood & Grafman, 2004; Law, Logie, & Pearson, 2006; Lee & Taatgen, 2002), there is a lack of study of media multitasking that focuses on human communication during multitasking, and the field lacks baseline information about some of the fundamental multitasking processes that may include information retrieval patterns, attention, memory, and the ways in which media multitasking may affect human communication. Therefore, the goal of current study is to fill this gap by examining the effect of multiple media use on task performance and communication between collaborators working on a task. In addition to task performance, this study also examines perceived satisfaction with the experience by comparing differences between self and partner impressions of communication experiences and contributions to the task under media multitasking conditions.

Results of the current study will provide valuable insights in this area and establish a “baseline” for further research. I contend that with rapid advances in digital technology and increased media multitasking, its impact on communication needs to be further examined. This study does so by utilizing cognitive psychology theory along with
the limited capacity theory to explore the information processing mechanism of multitasking behaviors, while additionally examining the effectiveness of such behavior from both self and other’s perspectives.
 CHAPTER 2  

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

A dearth of literature exists on the performance of media multitasking and its impact on the communication experience, which is one impetus for the current study. Meanwhile, studies focused on the phenomena of growing popularities of media multitasking behavior have been emerging in the past few years. In the first section of this chapter, the most relevant studies on media multitasking behaviors will be reviewed based on their methodology, objectives, and findings. Two Middletown studies about media multitasking behavior will be discussed first, then three studies based on Kaiser family foundation surveys will provide more detailed insights about media multitasking behavior among the younger generations. Two Pew Internet & American Life Project Studies, related to multitasking behaviors in college and multitasking patterns while instant messaging, will also be reviewed due to their relevance to the experiment participants and the research topic of the current study.

Following the reviews of the studies on multitasking behavior, the theoretical models and framework of the current study will be reviewed based on their connections to the study. The limited capacity models and theory will be used as theoretical framework for the proposed study to explain multitasking performance based on the
limitation of brain capacity when processing messages. Other potential predictors of multitasking performance such as attention, perceived communication experience, and personality will then be reviewed, and their application to the experiment design will be discussed. Since the study employs both self and partner perceptions to evaluate task performance, theories related to discrepancies between self impression and partner observation will also be reviewed, which include the co-orientation theory of communication and studies about systematic divergence in the assessments of self versus others.

2.1 Media Multitasking Behaviors

2.1.1. The Middletown Media Studies

The Middletown Media Studies are a comprehensive attempt to understand how consumers interact with all major media and the roles media play in consumers’ daily lives. The first Middletown Media Studies (Papper, Holmes, & Popovich, 2004) compared media time budget results using traditional telephone survey, media diary, and observational methods. Middletown Media Studies II (Papper, Holmes, Popovich, & Bloxham, 2005) explored the media time budgets of a much larger sample using an enhanced observational methodology.

The first Middletown media studies attempted to discover how media multitasking happens in the everyday life of the media user, as well as whether there are any patterns in how the media user employs multiple media sources. The study found that there appears to be more extensive simultaneous multiple media use than people realize.
The results suggest that TV usage is single media dominated. Based on observation, when people are watching television as their primary activity, they are focused on the media with their full attention. Combining television and the Web is the most prevalent form of media multitasking and that holds true for all age and gender groups. The study also found that some forms of media are frequently used in conjunction with other forms. For example, instant messaging, telephone, and newspaper use are often combined with usage of other forms of media at the same time; but watching movies on DVD is frequently a single-media experience.

Middletown Media Studies II (Papper et. al., 2005) explored the media time budgets of a much larger sample using an enhanced observational methodology. Investigators developed data-logging software to run on small laptop computer during observation. A targeted, demographically balanced population was recruited for the study. The researchers found that when television and radio are not the only media in play, they are likely to be a background medium to some other primary medium.

The Web has only 48.3 percent of its minutes as sole or primary medium. Such a relatively low single-medium figure is mainly caused by concurrent same-screen computer-based media (email, software and instant messaging). The Web also tends to be paired with “background” media such as television and music in terms of average minutes of media multitasking.

2.1.2 Kaiser Family Foundation Studies

Before the study conducted by Kaiser Family Foundation in 1999, no study in the public domain had ever examined the full pattern of media use among a representative
sample of U.S. children, let alone how children have accepted, adopted, and begun to use the proliferation of new media that have become available over the past few years.

In this study, a cross-sectional national random sample of 1,090 children aged 2 through 7 years and 2,065 adolescents aged 8 through 18 years, including over samples of African-American and Hispanic, completed media behavior questionnaires either by parents (2-7 years old) or independently at school. Of those same adolescent respondents, 487 also completed weeklong media diaries at home. Questions about access, amount of exposure, type of content consumed, and the physical and social context of media use were asked for each of the following: print (books, magazines, and newspapers), television, videos, motion pictures, audio media (radio, CD, and tape players), computers, and video games.

The study found that U.S. youngsters are immersed in media. Most households contain a variety of media (computers and video game systems are the exception), and the majority of youth have their own personal media. The average youth devotes 6.75 hours to media; simultaneous use of multiple media increases exposure to 8 hours of media. Overall, media exposure and exposure to individual media are found to vary as a function of age, gender, race/ethnicity, and family socioeconomic level. Television remains the dominant medium. About one-half of the youth sampled uses a computer daily.

The total sample spent slightly more than 0.5 h/day with the computer (21 min out of school and 13 min for school- or job-related work). That is less time than they spend on the leisure use of print, radio, and CDs and tapes, and about 5.5 times less than they
spend with television. Overall, computer exposure accounted for just 7% of U.S. 
youngsters’ total media time before the new century, and computers had yet to become 
the dominant medium used by American youth.

Before the new millennium, U.S. 8- through 18-year-olds spend almost one third 
of every day exposed to media messages. Television remains as the dominant medium, 
although music media become equally important for older teens. A substantial proportion 
of youngsters do not use a computer at all. However, those who do use computers spent a 
long time on the medium; computer users spend an average of more than 1.5 h per day on 
the computer.

2.1.3 Generation M: Media in the Lives of 8-18 Year-Olds

The Generation M study in 2005 updated the Kaiser Family Foundation’s 1999 
study, Kids & Media @ the New Millennium. It was based on a nationally representative 
survey of 3rd to 12th-grade students. The study explored American children’s access to 
and recreational use of a full range of media, including newspapers, magazines, books, 
TV, DVDs /videotapes, video games, movies, radio, MP3s, CDs and tapes, computers 
and the Internet.

Five years after the first study, U.S. 8- to 18-year-olds reported spending more 
than 8.5h daily exposed to (recreational) media content. Considering the time they needed 
for school activities and sleep, most kids were using two or more media simultaneously 
to generate a longer media exposure time. It appears that at least a quarter of their media 
exposure time is consisted of media multitasking behavior. When media multitasking is 
taken into account, the averages media time adds up to almost 6 and half hours per day.
Although overall media exposure time increased by more than an hour within the five-year span, media use only increased by two minutes. In other words, with growing exposure to media content from different channels, the time kids spend on media multitasking also increased rapidly. In fact, it increased so much that the actual amount of time devoted to media use remained constant.

Screen media continue to be dominating the most of kids’ overall media budgets (48%); 35% of kids’ media time is spent on TV and another 13% is used on videos, DVDs, and movies. Although there were differences in the media usage pattern by age, other demographic characteristics did not change the total media usage time significantly.

Compared with the previous five years, the amount of time U.S. kids spent with computers more than doubled, resulting from the combination of increased penetration of personal computers both at home and at school, the development of Internet technologies and applications, as well as the growing popularity of computer based activities and entertainment such as gaming and online social networking, whose leading users are teens and young adults. Five years ago, there were no questions asked about time spent playing games online, about various graphics programs or about time spent instant messaging. Since then, each of these activities has begun to occupy a substantial amount of the time kids spend on computers. The result of such change is that the average amount of time youth devote to various computer activities increased from 27 minutes daily to 62 minutes daily.
2.1.4 Media Multitasking Among American Youth: Prevalence, Predictors and Pairings

Based on data from the generation M study, Foehr later analyzed media multitasking among American youth (Foehr, 2006). The study used both seven-day media use diaries collected from the generation M study and multitasking-related data among the 1,205 7th – 12th grade participants in the national survey. In the media diaries, respondents listed each of their media usage that lasted more than 15 minutes. They were also asked to specify their primary media activity, and if applicable, they were also asked to list any secondary activity they may have engaged in, such as using another media (media multitasking), or completing chores, eating, working on homework, and/or talking on the phone (overall multitasking). While the 2005 Kaiser Family Foundation study documented the percentage of media time spent media multitasking, this analysis describes the teens most likely to “media multitask” and which media are combined the most in multitasking. It also explores how other characteristics and teen behaviors affect media multitasking. The report indicates:

- When used as the primary activity, TV and video games are the least likely to be simultaneously used with other media. On the other hand, activities such as reading, and using the computer are most likely being multitasked with other activities such as instant messaging, computer games and web searching. About two-thirds of the time when young people are reading, playing computer games or surfing the Internet, they also multitasking.

- Most young people are multitasking at least some of the time. In a typical week, eight in ten (81%) young people invest some media time utilizing more than one
medium at a time ("media multitasking"), including reading a magazine while watching TV, listening to music while playing a video game, etc. On the other hand, during the course of a typical week, approximately one in five (19%) young people do not media multitask at all. Young people who do media multitask spend an average of 26% of their media time simultaneously using more than one medium.

- Young people are most likely using other media when they use instant messaging (74%), surf the Internet (74%) or play computer games (67%). The least likely media multitasking is during the time when they are watching TV (17% of the time). Generation M survey with nationally representative data also found that TV is the medium that has the lowest multitasking rate. When respondents were asked how often they used another medium while watching TV, only 24% reported they did so “most of the time.” On the other hand, 33% reported they used another medium “most of the time” when listening to music or using the computer.

- Girls are more likely to media multitask than boys. By using the regression analysis of survey data from Generation M study, the research used demographics and personality traits among 7th–12th graders to predict young people’s media multitasking behaviors. After controlling other variables, the analysis indicates that most demographic characteristics cannot accurately predict how likely these youth are to multitask their media. Only gender shows to be a relevant indicator of multitasking behavior, which means girls are more likely than boys to engage in media multitasking.
Other factors that helped facilitate media multitasking were also found, such as access to computer at home, availability of TV within eyesight, and living in a home with a lot of TV exposure.

The regression analysis of this study also indicates adolescents who are more inclined to adventure and exciting experiences are more likely to media multitask more often.

The Generation M study reports that approximately 15% of 7th–12th graders state that “most of the time” they simultaneously use three of four media in the study (TV, reading, videogames, and computers). These respondents are considered “heavy” media multitaskers. On the other hand, another 15% state that they never or rarely use more than one medium and hence are classified as “light” media multitaskers. Light media multitaskers are exposed to 6 hours and 38 minutes of media each day, while “heavy” multitaskers are exposed to 12 hours and 49 minutes of media a day, almost double the amount of the light multitaskers.

2.1.5 Pew Internet & American Life Project Studies

The Pew Internet Project is a nonprofit, non-partisan think tank that explores the impact of the Internet on children, families, communities, the work place, schools, health care and civic/political life. The Project has been a reliable source of current information on the Internet's growth and societal impact.

The Internet Goes to College Report

College students are a unique youth population. Studying their Internet habits can yield insight into future online trends. The goal of this Pew Internet Project study was to
learn about the Internet’s impact on college students’ daily lives, and to determine the
impact of that use on their academic and social routines.

During the observations of student activities on college campuses, the study found
“multitasking” behavior patterns in the computer labs. Students were observed to “use
multiple programs at once, logging in to an instant messaging program while working on
papers, browsing Web pages while working on an assignment” (Pew Internet and
American Life Project, 2002).

Furthermore, it appears that multitasking is not confined solely to online
interaction. As the report described, on Friday afternoons, students were often observed
congregating in the computer labs in groups ranging from two to seven people. People
“sitting next to each other shared interesting Web sites they had found, scores for an
online game they were playing, or pictures they had received via email of a sorority party
they had attended together. Some appeared to be checking their email in order to make
plans with friends for the night or the weekend.”

Socializing is an important part of college students’ lives. The PIP study suggests
that the “multitasking behavior that students present online is not a new technique; rather
it is a supplementary method to reproduce the kinds of multiple interactions that students
performed offline.” The report claimed that today’s college students have “had long
experience with multitasking well before the Internet came into their lives.” Students are
using tools such as IM and email to maintain their socialization activities with the similar
multitasking patterns that they use to communicate with others in real life. Increasing
availability of wireless access on college campuses has also promoted the multitasking
behavior since students are now able to use email, IM, and other Internet tools on campus anywhere, any time.

How Americans Use Instant Messaging

This PIP report on Instant Messaging users is based on the findings of a daily tracking survey on Americans’ use of the Internet. The study found that IM users perform multiple tasks on the computer when they use instant messaging. When asked if they do other things on the computer or the Internet at the same time they are instant messaging, 32% of adult IM users report that they multitask all the time; 29% admit doing this some of the time.

According to the report, Generation-Y users (age 18-27) are the most avid multitaskers, but a substantial number of older IM users also switch their attention to other computer-related tasks when using IM. Almost half of Generation Y reported “conducting other computer-related business every time” or “almost every time” when using IM. The next age group with the highest multitasking rate is Generation X-ers (age 28-39), at 32%. For older generations, the multitasking percentage of each age group decreased. Fewer IM users conduct non-computer-related activities, such as talking on the phone or watching TV while using IM. One-in-five users reported to engage in other activities all the time and 30% reported multitasking some of the time.
2.2 Conclusion

Table 1 is a summary of survey studies reviewed in this section based on methodology. According to the Pew Internet and American Life Project, 82% of kids are online by the seventh grade. One quarter to one third Americans age 8 to 18 said they simultaneously absorb some other medium “most of the time” while watching TV, listening to music, using the computer or even while reading (Kaiser Family Foundation, 2005). The studies reviewed in this section clearly demonstrated that multitasking is prevalent among today’s children and youth. One thing that needs to be noticed is that these studies did not clearly differentiate the purpose or goal of media multitasking. In general, most media usage behavior can be classified as usage for work/study, usage for entertainment, and usage related to both work and entertainment. Media usage for different purpose or goal will strongly impact the media multitasking pattern and performance.
<table>
<thead>
<tr>
<th>Survey Study</th>
<th>Time/Location</th>
<th>Completed Sample Size</th>
<th>Data Collection Method</th>
<th>Media Usage Studied</th>
</tr>
</thead>
</table>
| 1st Middletown Media Study       | July – August 2003, “Middletown” Muncie and Delaware County, IN | 401 phone survey, 359 media diary (267 one-day diaries, 83 one-week diaries) 101 observation | Phone Survey: Pew Research Center RDD telephone survey  
Diary: a comprehensive daily log of media usage (at home, at work, and elsewhere) for one day or one week during the study period. Note each media use episode’s start and stop time, media source, and location.  
Observation: Shadowing observation | Computer, Internet, TV, Print (book, magazine, newspaper), and Radio |
| 2nd Middletown Media Study       | February – May 2005 Muncie & Indianapolis, IN | 394 Observations | Observation using data-logging software to run on “smart keyboards” (small laptop-like computers running the Palm OS™) | Same as the above |
| Kids & Media @ the New Millennium | November, 1998 - April, 1999, Nationwide | Two nationally representative samples totaling 3,155 children ages 2 through 18 years | 2,065 children in the 3rd through 12th grades provided media use via written questionnaires administered in school.  
Parents (or primary caregivers) of 1,090 children aged 2 through 7 years provided data on young children via face-to-face interviews administered in home.  
487 children in 3rd grade or above and 134 parents of 2-7 year-old children completed week-long media diaries providing a sample of 621 supplementary diaries. | Magazines, books, and newspapers for enjoyment and school work, TV, videotapes, movies, video games, CDs and tapes, radio, and any computer activities in and out of school. |

Table 1: Survey methodology summary
<table>
<thead>
<tr>
<th>Survey Study</th>
<th>Time/ Location</th>
<th>Completed Sample Size</th>
<th>Data Collection Method</th>
<th>Media Usage Studied</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generation M: Media in the Lives of 8-18 Year-Olds</td>
<td>October 2003 – March 2004 Nationwide</td>
<td>Interviews: 2,032 students age 8–18, 694 seven-day media-use diaries</td>
<td>Nationally representative face-to-face interview survey of 3rd- to 12th-grade students</td>
<td>Newspapers, magazines, books, TV, DVDs and videotapes, video games, movies, radio, MP3s, CDs and tapes, computers, and the Internet.</td>
</tr>
<tr>
<td>The Internet Goes to College Report</td>
<td>March – June 2002 Nationwide</td>
<td>2054 surveys from 27 colleges and universities nationwide</td>
<td>Surveys randomly distributed to college students at a wide range of two-year and four-year public and private colleges and universities in the continental United States. Observations at 10 Chicago area institutions of higher education.</td>
<td>Internet</td>
</tr>
<tr>
<td>How Americans Use Instant Messaging</td>
<td>February – June 2004 Nationwide</td>
<td>2,204 adults, 18 and older</td>
<td>Telephone interviews and tracking survey</td>
<td>Internet, Instant messaging, wireless devices</td>
</tr>
</tbody>
</table>

Table 1 (Continued): Survey methodology summary
As a convenient communication tool, Instant Messaging (IM) is an important part of the media multitasking scene. IM has been popular among teens and college students for several years (Jones, 2002). According to the recent AP-AOL Instant Messaging Trends Survey (AOL, 2007) that examined IM trends and usage, IM is now popular both at home and in the workplace. Seventy percent of teens and 24 percent of adults send more instant messages than emails. In addition, many IM users said they are engaged in multiple online activities while sending instant messages.

As an essential online communication medium, IM plays a key role in the online multitasking environment among youth. This study therefore used IM as the major communication tool in the experiment to make the online communication process and media multitasking environment more similar to real life experience.

2.3 Theoretical Framework for Media Multitasking and Perceived Performance

2.3.1 Brain Function during Multitasking

Although many aspects of media multitasking process remain scientifically uncharted, there is substantial literature on how the brain handles multitasking. It may seem a teenager is text messaging her friend, listening to music and searching for the information needed for completing her homework all at the same time. However, the really process is a rapid shifting among tasks rather than simultaneous processing.

According to a functional magnetic resonance imaging (fMRI) study (Knutson, Wood & Grafman, 2004), the control of switching of attention during multitasking occurs in the most frontal part of the brain, an area called Brodmann's Area 10. This area is
located right behind the forehead and it maintains long-term goals and controls the actions to achieve them. It allows one to put an incomplete task aside, work on another task, and then return to the stopping point of the earlier task and resume the work. This kind of rapid stop and resume generated an illusion of simultaneous processing or multitasking, but in fact, it is just constant switching of orders during processing. This area of the brain matures last and is the first to decline with aging. Therefore, young children can not multitask as well as older children, and adults over 60 lose their multitasking skills with aging. Recent fMRI studies at Toronto's Rotman Research Institute suggest that as people get older, it is even harder for them to promptly stop at one task and turn to another. On the other hand, younger adults can quickly switch their attentions among multiple messages and tune out distracting ones when they need to focus.

2.3.2 Effectiveness of Multitasking

Since human brains cannot process multiple messages at the same time, when attempting to perform a number of tasks within the same time period, individuals have to juggle their limited resources to successfully accomplish each task. Compared to focusing on one task at a time, the juggling method will make the combined task more difficult and sometimes even reduce the effectiveness of performance. For example, when a person is talking on a cell phone while driving, their conversation may become less focused, and their driving will also be worsened by lack of concentration. In the brain, the executive processing of multiple tasks requires the management of each individual task and the determination of the detailed processing procedure for each and every task. Such
management and arrangement decisions require more resources and increase the opportunity for error. More problems may occur when a person constantly switches from one task to another.

Fast switching among two or more tasks requires an individual to constantly reorient to the new task at hand, which takes time and other attention-related resources. Researchers from the Brain, Cognition and Action Laboratory at the University of Michigan studied this aspect of multitasking using a task-switching paradigm. In their task-switching experiments (Rubinstein et. al. 2001), participants either performed a single task or change between two tasks within a period of time. Rubinstein and colleagues compared the difference of completion times between single-task and dual-tasks to measure the cost for the task-switching processes.

Their experiments provided insights to understand how factors such as task difficulty and task familiarity may affect the cost of task-switching process. Even among young adults who supposedly can multitask relatively better, there are still limits on the performance. When a person attempts to perform two or more related tasks either at the same time or alternate rapidly between tasks, the error rate increases. In addition, instead of saving time, multitasking actually is more time consuming. To complete all jobs within same period of time often requires more than double the time compared to that required to complete the jobs sequentially. Even young adults with high multitasking skills cannot save time by processing several things together.

When an individual receives a number of varying messages via different information channels, such as through visual and auditory channels, Cocchini et. al.
(2002) stresses the simultaneous multitasking process presents a more difficult than “normal” challenge for the person. Posner (1999, 2000) comments that the concept of attending to something is not in a parallel format, but rather in a hierarchical selection structure. In addition, many dual attention studies in mass communication (e.g., Grimes, 1991; Lang 1995, 2000) strongly suggest viewers’ attention is insufficient for processing multiple information inputs, and hence cannot fulfill the requirement for efforts to effectively perform under multitasking conditions.

2.3.3 The Limited Capacity Models and Theory

Lang’s (2000) limited capacity model (LCM), as well as its application on motivated mediated message processing (Lang, 2000, Lang et al. 2005), present a theoretical framework that can be used to understand how multiple information objects are processed inside a mediated environment. This information processing model was developed from years of research on information processing in cognitive psychology (Eysenck, 1993; Lachman, Lachman, & Butterfield, 1979) and other experimental studies conducted by Lang and colleagues (Lang, 1995; Lang & Basil, 1998). The model was originally designed to examine television images processing and has recently been applied to online content (Diao & Sundar, 2004; Lang, Borse, Wise, & David, 2002). It has been proved that the limited capacity model and related theory are applicable to all contents, all media, and all goals. Thus, using this theory of information processing to study media multitasking provides the current study with a framework on how humans perceive, store, and access information.
This limited capacity model has variables that include the medium, the content of
the message, and the goal of the message. Different media, content, and goals will
generate different motivational and cognitive responses in viewers. During the process,
viewers interact with the structure and content of different messages, and the individual
differences of the media user will strongly affect how a message is processed during
multitasking, including which parts of the message are attended to, encoded, and stored
and how the message is evaluated and liked.

This model contains five major assumptions that are related to the nature of
cognition, motivation, media, time, and communication. First, the model assumed that
people are information processors with limited capacity (Basil, 1994; Schneider, Dumais,
& Shiffrin, 1984; Shiffrin & Schneider, 1977). They have only a limited number of
cognitive resources to expend on the tasks of perceiving, encoding, understanding, and
remembering the world in which they live. When there are insufficient resources
available, processing suffers (Lang, 2000).

Second, people have two underlying motivational systems, the appetitive (or
approach) system and the aversive (or avoidance) system (Bradley, 1994; Cacioppo &
Gardner, 1999; Lang, Bradley, & Cuthbert, 1997). These systems activate automatically
in response to motivationally relevant stimuli in the environment and influence ongoing
cognitive processing.

Third, media presented in adhesive and overlapping flow of information to
multiple sensory channels (eyes, ears, touch) using different formats (words, text, still
pictures, moving pictures, etc.).
Fourth, all human behavior occurs over time and is constantly changing from one second to the next. Human behavior, and therefore human cognition, is a dynamic process (Thelen & Smith, 1994).

Fifth, communication is the overtime interaction between the human motivated information processing system and the communication message (Geiger & Reeves, 1993; Lang, 2000; Rafaeli, 1988). This interaction is continuous and truly interactive.

According to the limited capacity theory, processing messages involves three major sub-processes: encoding, storage, and retrieval. These sub-processes occur continuously and simultaneously. Encoding is the act of creating a mental representation of a stimulus. It is the process of selecting information from the environment for further processing. It is an automatic (and unconscious) process to select the important aspects of a message and encode them. Information that is not encoded is lost.

Storage is considered as connecting recently encoded information with previously stored information. New and old encoded information are linked when they are activated concurrently. Thus, an active mental representation is generated when new information is encoded or when old information is retrieved. When both types of information are active simultaneously, a link is established. In general, new information that has more links to the old information will be better stored in memory. Therefore, to make a piece of information part of an individual’s long-term memory, it must be encoded and linked to already stored information. Although encoding is necessary for information storage, many things that have been encoded are only poorly stored, because few resources are allocated to storage. Thus, encoding does not necessarily predict storage (Lang, Bolls,
Potter, & Kawahara, 1999). The limited capacity theory argues that motivational relevance leads to the automatic allocation of resources to storage, which is indexed by cued recall techniques.

Finally, the third sub-process of information processing is information retrieval. This sub-process involves retrieving previously stored information. Like encoding and storage, resources are also required in order to retrieve stored information. The primary automatic mechanism is an activation process spread over stored information. Memory can be considered pieces of information that are loosely connected. When one piece is activated, the activation will spread through the links to activate closely related information. Thus, when information conveyed through message is encoded, the spreading activation system leads to simultaneous retrieval of information related to the topic of the message. Depending on the amount of resources that have been allocated to this process, the amount of information that can be retrieved varies.

The process that involves encoding-storage-retrieval is activated during media use, and the three steps occur simultaneously and continuously. During media use, factors such as long term goals, the message content, and the message structure are constantly being encoded, stored, and retrieved through automatic and controlled allocation and reallocation of the user’s resources. Resources are allocated independently to the three sub-processes out of the same fixed pool of limited resources (Basil, 1994; Lang et al., 1999). When the message requirements and the user’s goals need more resources than the available amount, there will be cognitive overload. This means that there are insufficient resources available to perform all three sub-processes with adequate resources needed for
each process. When there is a cognitive overload, there is no guarantee that each process will receive enough resource to performance well. Some processes may receive sufficient resources when others do not. The result will be deterioration of performance on one, two, or all three sub-processes. According to LCM, each message’s demand for time during the three-step process will impact the amount of resources allocated. Under the circumstance where the media user cannot control the speed of the message transfer, like watching TV or talking while driving, then sub-processes that require more time to accomplish will automatically receive more resources (like encoding and to some extent concurrent retrieval) and the final process storage will be cut short. When this occurs, the user will end up with a message that was well-attended to (with all resources allocated), encoded (with good recognition memory), but cannot be retrieved (poorly stored due to lack of resources).

2.3.4 Potential predictors of multitasking performance

Research on multitasking as an important human behavior has a long history (e.g., McQueen, 1917), and more recent research includes studies such as using multitasking scenarios as a personnel selection tool (e.g., Stankov et al., 1989), investigation of the neuroanatomical correlates of multitasking (e.g., Burgess, Veitch, de Lacy Costello, & Shallice, 2000), and information processing and executive control processes under multitasking conditions (e.g., Rubinstein, Meyer, & Evans, 2001).

Studies have found that under multitasking conditions, different tasks are very likely to interfere with one another (Pashler, 1994; Monsell, 2003). Several cognitive psychology models have tried to explain this interference (e.g. Meyer & Kieras, 1997;
Resource allocation theorists, such as Kahneman (1973), and communication researchers, such as Lang (2000), argue that during multitasking, a person’s mental resources are shared by different tasks. Because these mental resources are limited, the tasks interfere with each other and cannot be fully processed. Bottleneck theorists, such as Logan (2002) argue that interference occurs because certain mental operations cannot be divided, resulting in a bottleneck that allows only one task to pass through at a time. Cognitive psychology research on multitasking has indicated two possible predictors of multitasking performance: attention and working memory.

Attention has been linked to multitasking because the greater the amount of attention people have, the easier it is for them to (re)focus their attention to the task and the better their performance should be during multitasking (Kahneman, 1973). Other cognitive psychologists studying multitasking have focused more on working memory (e.g., Meyer & Kieras, 1997). Working memory is the system of the brain that permits the storage and processing of information needed in the execution of tasks (Berti & Schröger, 2003). The construct of working memory incorporates the older construct of short-term memory, but it is conceptualized more broadly (Oberauer et al., 2002, 2003). It includes both the passive system responsible for the temporary storage of information and an active system responsible for the executive control of cognitive processes (Oberauer et al., 2002; Oberauer et al., 2003). These executive control processes are important for multitasking. Working memory helps people switch between tasks when they are multitasking. For example, it helps people to store information related to the task that is not currently being worked on and control attention during task switching.
A third potential predictor of multitasking performance is fluid intelligence. There is some evidence that supports the idea (e.g., Ben-Shakhar & Sheffer, 2001; Stankov, 1988) that fluid intelligence, i.e., the ability to reason and to solve unfamiliar problems, will facilitate high multitasking performance. It is believed that intelligent people’s superior mental abilities should help them to cope with the greater demands of multitasking compared to the lesser demand of single task.

A fourth potential predictor is extraversion personality. Lieberman and Rosenthal (2001) argued on the basis of recent neuroscience research that multitasking depends on the level of catecholamines in the prefrontal cortex (Burgess et al., 2000). They claim that the level of catecholamines should be neither too high nor too low. Because arousal increases the level of catecholamines, an arousing situation such as multitasking (Delbridge, 2000) is good only for the performance of individuals with a low baseline level of catecholamines. Lieberman and Rosenthal assume that such individuals would be more likely to have extravert personalities. Therefore, according to their approach, extraversion should be positively correlated with multitasking. They found that when introverts had to multitask, they made more mistakes in a nonverbal decoding task than extraverts.

Among these potential predictors of multitasking performance, the current study examines the most basic predictor of multitasking performance – attention – through actor self evaluation and partner evaluation and the connection between extravert personality and task performance. The objective is to find out possible effects of media multitasking and distraction on attention focus and the connection between attention and
task performance. In addition, participants self evaluation on their intelligence, multitasking preference, communication and work style will also be assessed as potential influencing factors of task performance.

2.3.5 Theories Related to Self-Others Perception Divergence

The current study employs self and partner evaluation method to assess communication experiences under different media multitasking conditions. Such a design makes it necessary to review theories related to possible cause of difference between self and others’ perceptions. Co-orientation theory in communication and other theories related to divergence in self and others’ perceptions will hence be discussed in the following section to address this need.

Co-orientation Theory in Communication

The design of current study involves analysis of opinions and behavior of self and others for the same communication task. Such opinions are formed through both self-reflection and interpersonal communication. For the study of opinion formation through interpersonal communication perspective, co-orientation theory in personal communication will provide helpful insights that may assist our attempt to understand the impact of media multitasking on personal communication process and experience. The co-orientation theory traces its beginnings to psychological studies about the mutual orientation of two individuals to same object. Newcomb (1953) stated that co-orientation is a “very simple system (which) is designed to fit two-person communication” (p. 394). Also referred to as the A-B-X system, it examines the relation between two persons’ (A and B) self-reported attitudes toward an object (X) and their estimate of their partner’s
perception. In this system, partners (A and B) are tied together as a unit. Within the unit relationship, group members are interdependent, and they tend to adopt similar attitudes toward objects (X). According to Newcomb's AB-X theory, A and B should perceive X in a similar way and so they are co-oriented toward X. One question addressed in this current study is whether A and B agree more about X when A and B are friends, having similar personality traits or rather the opposite. The co-orientation effect also can be applied to difference between self and others perceptions. The object of perception (or X in Newcomb's original formulation) is now one of the two partners, for instance, A. In AB-A co-orientation, the question is the extent to which the perception of a partner matches that person’s self-perception.

Several co-orientation variables are produced by this theory. Person A’s understanding of B compares the report of B (e.g., a belief, preference, or attitude about X) and person A’s perception of the self-report of B. For example, if an actor reports that he/she thinks the communication experience is satisfying during the experiment and the collaborator perceives that the actor will be satisfied with the communication experience, then the collaborator agrees with the actor on this matter. Agreement refers to the degree of discrepancy between the self-report of actor and the collaborator. Perceived agreement reflects congruence between an actor’s own report (e.g., I am satisfied with my performance during the experiment) and the actor’s perception of the collaborator’s self-report on the same issue. Because communication is an information exchange process, the co-orientation method benefits by measuring the information itself (i.e., content) rather than simply measuring the behavior during the communication process. Co-orientation
model was advanced by McLeod and Chaffee (1973) and it specifically claimed that people’s behavior results from more than their internal thinking—it also is affected by their orientation to other people and perceptions of the views others hold. To apply co-orientation theory to this current study, the following diagram (Figure 1) shows connections between self and others perception based on the model.
Figure 1: Self and Partner Perception Based on Co-orientation Model
During current study, three elements of the co-orientation mode are assessed: (a) the experiment actor’s perceptions on the multitasking performance and collaborative efforts, represented by the beliefs of individual actors who participate in a decision making communication task; (b) the experiment partner’s views on the survival task performance and collaborative efforts issue; and (c) the actor’s estimate of his/her partner’s perceptions regarding task performance.

Consequently, the current study explores to what extent the experiment actor and his/her partner agree/disagree on task performance and collaborative efforts during the experiment. We will also examine to what extent the experiment actor and his/her partner perceive agreement/disagreement regarding task performance and collaborative efforts during the experiment. Finally, we will check to what extent do personality traits and familiarity affect agree/disagree on task performance and collaborative efforts during the experiment.

Using the co-orientation model of communication as another theoretical framework, this current study will measure the levels of agreement between the multitasker (A), who is under media multitasking condition, and the collaborator (B) and the distracter (C), who are both under single task condition on variables pertaining to task performance and communication collaborations (X). Analysis of the findings will provide insights of task performance under multitasking conditions and will lead to a better understanding of communication experience between the multitaskers and their communication partners.
Divergent Perceptions Regarding Self vs. Others

The relationship between the self and other’s perception has been a topic of longstanding interest to social scientists, and it seems that there is always a divergence between self assessment and perceptions from others. In the designed experiment of the current study, both self and others perceptions will be assessed regarding task performance and communication collaboration. Therefore, there is a need to review relevant theory about asymmetric perceptions regarding self versus others.

The best known account of systematic divergence in the assessments of self versus others was offered by Jones and Nisbett (1972). They used the label actor and observer to differentiate between the two parties of assessment. Under the same label, for this current study, the actor would be the experiment actor and the partner would be the observer. Jones and Nisbett argued that observers typically offer more dispositional (and less situational) attributions in accounting for actors’ responses than actors offer themselves. In analyzing this difference, Jones and Nisbett claimed that although it may in some cases reflect the “actor’s need to justify blameworthy action,” it “may also reflect a variety of other factors having nothing to do with the maintenance of self-esteem” (1972, p. 80). Their study offered convincing anecdotal evidence to show that the different amount of information accessible to each party may cause disparity in responses. But the factor that they provided the most empirical evidence is related to the difference in the attention of the actor and the observer. They pointed out that the actor tends to focus his/her attention on the situational features he or she is monitoring and addressing,
whereas the observer’s attention is focused on the actor’s behavior.

Jones and Nisbett (1972) noted that actors and observers are attending to and relying on different information. One source of such “different information” involves private mental events. They noted that “typically, the actor has more, and more precise, information than the observer about his own emotional states and his intentions” (Jones & Nisbett, 1972, p. 85). Whereas the actor’s knowledge of his or her own intentions is “direct,” the observer’s knowledge of those intentions is “indirect, usually quite inferior, and highly actor to error” (Jones & Nisbett, 1972, p. 84).

Based on this theory, differences in access to private emotional states and intentions lead to asymmetric perceptions between self and others. For the designed experiment of current study, actor (actor) and the collaborator (observer) have different information regarding their media use behavior and distribution of attentions during the communication process, which will contribute to the potential divergence in their later evaluations about task performance and collaborative communication experience.

2.3.6 Text communication and egocentrism

Through five experiments on email communication of humor messages, Kruger and colleagues (Kruger, Epley, Parker, & Ng, 2005) found that there are limitations to convey emotion and tone through text communication, such as email, and such limitations are often underestimated by people who are sending the message. They believe that such overconfidence is caused by egocentrism, i.e., “the inherent difficulty of detaching oneself from one’s own perspective when evaluating the perspective of someone else.” They claim that due to egocentrism, although the emailers can “hear” the
correct tone of their outgoing message, they can not fully appreciate that their audiences may not have the same advantage. As a result, the message they assume can be easily understood by the receivers may not always be correctly interpreted.

The current study also used a text communication tool (IM) as one of the major tools to communicate between participants. Without realizing it, actors under multitasking conditions may pay less attention to their partners by responding slowly or sending less content during the communication process since they need to split their time and attention between two tasks. There partners, however, only needed to focus on one task and did not know the actor was multitasking. Such difference in perspectives and task conditions should cause divergent perceptions of performance for both self and partner. Therefore, egocentrism theory and the findings from Kruger’s studies will provide relevant insights to explain the possible differences.

2.4 Conclusion

Despite the popularity of multitasking behavior and the common belief in increased productivity through multitasking, scientific studies indicate that the limited capacity possessed by the human brain to process information makes such beliefs invalid. Furthermore, due to the difference between self and other perceptions, people may overestimate their multitasking performance and underestimate the cost of multitasking to a satisfying communication experience for their partner. Based on theories reviewed in this chapter, the current study will employ a controlled experiment to test the hypotheses and find answers to the research questions as noted in the introduction of this study.
2.5 Operational Definitions

2.5.1 Media multitasking as defined in current study

Media users are not passive information receivers, but active media seekers, who routinely choose what forms of media they prefer, as well as when and how often to use media. As new media, including cable, the Internet, and mobile communication technologies, continue to routinely surface and expand, use of various types of electronic media has become seamlessly interwoven with other daily activities. In addition, the multiple functions served by new communication technologies, including the Internet and cell phones, enable individuals to routinely use more media in their lives. In turn, media multitasking constitutes a contemporary, prevalent phenomenon.

In the past, traditional distinctions among media were primarily based on its dominating feature or function. Now, however, the rapid proliferation of new technologies extends the functions of electronic devices. Computers and handheld telecom devices contain multiple functions, traditionally only available separately through a television, a telephone or a radio, etc. Previously, it appeared to be easier to discern distinctive functions and formats of different media when people multitasked. Now it is more challenging to identify distinctions with contemporary syndication of media functions in one device and the user’s active task switching.

For the current study, multitasking refers to one person working on two tasks for non-entertainment purposes and communicating with two partners simultaneously during a period of time through online communication tools such as MSN Instant Messaging and/or Skype—a online audio communication application that enables online calling. To
compare the difference in performance, there are three different task conditions for the main actor. In contrast to multitasking, the first condition is single task, where the actor only needs to focus on one task and communicate with one partner through one communication mode (IM). Both the second and third conditions are multitasking conditions. The second condition is to multitask on two different tasks and communicate with two partners through the same communication mode (IM). The third condition is also to multitask on two different tasks and communicate with two partners, but the communication mode is different between two partners. One is through IM and the other is through Skype. The design of current study tries to achieve two goals. First, such design will enable us to compare the task performance between single and multiple tasks. Second, it will provide the opportunity to compare the impact of different communication modes on performance during same multitasking process.

2.5.2 Multitasking performance measurement

As discussed in earlier sections, when attempting to perform many tasks at once, people have to juggle their limited resources in order to accomplish each of these tasks successfully. Limited resources during the information process may lead to poor task performance. The design of current study will evaluate multitasking performance from both objective and subjective perspectives. Objectively, the quantity and quality of the experiment questions finished by participants in different conditions will be used to evaluate effectiveness of multitasking. Subjectively, self and partner evaluations will be used to assess communication experience and task performance perceptions. Such measurement will provide more understanding of the multitasking performance from
different perspectives. The difference between self perception and other’s perception will also help us to understand the possible discrepancy between self-believed performance with partner-received performance.

2.6 Hypotheses and Research Questions

The purpose of the current study is to study people’s experience and perceptions under multitasking conditions. The study examines factors related to performance under multitasking conditions and possible differences related to self and others perceived communication experience under single task vs. multitask communication situations.

According to the limited capacity theory, cognitive resources are limited, which in turn limits the processing of information when multiple tasks are attempted simultaneously. Therefore, the constant shifting of attention will result in less effective encoding, storage, and retrieval of information. On the other hand, the younger adults’ lifestyle is filled with multitasking around media as well as other activities. And it is generally believed that by doing multiples things together, one can be more productive. Such contradiction between popular impression and research findings from the limited capacity literature lead to the following hypotheses for this current study:

H1a: Perceptions of demands of the task will be greater in the multi-tasking conditions than in the single-task condition.

H1b: Perception of task demand will be greater in the IM and Skype multitask condition than in the IM-only multitask condition.

In turn, increased task demands in the multitask conditions will lead to lowered
satisfaction with task performance.

H2a: Because of task demands and cognitive load, satisfaction with task performance will be lower in the multitask conditions than in the single task condition.

H2b: Satisfaction with task performance will be lower in the IM and Skype multitask condition than in the IM-only multitask condition.

H3: Number of questions answered in the single task condition will be greater than in the IM-only multitask condition, which will be greater than in the IM and Skype multitask condition.

H4: Actors in the multitask conditions will not perceive difference in contribution between self and collaborators whereas collaborators in the multitasking conditions will perceive weaker contribution from the actors. In the single task condition, however, no such differences are predicted.

Through the controlled experiment that will be discussed in the following chapter, current study will also examine the following perspectives of media multitasking:

1. Test the deterioration of task performance under multitask conditions
2. Compare self perceived multitasking efficiency with receiver’s evaluation and perception.
3. Search for potential connections between multitasking performance and factors such as attention, personality trait, self-perceived attributes, multitasking preference, and multitasking experiences.
4. Compare perceived communication task performance under concentrated and
5. Search for indicators for multitasking performance.
CHAPTER 3

RESEARCH DESIGN AND METHOD

3.1 Objectives of the Study

Based on the studies discussed in the previous chapters, it is projected that in contrast to the common preference for multitasking among younger generation while using media, there will be a negative correlation between performance and the multitasking status. In other words, the more tasks one is handling simultaneously, the worse his/her performance will be.

The primary hypothesis of this study is that under the limited capacity model, the distractions and competition for attention will affect task performance and communication collaboration during the process. The secondary hypothesis is to examine the divergence in self-assessment by the multitasker and the assessment of the performance of the multitasker by the collaborator.

In addition to the above mentioned factors, preference for media multitasking, a person’s motivation, experience with multitasking, communication style, and personality traits may all be influential to the effectiveness of task performance and communication collaboration. These variables will be introduced as control variables of covariates. Therefore, this study has been designed to do the following:
1. Test the deterioration of task performance under two multitasking distraction conditions: IM distraction, Skype phone distraction.

2. Compare self perceived multitasking efficiency with receiver’s evaluation and perception under both distraction conditions.

3. Search for potential connections between multitasking performance and explanatory variables, namely extraversion, motivation, individual differences in multitasking preference, and multitasking experiences.

4. Explore indicators of multitasking performance leading to a preliminary model.

3.2 Participants

For this study, undergraduate students were recruited from introductory communication courses through instructors at the Ohio State University. Both male and female students with diverse ethnic backgrounds participated in the study. A total of 254 students participated in the experiment and 238 participants’ responses were used for the study (see Table 2). Nearly 95% of the participants’ age ranged from 18 to 24 ($M = 20.0$, $SD = 1.4$). All participants were offered extra-credit points in exchange for their participation.

The following table lists detailed demographic information of the experiment participants.
<table>
<thead>
<tr>
<th>Category</th>
<th>No. of Subject</th>
<th>Total Percentage</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
<tr>
<td>Female</td>
<td>118</td>
<td>49.6%</td>
</tr>
<tr>
<td>Age 18-24</td>
<td>225</td>
<td>94.5%</td>
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<tr>
<td>Age 25+</td>
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<td>5.5%</td>
</tr>
<tr>
<td>Ethnicity</td>
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</tr>
<tr>
<td>Caucasian</td>
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<td>74.8%</td>
</tr>
<tr>
<td>African American</td>
<td>31</td>
<td>13%</td>
</tr>
<tr>
<td>Hispanic</td>
<td>8</td>
<td>3.4%</td>
</tr>
<tr>
<td>Asian/Pacific Islander</td>
<td>11</td>
<td>4.6%</td>
</tr>
<tr>
<td>Other</td>
<td>10</td>
<td>4.2%</td>
</tr>
<tr>
<td>Total</td>
<td>238</td>
<td>100%</td>
</tr>
</tbody>
</table>

*Table 2: Participant Demographics*
As shown in Table 1, the study participants included 120 males and 118 females. Among them, 178 were Caucasian, 31 were African-American, 8 were Hispanic, 11 were Asian, and 10 were of other ethnicity. 225 participants are between 18 to 24 years old, and 13 were above 25.

3.3 Measures and Instruments

3.3.1 Measures

Demographics. At the beginning of the study, participants were instructed to provide information regarding gender, age, and ethnicity.

Personality. The Eysenck Personality Questionnaire (EPQR-A) (Francis, Brown, & Philipchalk, 1992) was administered to determine participants’ tendency toward extraversion personality.

Interest and familiarity. After reading experiment instruction and practicing with similar questions that would be used in the study, participants were then asked about their interest in this study using close ended questions with 7-point Likert-type scale ranging from 1 (strongly agree) to 7 (strongly disagree). After the experiment, participants were asked about their familiarity with their partner(s) using close ended questions with 5 point Likert-type scale ranging from 1 (not familiar at all) to 5 (very familiar).

Media use and multitasking preference. General media use pattern and preference for media multitasking were asked using close ended questions designed by PI and co-investigator. On a 4-point Likert-type scale ranging from 1 (never) to 4 (always), participants were asked when using a computer for school work, how often they use other
media such as TV, radio, etc.. Media use and multitasking preference were also assessed using a similar 4 point Likert-type scale ranging from 1 (never) to 4 (all the time) on media multitasking (such as having multiple chat, or browser windows/tabs open, or having multiple applications/programs open at the same time, etc). (Appendix B)

**Self performance evaluation.** The multitaskers, referred to as actors in this study, answered close-ended questions designed by PI and co-investigator regarding self perceived task performance during the experiment. They evaluated various aspects of the communication process during the experiment, including their own performance during the experiment, perceived difficulty and time pressure during the experiment, communication experience with the partner and projections of the partner’s evaluation of themselves.

**Performance evaluation by collaborator and distracter:** The collaborator and distracter answered close-ended questions regarding his/her judgment of the central player’s performance during the experiment. Most of the evaluation questions were paired with actor’s self evaluation on the same perspective to enable paired comparison and check of self-other judgment divergence.

Detailed Pre-experiment and Post-experiment question constructs and questionnaires are included in the appendix. The pre-experiment questionnaire consists of demographics, a personality assessment, media use and multitasking preferences, communication and work style, interest and knowledge of study topic, and practice questions before the collaboration task. The post-experiment questionnaire includes the experiment assessment, partner familiarity, the self performance evaluation, and the
partner performance evaluation. Multitasking actors were also asked about their attention focus and time allocation during the experiment.

3.3.2 Instrument

**Collaboration tasks.** Two types of survival skill and dilemma questions were used for this study. All questions were based on The Worst-Case Scenario Book of Survival Questions (2005), which is the latest in The Worst-Case Scenario Handbook series. The actor and collaborator were given dilemmas in multiple choice quiz format where they need to discuss with each other and decide the final answer for each question. An example of task question between actor and collaborator is similar to the following:

You are on a tour of Braulio Carillo National Park near San Jose, Costa Rica. You are separated from a group and have lost your way. You shout for help, but hear no reply. You will have to make your own way out. You decide to mark your trail in case you need to backtrack—you don’t want to wander around in circles. To mark your path, do you:

a. Leave a trail of breadcrumbs  
b. Turn over leaves and other vegetation  
c. Line your trail with sticks set end to end  
d. Make blazes on trees with chalk or a sharp rock

For multitask conditions, actors were also asked to work with distracter to answer a “which is worse” question. The following is an example of worse-case scenario question between actor and distracter:

Which is your worst case?  
**Facing a mountain lion**  ---or---  **Facing a king cobra**?

The distracter provided the following tips after posing the question to engage the actor in the distracter task. One half of the distracters used an IM window to carry out this conversation, whereas the other half used Skype, an Internet phone to carry out the conversation.
Be Aware:
- A mountain lion can kill with a single bite to the throat.
- A king cobra's venom can stun your nervous system and stop your breathing.
- Much like domestic cats toying with a mouse, a mountain lion will kill for the sake of killing.
- A king cobra delivers more venom per bite than any other kind of cobra--as much as .2 fluid ounces, enough to kill 20 people.

During the pilot study before this experiment, students showed high interest in all different types of survival task questions. The fun and entertaining aspects of the task and format were used to encourage more involvement among participants during the experiment.

Manipulation check. All participants were asked to rate their level of interest with the experiment on a 7-point Likert-type scale ranging from 1 (strongly agree) to 7 (strongly disagree) (see Appendix B) before working on the task. Actors in multitasking conditions were also asked to give ratings on 5-point Likert-type scales on how they were interested in different tasks during the experiment. After doing the experiment task, actors in all collaboration conditions were asked to rate their familiarity with their experiment partners on a 5-point Likert-type scale ranging from 1 (not familiar at all) to 5 (very familiar). Finally, all participants were asked whether they found the task(s) interesting or demanding, and actors under multitasking conditions were also asked about the time/attention they spent on each task.

Communication mode. During the experiment of this study, two different communication modes were used based on experiment conditions. For the single task and multitask same communication mode conditions, actor and collaborators communicated through instant messaging, which has been shown in previous studies a popular mode of
communication among college-age students (Pew Internet and American Life Project, 2002). This experiment used instant messaging to make the communication experience closer to the reality. For the multitask different communication mode condition, in addition to IM, the actor also needed to use the online audio communication tool (Skype) to communicate with the distracter on another collaboration task. Such a design enabled the two most often used online communication tools, i.e., online text messaging and online callings to be compared under a multitasking condition.

3.4 Experiment Design and Procedure

An experiment with 3-conditions was designed. Participants were tested in small groups ranging from 2 to 3 people based on randomly assigned conditions. One female and two male experiment administrators conducted the study with different time shifts during the data collection process; all followed the same instructions. The administrator randomly rotated experiment conditions and randomly assigned different conditions and categories for each participant.

All sessions of the experiment took place in two computer labs. All participants were assigned an identification number upon arrival and handed a consent form by the administrator. After consent, participants were led to one of two labs and seated in front of pre-designated computers. Participants who were assigned as partners were led to another lab and seated in front of pre-designated computers depending on whether the partner was a collaborator or a distracter. The categories included: Single task collaborator, Multitask IM collaborator, Multitask IM distracter, and Multitask Skype
distracter.

*Experiment conditions.* There are 3 conditions in the experiment, namely single task, multitask IM, and multitask Skype. There were two participants in the single task condition, i.e., actor and collaborator; and three participants in both multitask conditions, i.e., actor, collaborator, and distracter. Detailed experiment procedures for each condition are listed below:

*Single task condition:* Actor and collaborator work together on survival multiple choice questions through online instant messaging (IM).

*Multitask (IM) same communication mode condition.* Actors were instructed to work simultaneously with both a collaborator and a distracter without telling the other parties that he/she was communicating with more than one person at the same time. Both collaborator and distracter were only focused on one task during the experiment. Between an actor and a collaborator, the task was multiple choice survival questions. Between an actor and a distracter, the task was worst-case scenario questions as discussed in the collaboration task section. All communications between an actor and his/her two partners were through online Instant Messenger (IM).

*Multitask (Skype) different communication mode condition.* The only difference between this condition and the multitask same-mode condition is that communication between actor and collaborator was through online text messaging (IM) while communication between actor and distracter was through online audio program Skype.

To eliminate unwanted distraction during the experiment, all actors wore headphones or earplugs to block out outside noises.
Independent baseline. Due to the changing number of participants in different sessions, sometimes there was one extra participant who could not be paired with others for the experiment. They would be given the multiple choice questions used for collaboration task and finished the questions independently. This group would provide a baseline for the study to see the difference between teamwork that involved online communication versus independent work without collaboration.

Procedure

I. Pre-experiment evaluation. Before starting to work on the experiment task, all participants filled out a Pre-experiment questionnaire online that included questions on demographics, personality, and media multitasking experience and preferences. After reading a short instruction on the survival skill task, each participant worked independently on 5 questions that were similar to the ones they would work on during the experiment. The answers were later used to test each participant’s survival skill and knowledge level. After finishing the pre-experiment questions, each participant was given a detailed instruction, based on participant’s randomly assigned category, describing the task needed for them to finish the experiment and the time limit and communication mode between partners. Finally, participants were asked about their interest in the upcoming task after reading the instruction.

II. Collaborative Communication Task. After clicking the submit button of the pre-experiment evaluation questionnaire, each participant was automatically transferred to a Web site designed for the experiment tasks. Each Web page contained one multiple choice quiz on an outdoor adventure dilemma as discussed in the collaborative task
section of this chapter. Actors and collaborators needed to communicate through IM to decide their answer for each question, submit and then move on to the next question.

III. Post-experiment evaluations. After the experiment, each of the participants filled out a post-experiment evaluation form online. All participants were asked to evaluate self and partner(s) performances during the experiment. For actors in multitask conditions, they were asked to evaluate the collaborator and distracter separately on same performance perspectives. Both collaborators and distracters were also asked about their impression of the actor during the experiment. Finally, all participants were asked about their familiarity with their partner(s).

IV. Debriefing. At the end, experiment administrator debriefed participants about the fact that actors under multitask condition had been multitasking during the experiment and explained to the participants about the design and objective of the study.

To better understand the flow of actions of this experiment, please refer to the experiment procedure diagram shown in Figure 2.

For detailed demographic information on participants under different conditions and categories, please refer to Table 3.
Figure 2: Multitasking experiment flow chart
<table>
<thead>
<tr>
<th>Condition</th>
<th>Independent</th>
<th>Single Task</th>
<th>Multitask IM Only</th>
<th>Multitask IM and Skype</th>
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<td>ACT</td>
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<td>33%</td>
</tr>
</tbody>
</table>

**Table 3:** Participants Demographics by Condition and Category (within group percentage)
This chapter provided detailed information about the experiment design and procedure. There are 3 different experiment task conditions (single task, multitask IM only, and multitask IM and Skype) and 3 participant categories (actor, collaborator, and distracter). Two different experiment tasks were used for the current study; one is multiple choice survival task between actor and collaborator, and the other is a worse-scenario task between actor and distracter. In Chapter 4, I will discuss data analysis procedure and results of the study based on univariate GLM and multivariate GLM repeated analysis of variance.
CHAPTER 4

RESULTS AND DISCUSSION

4.1 Demographics

Participants were assigned randomly to the different task conditions and roles (multitasker, collaborator, distracter). Table 3 provides a summary of the distribution by conditions and roles.

Among participants in single task condition, 61% were male and 39% were female and 94% were between 18-24 years old. The majority of participants were Caucasian (71% Caucasian), with 17% African-American, 6% Asian, and 5% other. Under multitasking IM only condition, 48% were male and 52% were female, and 96% were between 18-24 years old. There were 76% Caucasian, 15% African-American, 4% Hispanic, 1% Asian, and 4% other ethnicities in this group. There was no significant difference on demographic variables among different conditions and subject groups except a disproportional lower representation of females in single task collaborator condition.

For the purpose of this study, I examined only the participants assigned to the three collaborative tasks. A few students worked independently on the worst-case scenario quizzes, but these students were not included in the analysis because the focus of
this project on communication with others in multitasking and non-multitasking environments.

4.2 Pre-Experiment Test

4.2.1 Extraversion Personality

Before the experiment, all participants were asked questions about their personality, work style, and multitasking preference. The abbreviated form of the Revised Eysenck Personality Questionnaire (EPQR-A) was used to test the extraversion personality scale of each participant. The extraversion personality score were obtained from the total answer of 6 extraversion questions which include: (1) Are you a talkative person; (2) Are you rather lively; (3) Can you easily get some life into a rather dull party; (4) Do you tend to keep in the background on social occasions; (5) Are you mostly quiet when you are with other people; and (6) Do other people think of you as being very lively. The answer for each question is dichotomous with Yes and No choices. Among all participants, 180 (75.6%) has an extraversion personality score of 4 or above, \( M = 3.78, SD = .86 \).

4.2.2 Other Potential Impact Factors on Task Performance

Each participant was also given 5 survival questions prior to the experiment to test their survival skills related to the experiment task. The majority of all participants (83.9%) had 3 or more correct answers \( M = 3.34, SD = .836 \). No significant difference was found in pre-test ability across the three conditions. \( F (8, 228) = .64, P = .75 \).

Inter-item correlations were calculated for computer multitasking behavior
measures including “Have multiple browser windows/tabs open at the same time,” “Have multiple applications/programs open at the same time,” “Have multiple emails open at the same time,” and “Have multiple chat windows open at the same time.” All items were assessed on a 4-point scale (1 = never, 2 = occasionally, 3 = sometimes, 4 = always). The inter-item correlation Pearson rs ranged from .12 to .41. Items in the scale had a reliability of \( \alpha = .65 \). The items were averaged to create a single index of multitasking behavior \( (M = 2.1, SD = .51) \).

General preference for multitasking were tested on a 5-point scale \( (1 = \text{strongly disagree}, 2 = \text{somewhat disagree}, 3 = \text{neither agree nor disagree}, 4 = \text{somewhat agree}, 5 = \text{strongly agree}) \). The measure included “Can get things done more quickly by multitasking,” “Try multitasking whenever it is possible,” “Do better job if focus on one thing at a time.” The inter-item correlation Pearson rs ranged from of .26 to .45. Items in the scale had a reliability of \( \alpha = .63 \). The items were averaged to create a single index of multitasking preference \( (M = 3.16, SD = .97) \).

Despite the low inter-item correlations and low alphas, the two multi-tasking scales were retained as covariates because of the potentially important role they could play as moderators of multitasking behaviors.

Communication and collaboration proficiency measures, i.e., “Can easily communicate with others,” “State my ideas and opinions clearly,” “Provide many ideas when working in a team,” and “People want me to be on their team” were measured on a 5-point scale \( (1 = \text{strongly disagree}, 2 = \text{somewhat disagree}, 3 = \text{neither agree nor disagree}, 4 = \text{somewhat agree}, 5 = \text{strongly agree}) \). The inter-item correlation Pearson rs
ranged from of .33 to .51. Items in the scale had a reliability of $\alpha = .74$. The items were averaged to create a score of Communication Proficiency ($M = 4.1$, $SD = .56$).

### 4.3 Post-Experiment Test

To test the hypotheses of current study, I used both univariate and multivariate analysis to examine the differences between the 3 experiment conditions. For univariate analysis, the focus was only on actors in each condition and their interactions with the collaborators on Multiple Choice survival task.

Perceived task difficulty was measured by “I found the task of this study to be quite demanding” on a 7-point scale ($1 = strongly disagree, 4 = neither agree nor disagree, 7 = strongly agree$). Among actors, the mean increased from single task ($M = 2.81$, $SD = 1.66$) to multitask IM only ($M = 3.71$, $SD = 1.57$) and reached the highest level in the multitask IM and Skype condition ($M = 4.67$, $SD = 1.76$). Based on GLM analysis, there are significant differences of perceived task difficulties among actors on all 3 task conditions (Table 4). In short, these results on task demands provide evidence as a manipulation check, in that the multitasking conditions were more demanding than the single-task condition and that multitasking in the Skype condition was more demanding than multitasking with another IM window. No significant difference was found among collaborators on the same measure because regardless of condition, the collaborators were always asked to perform only one task. Hence, H1a and H1b, which focused on task demands, were supported.
I found the task of this study to be quite demanding

<table>
<thead>
<tr>
<th></th>
<th>Single Task</th>
<th>Multitask IM Only</th>
<th>Multitask IM and Skype</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actor</td>
<td>N = 32</td>
<td>N = 25</td>
<td>N = 24</td>
</tr>
<tr>
<td>M</td>
<td>2.81</td>
<td>3.71</td>
<td>4.67</td>
</tr>
<tr>
<td>SD</td>
<td>(1.66)</td>
<td>(1.57)</td>
<td>(1.76)</td>
</tr>
</tbody>
</table>

**Table 4:** Perceived task demand by experimental conditions

I found the task of this study to be quite demanding (Actor)

<table>
<thead>
<tr>
<th></th>
<th>F (1,78) = 4.19</th>
<th>p = .04</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Task vs. Multitask IM Only</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multitask IM Only vs. Multitask IM and Skype</td>
<td>F (1,78) = 3.98</td>
<td>p = .05</td>
</tr>
<tr>
<td>Single Task vs. Multitask IM and Skype</td>
<td>F (1,78) = 17.09</td>
<td>p &lt; .001</td>
</tr>
<tr>
<td>Single Task vs. Multitask Combined</td>
<td>F (1,78) = 13.37</td>
<td>p &lt; .001</td>
</tr>
</tbody>
</table>
The current study predicted that increased task demands in the multitasking conditions will in turn lead to lowered satisfaction with task performance. Hence, next I focused on overall task satisfaction, which was measured with the item “Overall I am satisfied with my performance on the Multiple Choice Survival task.”

For satisfaction with task performance, the average rating deteriorated from single task to multitask conditions (Table 5). Performance satisfaction is significantly higher for the actors in single task condition than the actors in both multitask conditions. There is no significant difference on performance satisfaction between actors in the two multitask conditions. Planned contrasts were used to test the difference between the single and multitask conditions. The results are summarized in Table 5.
Overall I am satisfied with my performance on the Multiple Choice Survival task

<table>
<thead>
<tr>
<th></th>
<th>Single Task</th>
<th>Multitask IM Only</th>
<th>Multitask IM and Skype</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actor</td>
<td>N = 32</td>
<td>N = 25</td>
<td>N = 24</td>
</tr>
<tr>
<td>M</td>
<td>5.53</td>
<td>4.76</td>
<td>4.75</td>
</tr>
<tr>
<td>SD</td>
<td>(1.37)</td>
<td>(1.39)</td>
<td>(1.54)</td>
</tr>
</tbody>
</table>

Overall I am satisfied with my performance on the Multiple Choice Survival task

<p>| | | |</p>
<table>
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</thead>
<tbody>
<tr>
<td>Single Task vs. Multitask IM Only</td>
<td>$F(1,78) = 4.10$</td>
<td>$p = .05$</td>
</tr>
<tr>
<td>Single Task vs. Multitask IM and Skype</td>
<td>$F(1,78) = 4.11$</td>
<td>$p = .05$</td>
</tr>
<tr>
<td>Single Task vs. Multitask Combined</td>
<td>$F(1,78) = 5.72$</td>
<td>$p = .02$</td>
</tr>
</tbody>
</table>

**Table 5**: Overall Task Satisfaction by Experimental Conditions
The findings on task satisfaction support H2a, wherein it was predicted that increased task demands in the multitask conditions will in turn lead to lowered satisfaction with task performance. However, the experiment data did not support H2b, and no statistically significant difference in satisfaction was found between multitask with IM and multitask with Skype conditions.

The third hypothesis for this study is that number of questions answered in the single task condition will be greater than in the IM only multitask condition, which will be greater than in the IM and Skype Multi task condition. The number of questions answered in single task condition ($M = 11.51, SD = .70$) was higher than those of IM only multitask condition ($M = 9.80, SD = .79$) and IM and Skype ($M = 9.50, SD = .81$) multitask conditions, $F(1, 77) = 4.2, p = .04$, the difference was not significant between the IM and Skype multitask conditions.

The last hypothesis predicted that actors in the multitasking conditions will not perceive difference in contributions between self and collaborators whereas collaborators in the multitasking conditions will perceive weaker contribution from the actors. In the single task condition, however, no such differences are predicted. In short, this hypothesis translates into a 3-way interaction between task type, actor vs. collaborator, and ratings of self and partner.

To test this hypothesis, a 7-item assessment of self and partner performance ratings were used. The items were as follows: “collaborated with my partner to come up with decisions acceptable to both of us,” “communicated with partner as much as possible,” “promptly responded to questions and feedback,” “closely followed the flow of
conversation,” “closely followed experiment directions,” “considered partner’s opinion when there was disagreement,” “communicated with partner as much as possible,” and “contributed good ideas to the experiment task.” All evaluation questions were measured on a 7-point scale (1 = strongly disagree, 4 = neither agree nor disagree, 7 = strongly agree).

For the self performance evaluation, the inter-item correlation Pearson $r$s ranged from of .41 to .70. Items in the scale had a reliability of $\alpha = .89$. The items were averaged to create a composite measure of self performance rating ($M = 5.74, SD = .01$). For the partner performance evaluation, the inter-item correlation Pearson $r$s ranged from of .45 to .74. Items in the scale had a reliability of $\alpha = .92$. The items were averaged to create a single index of partner performance rating ($M = 5.48, SD = .08$).

To test the three-way interaction hypothesized in H4, a 3 (Task Condition: single task, multitask IM, multitask Skype) x 2 (Role: actor, collaborator) x 2 (Self-Other: self assessment, partner assessment) mixed model was used, with task condition as the between-individual factor and the other two as within-individual factors. When the results were examined, only the targeted 3-way interaction was significant, $F(2, 155) = 5.01, p < .01$, and the main effect for self versus other, $F(1, 155) = 8.76, p < .01$, were significant.
<table>
<thead>
<tr>
<th></th>
<th>Single Task</th>
<th>Multitask IM Only</th>
<th>Multitask IM and Skype</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Actor</td>
<td>Collaborator</td>
<td>Actor</td>
</tr>
<tr>
<td>Self</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>5.84</td>
<td>5.85</td>
<td>5.40</td>
</tr>
<tr>
<td>SD</td>
<td>(.91)</td>
<td>(1.07)</td>
<td>(1.19)</td>
</tr>
<tr>
<td>Partner</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>5.69</td>
<td>5.60</td>
<td>5.59</td>
</tr>
<tr>
<td>SD</td>
<td>(1.03)</td>
<td>(1.40)</td>
<td>(.97)</td>
</tr>
</tbody>
</table>

**Table 6**: Ratings for Self Performance and Partner Performance
From Table 6, we can see that actor’s rating of both self performance and partner performance did not change much with task demand. By the same token, collaborator’s self-ratings, did not change significantly across conditions. On the other hand, collaborator’s ratings on actor dropped significantly for the multitasking IM and Skype condition. Figure 3 shows graphically the discrepancy between self and partner ratings under different conditions. It can be observed that under single task condition, actor and collaborator self ratings are very similar. And actor and collaborator partner ratings are very close as well. And finally, both actor and collaborator rated self performance slightly higher than partner performance.

Under IM multitasking condition, collaborators’ self rating increases because they only need to focus on one task and they rate themselves as having done a good job compared to their partner, the actor, who needed to juggle two things through IM at the same time. On the other hand, under the same multitasking IM only condition, the actor had lowest self rating in three conditions. This could be caused by decreased satisfaction with increased task demand.

Under Skype multitasking condition, collaborator’s rating on actor dropped significantly compared to the other two conditions. Since the actor needs to use Skype to communicate with distracter, they paid much less attention to the IM communication with collaborator. The distracted actor not only caused collaborators to rate their partner poorly, it also caused the collaborators to have a lower satisfaction of self since they cannot get their partner, the actor, pay more attention to them.
Figure 3: Self and Partner Ratings on Task Performance (Actor and Collaborator)
Table 7 shows that despite the comparable self ratings on performance in the three experimental conditions, the manipulation itself was quite effective when evaluated by perceived contribution. When perceived self contribution was examined, the average rating deteriorated from single task to multitask IM and Skype conditions (Table 7). *A priori* contrasts indicated significant difference in single task vs. multitask IM and Skype conditions, and single task vs. multitask combined conditions. No significant differences were found between single task vs. multitask IM only condition and between the two multitask conditions.

Together, these findings suggest that even though the multitasking actors reported having contributed less when under pressure, when making global assessments of their communication performance, they did not see a difference in the quality of their interaction and that of the single-tasked partners. In short, they were blind to the deterioration in performance, perhaps because they were factoring in the situational constraints of the performance. However, the collaborator, who had only one task to perform, was sensitive to the weaker communication performance by the actor. In short, there was partial support for H4, with a perceived difference in performance between self and others by experimental condition and the role of the participant.
I contributed significantly to the Multiple Choice Survival task

<table>
<thead>
<tr>
<th></th>
<th>Single Task</th>
<th>Multitask IM Only</th>
<th>Multitask IM and Skype</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Actor</strong></td>
<td>N = 32</td>
<td>N = 25</td>
<td>N = 24</td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td>5.81</td>
<td>5.24</td>
<td>4.96</td>
</tr>
<tr>
<td><strong>SD</strong></td>
<td>(1.12)</td>
<td>(1.09)</td>
<td>(1.16)</td>
</tr>
</tbody>
</table>

Table 7: Self Perceived Contribution

Single Task vs. Multitask IM and Skype  F (1,78) = 7.93  \( p = .006 \)
Single Task vs. Multitask Combined   F (1,78) = 7.81  \( p = .007 \)
4.4 Distracter ratings

Distracters in current study only worked on the Worst-Case Scenario task through either IM or Skype with the actor. In this study, the distracter is considered as an experimental artifact and performance to be a random variable. The following tables (Table 8-10) reported descriptive statistics of all 3 subject groups in both multitasking conditions to provide a comprehensive view of distracter ratings on variables that have been used in earlier analyses between actors and collaborators.
I found the task of this study to be quite demanding

<table>
<thead>
<tr>
<th></th>
<th>Multitask IM Only</th>
<th>Multitask IM and Skype</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N = 25</td>
<td>N = 24</td>
</tr>
<tr>
<td><strong>Actor</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>3.72</td>
<td>4.67</td>
</tr>
<tr>
<td>SD</td>
<td>(1.57)</td>
<td>(1.76)</td>
</tr>
<tr>
<td><strong>Distracter</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>3.00</td>
<td>2.63</td>
</tr>
<tr>
<td>SD</td>
<td>(1.73)</td>
<td>(1.10)</td>
</tr>
</tbody>
</table>

**Table 8:** Perceived task difficulty among different subject groups under multitask conditions
I contributed significantly to the Worst Case Scenario task

<table>
<thead>
<tr>
<th></th>
<th>Multitask IM Only</th>
<th>Multitask IM and Skype</th>
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<tbody>
<tr>
<td></td>
<td>N = 25</td>
<td>N = 24</td>
</tr>
<tr>
<td><strong>Actor</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>4.64</td>
<td>5.33</td>
</tr>
<tr>
<td>SD</td>
<td>(1.89)</td>
<td>(1.24)</td>
</tr>
<tr>
<td><strong>Distracter</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>5.32</td>
<td>5.46</td>
</tr>
<tr>
<td>SD</td>
<td>(1.31)</td>
<td>(1.35)</td>
</tr>
</tbody>
</table>

Table 9: Self Perceived Contribution among different subject groups under multitask conditions
Overall I am satisfied with my performance on the Worst Case Scenario task

<table>
<thead>
<tr>
<th>Overall I am satisfied with my performance on the Worst Case Scenario task</th>
<th>Multitask IM Only</th>
<th>Multitask IM and Skype</th>
</tr>
</thead>
<tbody>
<tr>
<td>N = 25</td>
<td>N = 24</td>
<td></td>
</tr>
</tbody>
</table>

**Actor**
Mean 4.92 5.46
SD (1.58) (.83)

**Distracter**
Mean 5.04 5.67
SD (1.40) (1.49)

Table 10: Overall satisfaction among different subject groups under multitask conditions
Among these three measures that have been used for GLM analysis in earlier section, only perceived task difficulty showed a significant difference between the two multitasking conditions ($p = .022$). Distractors under the multitasking IM and Skype condition received more attention focus from their partners (i.e., actors) during the experiment and hence felt the experiment to be less demanding than other groups did. In addition, distracters also had directionally higher ratings on self-perceived contribution and overall satisfaction compared to the actors. However, due to the small sample size, no other difference is statistically significant.

4.5 Co-orientation Analysis

To compare the difference between the actor’s and the collaborator’s perceptions of task performance and the actor’s and the collaborator’s estimate of their partner’s perception of task performance under single and multitask conditions, a co-orientation model was used. To measure perception and estimate of perception, I used the question, “I enjoyed working with my partner,” and, “I think my partner enjoyed working with me,” as the task performance measure. As shown in Figure 4, under the single task condition, there is a significant difference between actor’s perception of task performance and actor’s estimate of collaborator’s perception of task performance ($p = .01$). There is also a significant difference between actor’s perception of task performance and collaborator’s estimate about actor’s perception on task performance ($p = .01$).

Figure 5 - 7 show the experiment results under multitask conditions and the $p$ value of mean comparison.
**Figure 4:** Self and Partner Perception about Task Performance Based on Co-orientation Model (Single Task)
**Figure 5**: Self and Partner Perception about Task Performance Based on Co-orientation Model (Multiple Task IM only)
Figure 6: Self and Partner Perception about Task Performance Based on Co-orientation Model (Multiple Task IM and Skype)
Figure 7: Self and Partner Perception about Task Performance Based on Co-orientation Model (Multiple Task Conditions)
As shown in the above figures, under multitasking conditions, however, the
difference between self-perception and other’s estimate about self-perception disappeared. (Figure 5-7). Therefore, the data was not supporting co-orientation theory’s claim about self and other differences. Such result could be caused by using only one measure of task performance and small sample sizes under each condition. Another reason could be that co-orientation is more focused on perception of a single concept, while the current study involved performance and experience from many different perspectives.
CHAPTER 5

FINDINGS AND CONCLUSION

Media multitasking is a popular behavior in younger generations. There is a common belief that by doing multiple things simultaneously, one can get more things done and hence increase productivity. Scientific researches on human brain activity, cognitive psychology and communication on the other hand, indicate that multitasking is not an optimal way to effectively process information and message. Despite the contradiction between common assumption and scientific results, no study has been conducted to closely examine the impact of multitasking on both task performance and communication experience. People may think that by juggling several things together, they are getting more things done and paying enough attention to each of the tasks they have been working on. Their communication partners, however, may not have the same experience. The current study was designed to examine the perceived demand of the multitasking task, which was compared to the single-task condition. Once the added demand was established, deterioration in task performance, perceptions of self and others in the different task conditions and the differences in communication experience between self and others under both single task and multi-task conditions were examined.
5.1. Findings from the Experiment

This study used the outdoor adventure game “Worst-Case Scenario” as the experiment task. During the pilot study, this game was well received by the participants. Students were interested in the topic and enjoyed working on the questions during the experiment. We believe a task that is more attractive to the subjects will help produce data closer to a real-life experience and provide more reliable information to the multitasking process that is under examination.

Three task conditions with two different communication tools were used in a controlled experiment to study the online communication process. Task conditions include first, single communication task between actor and collaborator through IM; second, multitask communication between actor, collaborator, and distracter, all through IM; and third, multitask communication between actor and collaborator through IM and between actor and distracter through Skype. Such a design enabled us to study communication multitasking by both task type and communication mode. We were then able to differentiate the impact caused by number of tasks versus those caused by different communication modes.

Based on the limited capacity model, we predicted that the perception of task difficulty and task performance would deteriorate with the increase of demand from more than one task. People under multitasking conditions therefore would perceive the tasks to be more demanding and feel less satisfied about their performance and the communication experience. Experiment data supported our hypotheses. With increasing demand from
multiple tasks, people reported that the tasks were more difficult to work with and required more effort to accomplish. In other words, if you focus on one thing at a time, the task will seem to be easier and require less time to process. When you work on multiple things at the same time, a simple task becomes more difficult in the eyes of the actor, and they will assume that task demands more effort. This increased perception of task demand may explain why people feel good about multitasking; they think they accomplish more difficult things by multitasking. But as a matter of fact, the only change is their perception of the difficulty of the task. Still, the key question is whether multitasking affects task performance?

Findings from this study suggest that there is a significant difference between single task and multitask on number of questions answered during the experiment. This indicated that when doing more than one task at the same time, participants slowed down with their work and therefore there is no improvement productivity as is commonly assumed. Further, I examined whether the quality of work was affected in terms of the accuracy or the number of correct answers by groups working with the different conditions. No significant differences were observed. In short, in this study, multitasking resulted in fewer questions answered by multitask teams in comparison to single-task teams, though there were no differences in the percentage of correct answers between the different experimental conditions.

Based on divergent perceptions between self and others, we also predict that people will not realize their short attention span and loss of focus during the communication process and will think they contributed similarly like their partners.
(collaborators and distracters) who are only focusing on one thing during the process. Our experiment showed that there is significant difference between self-perceived contribution and partner perceived contribution. Under single task condition, both actors and collaborators have similar ratings on each other’s performance. Under multitasking conditions however, the actor (multitasker) rated performance by self and by collaborator were on par, whereas the collaborator rated performance by self higher that the performance by their multitasking partner. This finding is particularly interesting in light of the fact that the multitaskers conceded that their contributions were less in comparison to the collaborators. One explanation for the higher rating of self by the multitaskers may be that they took into account the constraints of their situation when evaluating their performance. Given the demands and constraints of their situation, they might have thought that they did a good job.

The implication of this finding is that the person you are talking to over the phone may not know you are also replying your e-mail at the same time, but he/she can feel that you are either not fully focused on the conversation or you are less interested in the topic. At the same time, the multitasker might indulge in ego-centric or biased processing and believe that the drop in their performance was not noticeable by the other person.

Another contribution of this study was the examination of two types of multitasking, same communication-mode multitasking and different communication-mode multitasking. This study used both IM and Skype as communication modes between actors and their partners. We predicted that with more than one communication mode involved during the process, performance will deteriorate. This assumption was not
supported by the experiment.

However, as expected, actors pay more attention to their audio communication partner through Skype than their communication partner through IM. Therefore, collaborators who were in an IM chat with the actor were less satisfied when the actor was talking to another person on the phone than when the actor was in an IM chat with another person. Actors, on the other hand, had a better experience under this condition because they were optimally challenged by the additional communication tool and had a better flow experience under this condition. However, due to the blind spot bias and egocentrism, actors cannot realize that their other partner who received less attention is sacrificed during the process.

There are several other potential factors we think might have impact on task performance, including personality, multitasking preference, multitasking experience, and communication proficiency. However, the experiment data did not show strong connections between these factors and the task performance. One explanation is that our subject pool is not as diverse as the general population. There are more similarities among college students who went to the same entry level communication class than others who do not. The limited number of participants in an experiment also hindered us to generate a more robust connection between these factors and the real performance.

5.2 Limitations and Future Study

Due to the type of tasks used in the experiment, we cannot use the number of correct answers as a reliable indicator of task performance since outdoor survival skills
cannot accurately reflect problem solving performance in general. In addition, difference in number of questions answered cannot be a sole objective indicator of task performance. A study with tasks that requires more problem solving skills may provide for a more objective task performance.

As discussed in the literature review section, at a younger age, people tend to be able to process more information simultaneously than older adults (Knutson, Wood & Grafman, 2004). Children and young adults have been raised in a multimedia environment and seem to be more adaptive to media multitasking compared to the older generation. Therefore, a study that includes subjects with different ages will help us understand better about the multitasking effectiveness among different age groups.

Another challenge for current study was to find a better analysis model that will further reflect the interaction among different parties in the multitasking communication process. A model that simultaneously considers perceptions and experiences of all three parties in a multitasking condition will provide more insights on the interaction perspective of such a communication process. Such data analytic models are not readily available and future research should address some of these inadequacies.

Studies of multitasking have been mostly focused on different executive tasks and the switch of attention during multitasking. No study has been conducted thus far to closely examine multiple threads of communications between human subjects at the same time. This study is one of the few attempts to examine the multitasking behavior under an environment that simulated the real-life online communication experience. Although numerous survey studies have provided evidence about the prevalence of media
multitasking among younger and older generations, this study provide more insights about the discrepancy between self and other’s perception and experience during multitasking process. Since we used an experiment design in this study, the results cannot be applicable to the general population. However, future study may use our findings to further investigate the multitasking communication process on a broader basis. New study that mimics real world with more ecological validity will be able to provide more insights that are generalizable.
REFERENCES


APPENDIX A

Experiment Instruction

Thank you for participating in the online multitasking experiment! This study tests your reasoning skills and online communication performance under time pressure.

In this experiment, you need to work closely with your partner to solve some worse case scenario problems like the ones you just did.

For each question, discuss through IM with your partner and submit the answer you both agree upon. Make sure that you and your partner agree on the responses.

Try to complete as many questions as possible in 20 minutes. In addition to the number of right answers, you will receive points based on the quality and amount of communication generated between you and your partner during the experiment.

At the end of this quarter, when all the data are collected, the top 10 participants with the highest scores will win a monetary prize of $10 and we hope the winner will be YOU! To win the prize, you should make it a point to have sufficient back and forth discussions in IM and also get as many questions correct. Incorrect answers, and insufficient discussion will result in penalty points.

If you have any questions, please raise your hand.
Experiment Instruction for Multitask Conditions

Thank you for participating in the online multitasking experiment! This study tests your reasoning skills and online communication performance under time pressure.

In this experiment, you need to work closely with your partner to solve some worse case scenario problems like the ones you just did.

For each question, discuss through IM with your partner and submit the answer you both agree upon. Make sure that you and your partner agree on the responses.

Try to complete as many questions as possible in 20 minutes. In addition to the number of right answers, you will receive points based on the quality and amount of communication generated between you and your partner during the experiment.

When working with this partner, another partner will ask some questions. Please be careful NOT to tell either of your partners that you are multitasking. They have been instructed to give negative points if they suspect that you are not fully engaged with them and your total score will then be reduced.

At the end of this quarter, when all the data are collected, the top 10 participants with the highest scores will win a monetary prize of $10 and we hope the winner will be YOU! To win the prize, you should make it a point to have sufficient back and forth discussions in IM and also get as many questions correct. Incorrect answers, and insufficient discussion will result in penalty points.

If you have any questions, please raise your hand.
Multitask Different Communication Mode Instruction

Thank you for participating in the online multitasking experiment! This study tests your reasoning skills and online communication performance under time pressure.

In this experiment, you need to work closely with your partner to solve some worse case scenario problems like the ones you just did.

For each question, discuss through IM with your partner and submit the answer you both agree upon. Make sure that you and your partner agree on the responses.

Try to complete as many questions as possible in 20 minutes. In addition to the number of right answers, you will receive points based on the quality and amount of communication generated between you and your partner during the experiment.

When working with this partner, another partner will ask some questions using Skype, an Internet phone. Please be careful NOT to tell either of your partners that you are multitasking. They have been instructed to give negative points if they suspect that you are not fully engaged with them and your total score will then be reduced.

At the end of this quarter, when all the data are collected, the top 10 participants with the highest scores will win a monetary prize of $10 and we hope the winner will be YOU! To win the prize, you should make it a point to have sufficient back and forth discussions in IM and also get as many questions correct. Incorrect answers, and insufficient discussion will result in penalty points.

If you have any questions, please raise your hand.
APPENDIX B

Pre-Test Constructs

1. Extroversion Scale
   - Are you a talkative person?
   - Are you rather lively?
   - Can you easily get some life into a rather dull party?
   - Do you tend to keep in the background on social occasions?
   - Are you mostly quiet when you are with other people?
   - Do other people think of you as being very lively?

2. Multimedia – experience and preference
   - How often do you multitask?
   - When using a computer do you also do something else at the same time?
   - I can get things done more quickly by doing multiple things at the same time.
   - I try to multitask whenever it is possible.
   - I do a better job if I focus on one thing at a time.

3. Communication Technology – experience and preference
   - How often do you use Instant Messaging when you communicate with others?
   - How often do you use online calling such as Skype, Google talk, or MSN when you communicate with others?

4. Preference and perceived ability for collaborative work and communication and interaction
   - I can easily communicate with others
   - When working with others, I always state my ideas and opinions clearly.
   - To finish a project, I prefer team work instead of independent work.
   - I always provide many ideas when work in a team.
   - People want me to be their team member all the time.

5. Interest and intrinsic motivation for the two tasks; prior knowledge about the tasks
   - Are you in a good mood today?
   - Do you think the experiment will be an interesting one?
   - How interested in the worst case scenario task?
   - How much do you know about the worst case scenario game?
Post-Test Constructs (For Actor)

1. Manipulation checks – attentional focus (which task they attended to more, how much time and attention and effort, concentration)

- Using the following scale, where 1 = Focused mainly on the on the multiple choice survival task, 5 = Focused mainly on the worst case scenario task, rate how much attention you paid to the two tasks during the experiment. (only for multitasking actor):

- Using the following scale, where 1 = you made all your effort in the multiple choice survival task, 5 means you made all your effort in the worst case scenario task, compare the effort you expended to the two tasks during the experiment. (only for multitasking actor):

2. Partner familiarity questions

- How well do you know your experiment partner?

3. Interaction with partners

General experience Self Standpoint:
- I enjoyed working with my partner.
- The discussion between me and my partner was effective.
- Overall, I feel the interaction was satisfying.

General experience Other Standpoint:
- I think my partner enjoyed working with me.
- My partner communicated well with me
- My partner closely followed the flow of conversation.
- My partner responded promptly.
- I think my partner understood my point of view.

Perceive Self Collaboration/cooperation/communication:
- I collaborated with my partner to come up with decisions acceptable to both of us
- I communicated with my partner as much as possible
- Closely followed the flow of conversation
- I responded to my partner promptly.
- I understood my partner’s point of views.

Perceived Self-contribution to task:
- Contributed great ideas to the worst case scenario task
- The information I provided was of high value and relevant
- I gave a lot of input to the collaborative task with my partner
- Overall I am satisfied with my performance on the task
Self-Perceived Effort or Commitment
➢ My level of effort is higher than my partner.
➢ I tried to bring all our concerns out in the open so that the problem could be resolved in the best possible way.
➢ Considering partner’s opinion when there is disagreement
➢ I expressed my ideas and opinions very clearly to my partner.

4. Satisfaction with the experience and Task

   Experiment experience
➢ I find the experiment very interesting.
➢ I enjoyed working on this experiment.

   Degree of Challenge:
➢ I think the experiment is quite demanding.
➢ There were a lot of problems that occurred during the experiment
➢ I am under a lot of stress during the experiment.
➢ Given more time, I would have done a better job with the multiple choice survival task
➢ Given more time, I would have done a better job with the worst case scenario task.

100
Post-Test Constructs (For Collaborator/Distracter)

1. Partner familiarity questions
   - How well do you know your experiment partner?

2. Interaction with partners
   General experience:
   - I enjoyed working with my partner.
   - The discussion between me and my partner was effective.
   - Overall, I feel the interaction was satisfying.

   Perceive Self Collaboration/cooperation/communication:
   - My partner collaborated with me to come up with decisions acceptable to both of us
   - Communicate with me as much as possible
   - Closely followed the flow of conversation
   - My partner responded to me promptly.
   - My partner understood my point of views.

   Perceived Self-contribution to task:
   - I contributed more to the task.
   - My partner contributed great ideas to the Vaccine distribution task
   - The information my partner provided was of high value and relevant
   - Overall I am satisfied with my partner’s performance on the vaccine distribution task

   Self-Perceived Effort or Commitment
   - My level of effort is higher than my partner.
   - My partner tried to bring all our concerns out in the open so that the problem could be resolved in the best possible way.
   - My partner considering my opinion when there is disagreement
   - My partner expressed his/her ideas and opinions very clearly.

3. Satisfaction with the experience and Task

   Experiment experience
   - I find the experiment very interesting.
   - I enjoyed working on this experiment.

   Degree of Challenge:
   - I find the experiment to be quite demanding
   - There were a lot of problems that occurred during the experiment
   - I am under a lot of stress during the experiment.
   - Given more time, I would have done a better job.