DOES GROUP MEMBER EXPERIENCE AFFECT DECISION QUALITY AND USER SATISFACTION WITH COLLABORATIVE TECHNOLOGY? A STUDY OF THE TECHNOLOGY-GROUP INTERACTION PROCESS

By

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To the Faculty of Washington State University:

The members of the Committee appointed to examine the dissertation of ADAM DOUGLAS BENSON find it satisfactory and recommend that it be accepted.

Chair

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To all of you I would like to say thank you, your time and energy was not wasted.

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Abstract

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Two goals of collaboration technology (CT) research are improved outcomes, like high decision quality, and continued systems use. Current CT designed and implementation practices seem to offer persistent support structures that help improve decision quality, but at the expense of system flexibility. This lack of flexibility may lead to a drop in user satisfaction, which would threaten continued system use.

This study suggests an explanation for this phenomenon by referring to group interaction process (GIP), a premise of McGrath' time, interaction, and process (TIP) theory (1991). GIP states people's skills as well as perceptions/expectations of themselves and others change with experience. This study applies this theory in the context of CT by looking at the effects of an technological external support structure influencing GIP, technology-group interaction process (T-GIP). As system users learn to use the system, the support structures may not only be unnecessary, they may be an obstruction to performance and satisfaction.

In this study, data is collected in a longitudinal experiment to capture the changes in the measures of performance and satisfaction over time. The findings of this study suggest that

dynamic support structures within CT can both improve outcome and maintain high levels of satisfaction.

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Dedication

To Sam and Caitlyn, I'm sorry I was gone for so long.

1. Introduction

Innovative or useful projects like the design of new aircraft, enterprise wide information systems, or even films are becoming increasingly intricate and the number of opportunities where a single person can undertake and successfully complete one of these types of projects are diminishing (Bennis and Biederman 1998). It takes the input of multiple people with specialized knowledge to identify problems and allocate resources that will eventually help these projects reach completion (Bennis et al. 1998). Collaboration technology (CT) is a label that describes information systems assisting people in the development of an idea, the creation of a design, or the achievement of a shared goal. CT effectively provides the mechanism for many participants to work together on a common deliverable. Two examples of CT that help these people are group support system (GSS) and group decision support system (GDSS) (DeSanctis and Gallupe 1984; DeSanctis and Gallupe 1987).

Current CT designed and implementation practices seem to offer persistent support structures that help improve decision quality, but at the expense of system flexibility. This lack of flexibility may interfere in the naturally occurring changes within social interaction. McGrath' time, interaction, and process (TIP) theory (1991) describes how the people participating in a given group task learn how to perform the task but also interact with one another by way of group interaction process (GIP). CT developers include structure mechanisms within the system to guide the group members' interactions in order to help the group reach the desired outcome. The structures may be helpful, but they are, for the most part, static. This lack of flexibility may lead to a drop in user satisfaction, which would threaten continued system use.

This study draws from anecdotal evidence collected watching people learn to ride bicycles. It appears that external support structures, e.g. training wheels, help early riders keep from falling off their bicycles while the riders work on both the balance and coordination needed to ride a bicycle. When the bicyclists have sufficient balance and coordination, the training wheels come off and the riders continue to develop their riding skills. If the training wheels are not taken off, riders may become frustrated, especially if the training wheels keep the rider from performing as desired.

It seems logical that if people could become frustrated when training wheels are not removed after they are no longer needed, couldn't the support structures of CT have a similar effect on system users? If CT is to be effective in helping people complete these complex projects then the technical and social components of the systems and their users need to be identified and understood in terms of how they interact and influence one another. What happens when people use CT long enough to no longer need the "training wheels," do they become frustrated and discontinue usage? Maybe the extant literature can answer this question.

A recent critical review of CT literature (Arnott and Pervan 2005) claims the topic of CT research reached its peak in publication popularity in 1994 and has fallen since, implying that with the changes in technology, many assumptions or discoveries may no longer help researchers or managers. One suggested reason for the decline was the possibility of finding conflicting or inconsistent results within the literature (Arnott et al. 2005). Other scholars have complied comprehensive literature reviews and meta-analyses (Dennis, Wixom, and Vandenberg 2001; Fjermestad and Hiltz 1998/1999) showing the literature is consistent, when the reader approaches the information from an appropriate perspective (Dennis et al. 2001). This leads to the first research question:

RQ1. Why would scholars reach conflicting conclusions when looking at the similar issues in CT research?

As it is, most studies have relied on cross-sectional analysis and somewhat selective perspectives of satisfaction within the entire CT experience, which may have missed the more subtle changes in satisfaction that may evolve over time. In effect, it would be like a researcher putting training wheels on a bike for a new user and claiming that the wheels are necessary for safe and enjoyable riding. The research would be correct – for new riders only however.

A longitudinal study measuring multiple forms of users' satisfaction of CT could show that measures of different forms of satisfaction may change over time. This more sophisticated understanding would help managers and researchers be more informed consumers of the information in the extant literature. It may also encourage or renew interest in broader CT research and look at the topic in new ways.

Much of the CT literature focuses on developing an understanding of what factors affect decision quality and satisfaction (DeSanctis et al. 1984; DeSanctis et al. 1987; Nunamaker, Briggs, Mittleman, Vogel, and Balthazard 1996; Nunamaker, Dennis, Valacich, Vogel, and George 1991). The findings have lead to some debate as to what researchers understand about CT in terms of decision quality and satisfaction (Arnott et al. 2005; Dennis et al. 2001). Some critics believe the current difference in opinions is largely due to the fact that the majority of research uses a technocentric perspective (Sambamurthy and Chin 1994).

Sambamurthy and Chin argue that the majority of CT research frames questions from a perspective that user's performance is purely a function of the system's capabilities. The users' experience with the task or other group members is not accounted for when using a technocentric perspective. A techno-social perspective acknowledges the influence of technology on how people perform a given task. However, this perspective also acknowledges that people have an impact on how the technology is used in performing that task as well. This leads to the second research question:

RQ2: Would a techno-social perspective add to the understanding of how work groups' use of CT benefits or changes over time?

Additionally, the cross-sectional temporal structure (Harrison, Mohammed, McGrath, Florey, and Vanderstoep 2003; Markus and Robey 1988) of the majority of CT research may not model or test phenomena as it really exists. More recent literature (Harrison et al. 2003) finds that the conflicting or inconsistent results are due to two types of temporal errors: conclusions about relationships derived from cross-sectional data or short-lived teams, that do not hold up over longer or more natural situations (Type I), and overlooking effects or processes that operate in longer-term teams, but that would not surface in short-lived ones (Type II). This begs the third research question:

RQ3: Would a longitudinal study of CT usage add to the understanding of how work groups' use of CT benefits or changes over time?

Longitudinal studies are generally more difficult to conduct that cross-sectional studies. However, longitudinal studies are better at testing hypotheses regarding how peoples' relationship with one another and the technology develop and change over time (McGrath 1990; McGrath 1991; McGrath, Arrow, Gruenfeld, Hollingshead, and O'Connor 1993; McGrath and Kelly 1986). Cross-sectional studies and their models are said to lead researchers to make poor assumptions or draw incorrect conclusions when the patterns are not correctly modeled and tested exposing the dynamic processes as they transpire (Harrison et al. 2003).

One theory which is believed to appropriately model the dynamic relationship of groups is the Time, Interaction, and Performance (TIP) theory (McGrath 1991) which offers a group interaction process (GIP) model explaining both the technical and social challenges groups must negotiate to be productive over time. GIP states people's skills as well as perceptions/expectations of themselves and others change with experience.

The technological external support structure of CT is intended to influence GIP to help groups though the learning curve so they perform better and sooner than if left to their own devices. However, because current CT structures are not adaptive and dynamic in a way that people are, it may inhibit GIP and introduce stress by way of a restrictive environment or lack of variety, which in turn leads to dissatisfaction (Lo 1987; Sieber 1974). This leads to the fourth research question:

RQ4: Can changing the CT process structure allow system users to maintain high performance and high satisfaction with the CT experience?

The logical result of finding the anticipated answers to the four research questions would be that researchers have indeed looked at the same phenomenon but at different point in time or focusing on slightly different outcomes. The techno-social perspective would add to our understanding of how social structures may be identified and manipulated to help people be more satisfied and productive in their efforts at work. A longitudinal study would capture the changes in performance and satisfaction while accounting for the influence of technology. Finally this study would show that an adaptive structure mechanism could promote both high performance and levels of satisfaction.

1.1. Justification

1.1.1. Theoretical Importance

There is an old saying that goes, "when all you are holding is a hammer, everything starts to look like a nail." For many researchers, data collection and analysis is restricted to performing cross-sectional studies. McGrath observed that longitudinal studies are difficult to conduct given the fact that recruiting enough participants to have a significant number complete the study was expensive in terms of time and other resources (1993). Most published researchers have avoided longitudinal studies and done quite well. To some degree, researchers, who are often short on resources and needing to make tenure, avoid doing something other than cross-sectional in order to maintain and preserve their careers. When the majority of studies published are cross-sectional in nature, it leads the readers to think along those lines of questioning and analysis and before long cross-sectional studies are the *lingua franca*. But cross-sectional studies cannot tell the whole story.

Longitudinal studies such as this one can not only provide insight as to whether or not a treatment was effective, they can also show when the treatment was effective and what the long term effects were on the subjects of the study. In this study, the process structure within a group decision support system, a form of collaborative technology, is manipulated to show the long and short-term effects of different process structures over time. The task the participants perform is repeated as many as eight times. This gives us an opportunity to see how the participants use their experience to modify not only their behavior, but their attitude in terms of system, outcome and process satisfaction.

This may be the first laboratory-based experiment testing of McGrath's TIP theory (1991). The implications of a successful study would mean opening up a host of opportunities to further our understanding of what IS based problem solving and conflict resources are of benefit/harm and when those resources may switch from beneficial to harmful or *vice-versa*.

1.1.2. Practical Importance

The practical implications of this study are that system designers and personnel managers will have evidence that the tools designed for conflict resolution in collaborative technology may need to be adaptive.

Designers of current systems do not normally provide for adjust a system's characteristics based on user's experience. Much of the IS practices of systems analysis and design do not take a user's changing experience into account. More often subject matter experts, managers, and occasionally end users are able to provide some input as to inputs, process and outputs in terms of workflow, but accounting for the changes in skill or perspective of the user is not a usual consideration. In effect, a system is built with a "one size fits all" philosophy.

This study will not only show that one size will not always fit all, it will explore how measures of decision quality as well as system, outcome and process satisfaction change and when they do so, so that system designers may make options that allow for more user latitude when it is appropriate/needed. For managers, the practical implications are that user characteristics of performance and satisfaction may not only be anticipated, they may be more effectively managed.

1.2. Structure of Dissertation

This chapter provides a general introduction to the topic of TIP theory and the premise of GIP. Furthermore, it offers the research questions that motivate and guide the study. Finally, this chapter offers the importance of the research along with the general form of the remainder of the study. The remaining chapters are structured as follows:

Chapter 1, Introduction: this chapter consists of the motivation, research questions, and potential relevance of research in respect to research and practice.

Chapter 2, Literature review: this chapter provides a review of the prior research related to CT and TIP. It suggests the two streams are worth combining in order to understand how performance and satisfaction may be affected as a result of both configuration of technology and experience working with an intact group on a reoccurring task.

Chapter 3, Research model: in this chapter the theoretical model of technology-group interaction process are presented in detail. Finally, the hypotheses are presented.

Chapter 4, Research method: this chapter provides a detailed account of the experiment and the data collection. It includes the definition and operationalization of the variables, instruments, and measures used.

Chapter 5, Results: this chapter provides a detailed description of data that was collected for this study. The results of the data analysis are used to show whether the hypotheses were supported.

Chapter 6, Discussion: this chapter summarizes the results provide in the previous chapter and puts them into context to explain how and why the support of the hypotheses or lack thereof, is relevant to the proposed goals of this study. A generalization at the end of the chapter puts the findings into context.

Chapter 7, General discussion, limitations, and conclusion: this chapter reviews the implications of the study as well as the limitations of what can be claimed as understood or found to be applicable. Next, the chapter reviews what was accomplished in running this study. Finally alludes to the next studies to be run using this theoretical perspective and experimental procedure.

2. Literature Review

The proposed research has significant importance for both theory and practice in the area of information systems (IS). TIP (McGrath 1991) is a group psychology theory relatively unused by IS researchers. Since the majority of IS research is cross-sectional and not sensitive to the development and changes of patterns or performance over time, this process oriented theory may reconcile the different opinions researchers have put forward and add to a notion of continuity in the literature. Additionally, given that research has been largely technologically focused to date (Sambamurthy et al. 1994), TIP should be helpful in explaining both how and why the people in work groups function as they do when using information systems. From a practical perspective, a parsimonious model that helps managers correctly identify/manipulate a given situation is of practical importance by definition.

This study begins with a review of two goals of CT usage, decision quality, and the notion of user satisfaction. This study then reviews the role of CT structure as the technical mechanism available to help groups reach these goals. Next, the study briefly reviews TIP theory, specifically GIP, and its similarity to CT structure but with respect to the social action in group decision-making (McGrath 1991) and considers the hypotheses of the study. This study then reports the method of research, the hypotheses, as well as analysis of data. Statistical analysis of the data is used to show whether or not the hypotheses were supported and what the implications are of these findings. The limitations of the study, conclusions, and future research options complete the text.

2.1. Theory Base and Prior Research

There is a significant amount of research addressing collaborative technology from describing what components are helpful (Nunamaker et al. 1991) to the role of various participants (Griffith, Fuller, and Northcraft 1998). Even the size of the group has been a topic of study (Valacich, Dennis, and Connolly 1994). There is currently no research that address how a group's performance may change as a result of experience using collaborative technologies (CT) as suggested by McGrath's (1991) theory of time, interaction and process (TIP).

This chapter presents the constructs of interest and theoretical justification for their relationship to one another in order to describe how IS research has addressed this topic. This chapter begins with a review of the purpose for using CT in terms of the outcomes of decision quality and satisfaction. Next, it covers how the structure of CT may affect the outcomes. The next section covers the theory of Time, Interaction, and Process (McGrath 1991) with special attention given to the proposition group interaction process. Next, the chapter combines all these ideas to present a way of describing the lifecycle of CT usage. Finally, the chapter concludes with a description of how this study may add to the body of knowledge.

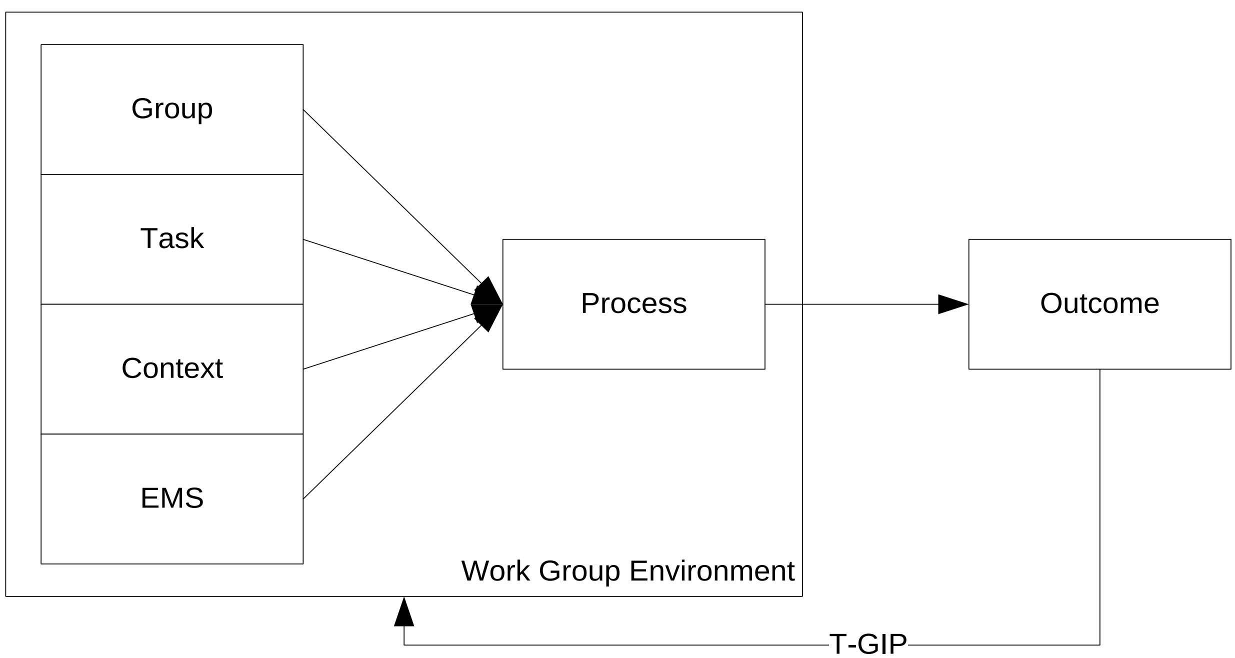
2.2. Workgroup Outcomes in Collaborative Technology

In this section, we review the outcomes of using a CT with the intention of identifying an opportunity to help developers and researchers create and manage systems that will ultimately benefit the system users.

Much of the cited literature categorizes CT outcomes in terms of the quality of the outcome and/or satisfaction (DeSanctis et al. 1984; DeSanctis et al. 1987; Nunamaker et al. 1996; Nunamaker et al. 1991). However some meta-analysis shows CT research has neither improved decision quality, nor led groups to feel more satisfied with the decision outcome (Dennis et al. 2001), yet some groups using CT have reported higher feelings of satisfaction with the meeting process than when working face-to-face (Dennis et al. 2001). Some literature claims it is possible to interpret the findings in this stream of research as confusing and conflicting, leaving management feeling frustrated and doubting the credibility of IT professionals and researchers dealing with CT (Arnott et al. 2005). The question to ask then is, have the researchers of CT identified and defined the outcomes, i.e. dependant variables, to an extent and accuracy that will benefit users, developers and researcher/analysts alike (Arnott et al. 2005; Fichman 2004; Keen 1980). Moreover, if the outcomes have been properly identified, can managers and users of CT have high satisfaction while reaching high quality outcomes like high quality decisions?

To begin to answer these questions, this study will use the meta-model of CT such as electronic meeting systems, as proposed by Nunamaker et al. (1991, p. 44), but add McGrath's proposition of GIP as a temporal aspect providing feedback as a group continues to use the CT over time (Figure 1).

Figure 1 Meta-model of CT usage over time



In this model, a *group* is a collection of people with a shared purpose in their work together (McGrath 1984). The *task* is the members of a group coming together to make a decision. The *context* is the group members meeting together for a synchronous meeting in which the decision is to be made, regardless of the experience the group members have working together. The *electronic meeting system* (EMS) refers to the characteristics of the CT. A *Process* is the collection of group, task, context, and EMS and the relationship of those items with respect to the entire decision-making experience[1]. *Outcome* is the result of that combination in terms of decision quality and satisfaction. This study adds a feedback arrow from outcome to the work group environment is the effect of the *technology-group interaction process* (T-GIP) experience.

To answer the questions above, this study will review next the notion of outcome in terms of decision quality and satisfaction to present what is believed to be a set of outcomes (DVs) that will better describe how CT use changes over time. After the outcomes are covered, the study will look at what factors affect a groups' ability to optimize those outcomes.

2.2.1. Decision Quality

Decision quality is thought of as the crucial output of CT (i.e. group decision support system) usage, helping direct an organization in its allocation of efforts and resources (DeSanctis 1993; DeSanctis et al. 1987; Morton 1971; Sprague 1980). The quality of a decision may be measured as whether or not it is correct or optimal, and how long it took to reach that decision (Dennis et al. 2001). The issue of time is simply a matter recognizing

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[1] At this point it should be noted that the term process refers to a single iteration of executing a single task. The notion of working on a project that is comprised of multiple tasks, or repeated tasks will be covered in the section pertaining to TIP theory.

that if two decisions are equivalent in terms of being correct or optimal, the one made in less time is higher in terms of its quality because it would allow management to address the issue and move on to other matters.

One challenge to evaluating decision quality is in understanding the sort of decision a group is making. Groups generally perform one of two types of decision tasks: decision-making or intellective (McGrath 1984). Intellective tasks are decisions that have a demonstrable right answer, whereas decision-making tasks are those tasks in which there is no "correct" answer per se, rather a preferred consensus. This distinction is important not only for the value of the decision, but also the group member's perception of its performance as it relates to satisfaction[2].

Managers often resist use of complex models or systems that can effectively lead to the desired outcome (Todd and Benbasat 1999, p. 356) and choose instead a system that provides output which holds little useful information (Arnott et al. 2005). The spirit of the action is compromised but the managers/institution are able to claim that they performed the required work (Hirschheim and Newman 1991). Literature identifies this as a conflict between satisfaction with the system and satisfaction with the outcome and decision-making process (Huang and Lai 2001; Paul, Seetharaman, and Ramamurthy 2004). The CT

[2] It is important to acknowledge that some studies have looked at various group decisions and findings show the outcome is influenced by factors such as politics (Cooper and Zmud 1990) or member status (Sarker, Valacich, and Sarker 2005). Though those studies did not involve use of CT to bring the group to an optimal decision they are representative of situations where some, or many, of the group members can be left feeling dissatisfied to some degree (Hare 1981). Additionally, Hare's research (1981) finds that the larger the size of the group, the less the interests or goals of the individual are observed, which leads to a lower sense of satisfaction in that individual because the interests of the individual are overlooked for the unifying interest of the group or sub-group. The dynamics of politics, member status and group size, among others, are beyond the scope of this study but acknowledged as worthy of study at a future time.

can help users get to an optimal decision, but users do not want to use the system; somehow, it is not satisfying. The experience may even be frustrating.

2.2.2. Satisfaction

Bhattacherjee (2001, pp 353-354) proposed that the intention to continue use of an information system such as CT was, in part, dependant on a system user's sense of satisfaction. In this case, *satisfaction* is described as a positive emotional state resulting from some experience, or a sense that, at the very least, one was not let down. The items used by Bhattacherjee (2001, pp 353-354) to measure satisfaction suggest it is a monolithic construct in that the survey asks users to express their feelings about the "overall experience." The construct of satisfaction is blunt when compared to the eight sub-constructs of satisfaction noted some two years earlier by Fjermestad and Hiltz (1998/1999). It is interesting that literature suggests the sense of satisfaction changes or evolves with additional experience (Bem 1972; Bhattacherjee 2001) yet there is very little research looking at how satisfaction changes over time.

The multi-level model of Theory of Reasoned Action (TRA) (Fishbein and Ajzen 1975)/Planned Behavior (TPB)(Ajzen and Fishbein 1980) was tested to show that a construct, like intention, changes over time with respect to adoption and continued use of an information system (Karahanna, Straub, and Chervany 1999). Karahanna, et al. (1999) show that the relationship of the two first-order constructs in attitude and subjective norms, change in terms of weight and significance over time with respect to intention. Initially, the subjective norm has the greatest weight in predicting intention. Over time however, subjective norm become insignificant and attitude becomes the greatest predictor of intention. This study posits that a similar phenomenon exists with respect to the general measure of satisfaction in CT research. This study's research model suggests that satisfaction in a CT application should ultimately be measured as multiple constructs of satisfaction with the information system, the outcome of that decision in terms of its objective or subjective value, and the process by which that outcome was reached.

Because the literature shows that there are a number of first-order constructs that researcher's claim contributed to a user's sense of satisfaction, it raises a question as to whether or not an omnibus measure of satisfaction is appropriate when studying CT. If researchers believe that there exists more than one aspect of satisfaction, it follows that the determinants of satisfaction may differ. This broader view of satisfaction would help the authors of critiques or concerns (Arnott et al. 2005) find that the extant literature is indeed valid and supportive of the collaborative effort to understand the use of information systems. To this end, it is proposed that CT experience satisfaction (overall satisfaction) be defined as an uncorrelated collection of constructs and sub-constructs of satisfaction that have been, or will be, applied in CT research. Furthermore, the sub-constructs of satisfaction may change in terms of weight, significance, and covariation. This would then imply some overall notion of satisfaction is a formative construct (Jarvis, MacKenzie, and Podsakoff 2003). This would then address the first research question, to explain why scholars would reach conflicting conclusions when looking at the same issues in CT research.

This section of the study proposes to review and test the variety of ways in which satisfaction may be defined and measured. The study will also show how the values of those measures of satisfaction change over time. The remainder of this section will share the refinement of the definition of satisfaction as well as summarize the temporal structures used to study satisfaction, which will lead to the contribution of this piece.

DeLone and McLean's model for IS success (2003) finds that Torkzadeh and Doll's model of satisfaction should be included whenever researchers want to measure satisfaction with an information system, and only the system. Doll, Xia and Torkzadeh (1994) offer a confirmatory factor analysis (CFA) of their satisfaction model which argues that a five-factor first-order factors[3], (content, accuracy, format, timeliness, and ease of use) with a single second-order factor (general satisfaction) has acceptable fit and is theoretically more interesting and it explains the first-order factor covariation (p457). It is clear the survey items' measures focus on the user's experience with the information system in terms of the hardware and the interface characteristics of the software.

More recent research focused on CT (Paul et al. 2004) builds upon the literature review of Fjermestad and Hiltz (1998/1999) to suggest satisfaction should be measured as three distinct constructs: satisfaction with the system, satisfaction with the decision outcome, and satisfaction with the decision-making process. *System satisfaction* refers to the group members' contentment with the EMS, or the particular CT application used. *Outcome satisfaction* is the measurement of the group members' contentment with the decision (Paul et al. 2004) and develops as a result of decision quality feedback whether the task is decision-making or intellective in nature. *Process satisfaction* is a measurement of the contentment the group members hold with regard to the method and manner in which the group arrived at their decision.

An unexpected finding is that process satisfaction has a **negative** relationship to system satisfaction (Paul et al. 2004)[4] which presents new research opportunities. Given the extant

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[3] It is also worth noting that many of the first order factors are only measured with two items. For people trying to validate the proposed model of satisfaction, the under-identified items of accuracy, format, timeliness, and ease of use might raise concern about the reliability of the items in measuring the constructs. It is not the goal of this study to modify or challenge the existing model. Nevertheless, this vulnerability to validating the model should be addressed in future studies.

[4] The negative relationship is with respect to time to reach a decision and the number if iterations it takes to reach a decision. When decision time increases, the system seems

literature is predominantly cross sectional studies that do not report on changes of the satisfaction constructs; and currently no longitudinal studies exist which investigate the anticipated changes in the three constructs of satisfaction, this is an opportunity to better understand the conflict between decision quality and satisfaction framed by the system and the process.

2.3. CT structure

In this section, we review the system as what CT structure is and why we believe it is important to decision quality and satisfaction. A CT is defined as a "computer-based 'social technology,' the basic purpose of which is 'to increase the effectiveness of decision groups by facilitating the interactive sharing and use of information among group members and also between the group and the computer.' (Huber 1984) Turoff, Hiltz, Bahgat and Rana (1993) cite DeSanctis, et al. (1987) saying CT such as GDSS, "combines communication, and decision support tools and processes to support problem formulation and solution." Nunamaker, et al. (1991, p. 45) add, "there are at least four theoretical mechanisms by which [CT] can affect the balance of gains and losses: process support, process structure, task structure, and task support." Both process and task support address infrastructure in the CT; both process and task structure address the techniques and/or rules that help the group achieve its goal.

CT structure provides techniques or rules that direct the pattern, timing or content of information flow and usage so that the group's actions are more likely to lead them to an optimal decision. CT structure varies in terms of being "high" or "low" with respect to process and task aspects of group decision-making. *High structure* CT employs "explicit

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unproductive but users are more satisfied with the process, and vice versa as the number of iterations increases to reach a decision.

rules and resources intended to govern interaction," which establish or modify a group's structure in a specific way. *Low structure* CT are not intended to guide a group's structure in any specific way (McLeod and Liker 1992). Groups may not always accept the structure within a CT, or use the structure as intended by system developers, cf. Adaptive Structuration Theory (DeSanctis and Poole 1994). However, as the structure mechanisms of the CT increasingly influence how the group functions, the structure is said to be higher.

Process structure is the combination of personnel and technical resources that help identify the group's strategy or agenda and covers the rules directing the pattern of communication to develop a strategy of what to do next and can be through social means by way of the facilitator (Dennis and Valacich 1999; Griffith et al. 1998; Nunamaker et al. 1991). It is "technology that supports, enhances, or defines the process by which groups interact, including capabilities for agenda setting, agenda enforcement, facilitation, and creating a complete record of group interaction (via storing the agenda, all the input, the votes, and so on)" (Zigurs and Buckland 1998, p. 319).

Now that we have reviewed the relevant system attributes and outputs of CT, we will introduce McGrath's (1991) theory of Time, Interaction, and Performance to hypothesize why group member's satisfaction with the process may change over time relative to the process structure of CT.

2.4. TIP

TIP, the theory of Time, Interaction, and Process (McGrath 1991), is a theory derived from empirical research which focuses on the temporal factors affecting individuals, groups and organizations. Every group action involves one or another of four modes of group activity: mode 1 - inception (group assembly and project initiation), mode2 - solution of technical issues (how tasks within a project are to be done), mode 3 - resolution of conflict/political issues (who performs a task and when), and mode 4 - execution of the performance requirements (actual performance of tasks for the purpose of project success). The four modes are not a fixed sequence; groups can vacillate between modes, and modes 2 and 3 are optional.

Figure 2 McGrath's TIP theory with its four modes and alternate paths

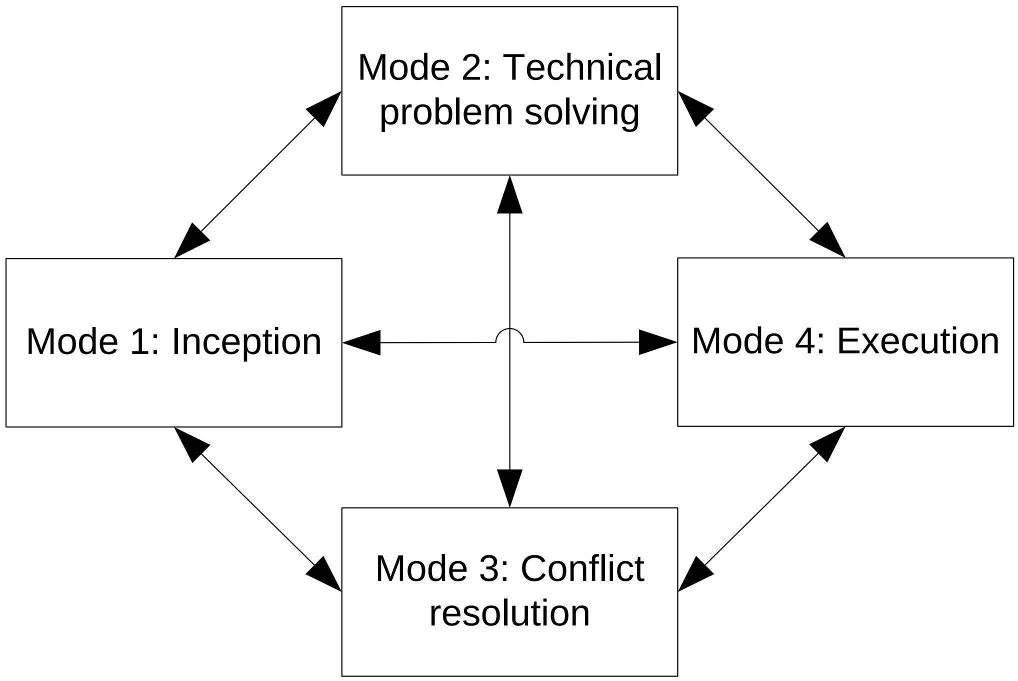

Figure 2 illustrates that TIP is non-linear and groups performing a given function are capable of moving between modes in the performance of a given task. The arrow that goes from execution back to inception is similar to the feedback arrow in figure 1. Groups that move from modes 2, 3, or 4, back to mode 1 are in a position to question whether or not they will continue to perform a given task. Within the context of this study, mode 1 represents the beginning of a new round of decision-making with the aid of the CT. The mode of conflict resolution, mode 3, may be influenced by the degree of process structure provided by the CT.

A group that has gained experience in terms of conflict resolution would need to spend less time in this mode if the issues that might be addressed in this mode have already been addressed. This would then allow a group to move from inception to execution faster, which could mean higher decision quality, as discussed above. This notion of learning from experience is the next topic in this literature review.

2.5. GIP

One proposition in TIP theory is *group interaction process* (GIP) which addresses group member interaction with regard to: the type of action, source of action, and time of action (McGrath 1991). Research shows that as members of a group interact, i.e. gain experience working together, they learn problem solving strategies and assume roles and develop expectations of each other in fulfillment of those roles – which explains how modes 2 and 3 of TIP may be optional (Futoran, Kelly, and McGrath 1989). Furthermore, after initial group formation, group members' understanding of their roles and expectations of one another adjust to some degree with each subsequent interaction (Futoran et al. 1989; Harrison et al. 2003). What is missing from the CT literature is an understanding of the changes that transpire from and after the group's inception.

To this point, the literature review has described how a group of people may use CT to aid them in achieving a desired outcome. The literature review also includes a description of satisfaction as an outcome, which would affect that group's performance in undertaking another task using CT. This model suggests that the group, task, context, and characteristics of the CT combine in a process which leads to some outcome (see Figure 1). That experience is thought to influence the way the group, task, context, and characteristics of the CT combine in subsequent tasks which in turn affects further outcomes. This feedback is modeled in the TIP model (Figure 2), suggesting that experience can influence how a group may go from the mode of inception bypassing problem solving and conflict resolution to arrive at the mode of execution expeditiously.

The concept of process structure suggested that CT may include characteristics which would help the group function more effectively by structuring the group members in their interaction – reducing the time needed in mode 3 working on conflict resolution. Similar to a beginning bicyclist relying on training-wheels to provide some external stabilization until the rider's sense of balance had developed sufficiently, a group using CT may benefit from high process structure that defines the process by which groups interact until such time as the group members can function effectively without the CT's high process structure.

There is potential liability in maintaining high process structure in CT. Just as bicyclists are likely to become frustrated with their training wheels once the riders have developed a sense of balance, there is reason to believe that a group that enjoyed the benefit of high process structure in early stages of task experience may grow frustrated with that component of the CT if they feel they can function well enough without it. This frustration has been studied as "role strain."

People experience stress and frustration when institutionalized roles bring about role strain. Role strain is a situation where people have trouble meeting the demands of a particular role because its behaviors are incompatible with those associated with roles they 'must' play (Heiss 1981, p. 268). A CT with high process structure forces people to behave unnaturally[5] in that they are unable to interact outside of the roles and patterns established by the CT.

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[5] The term "unnaturally" refers to the condition where the dynamics of modification cannot play out. People naturally look for feedback on their performance and make modifications

When the people cannot interact naturally it requires more effort to adopt some artificial role while performing the task at hand which makes the act of performing that task that much more difficult vis-à-vis effort versus accuracy (Todd et al. 1999). For some people, the effort of maintaining a static social condition is no longer worth the benefit of a desired outcome. The static social process environment creates a stress which leads to a general sense of dissatisfaction (Lo 1987; Sieber 1974). It is this phenomenon of role strain that may lead groups to lose their sense of satisfaction in a CT with high process structure. The groups, like the bicyclist, will want the freedom that is only possible once the external structure mechanisms are reduced or removed. The next chapter presents hypotheses that argue the process structure that may be beneficial to outcomes like decision quality and satisfaction early in a group's experience may interfere, even thwart, those outcomes as the group gains experience. If the group using CT is to benefit from the system at early and later stages of experience, the CT will need to be able to change to meet the needs of the group. This brings us to the final section of this chapter, technology-group interaction process (T-GIP) and the life cycle of system usage.

2.6. T-GIP

Much of the IS adoption and continuance literature is predictive. Adoption is described in a rich body of literature as the result of someone's perception of ease of use and usefulness (Venkatesh, Morris, Davis, and Davis 2003). More recently however, there has been a shift in attention to post-adoption use (Bhattacherjee 2001; Kim, Malhotra, and Narasimhan 2005) suggesting that continued use is either the result of habit or conscious choice to use a given technology. Both streams employ a predictive model. What seems to be lacking is

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accordingly. Stasis does not exist in social interaction (Arrow, McGrath, and Berdahl 2000, pp. 94-97).

that in T-GIP correlation, not causation, is implied. T-GIP lifecycle takes a descriptive position offering more nuanced constructs that include initiation, adolescence, maturation, decline, decrepitude, termination.

In the T-GIP system lifecycle, **initiation** refers to the time when a group first uses a given technology (measures of performance or perceptions of satisfaction can be recorded for the first time). **Adolescence** is the span of time after initiation extending through the time when measures significantly differ from those recoded at the initial use. **Maturity** is the point after adolescence where measures of satisfaction or performance peak or plateau. **Decline** is the period when measures of performance or satisfaction drop significantly from the high marks reached during maturity (this may be a temporary condition). **Decrepitude** is the period when measures fall and remain significantly below the high marks reached during adolescence and maturity. **Termination** is the point when the technology is no longer used for whatever reason. These points are important in explaining and predicting how and why group performance and satisfaction change as a result of experience using CT to perform a given task.

Remember that the intended function of CT is to improve decision-making directly and indirectly, vis-à-vis satisfaction. The notion is that as the members of a group use a CT, measures of performance will be relatively better than values recorded upon initial use. This is the application of McGrath's TIP theory (1991) in the context of CT, where groups can move from inception to execution more quickly and the outcome of execution is of a relatively higher quality than outcomes derived by groups not using CT. From the perspective of Bhattacherjee (2001), maintained or improved levels of satisfaction will lead to continue to use the CT. This relationship of the characteristics of the CT and experience as they relate to outcomes of decision quality and satisfaction are discussed in the next chapter, hypotheses.

3. Research Model

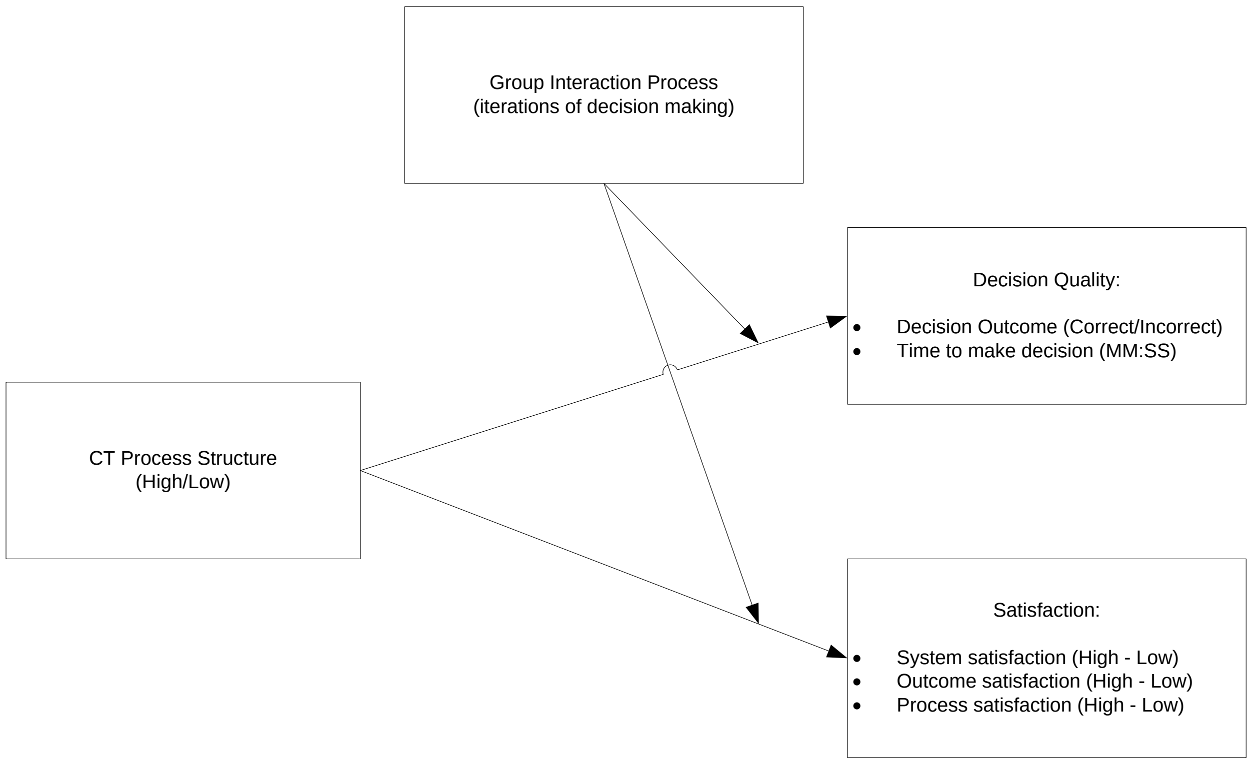
This chapter presents an overview of the research model, followed by a discussion of the hypotheses. Specifically, this chapter presents the research model along with specific, testable hypotheses about the factors that affect decision quality and measures of system, outcome, and process satisfaction. This chapter will finish with an explanation of how these hypotheses support the notion that developers and management can achieve higher quality decisions and higher measures of satisfaction both sooner and for a longer period of time than current CT configurations do.

3.1. Research model detail

The proposed research model refers to the extant CT literature to present a logical depiction of how the process structure of a CT mediates decision quality and measures of system, outcome, and process satisfaction. The experience a group has in using the CT to perform a task vis-à-vis group interaction process, moderates decision quality as well as measures of system, outcome, and process satisfaction (see Figure 3).

This study will present an argument that high process structure within CT is beneficial to a group's performance in the learning stages of task performance, but that high process structure can be removed when the necessary skills have developed within the group without loss of performance. Additionally, removal of the high process structure may help the group after going through the learning stages of task performance.

Figure 3 The research model



The following section will provide the logic and hypotheses of this model. It will state how and why CT and GIP influence decision quality as well as measures of system, outcome, and process satisfaction.

3.2. Hypotheses

The function of training wheels is to provide additional stability to the bicycle so that people learning to ride the bicycle can do so with fewer mishaps. If the learners are not falling over, but focusing on how to operate the bicycle while developing their skills the experience is likely to be more enjoyable, quicker and easier. In a similar sense, CT with a high process structure helps the group focus more on performing the task and less on resolving conflict.

Experience will have a direct relationship to decision quality

It is an axiom that with the experience gained by performing a given task, people learn to perform that task better. With respect to people working collectively on a given task, theories like TIP (McGrath 1991), argue that as groups gain experience they spend less time and energy solving problems or resolving conflicts and more time and energy executing the task. The phenomenon of learning how to perform a given task exists regardless of the presence of external mechanisms designed support the execution of that task. Through group interaction process, GIP, the group's performance in decision-making tasks improves. The groups tend to routinize the ways they use technology to complete the task. The increase in routinization "reduces ambiguity and increases predictability, which in turn reduces the level of intragroup coordination and information exchange required" (McGrath et al. 1993, p. 408) this happens through "a cycle of experimenting/ learning/ experimenting" (Zigurs, DeSanctis, and Billingsley 1991).Therefore:

Hypothesis 1: Experience will have a direct relationship to decision quality such that groups with less experience will have lower scores of decision quality than groups with more experience.

As groups' experience grows by way of GIP (McGrath 1991), group members' expectations develop and change as a result of that experience. Keeping in mind Bhattacherjee's (2001) notion that satisfaction is the product of whether or not expectations are met or exceeded, if the task and its outcome remain relatively the same though repeated performance of role strain develops(Heiss 1981). As the members of a group continue to perform the task, they are more likely to perceive they are working harder than they need to and will eventually become dissatisfied (Heiss 1981) regardless of system, outcome, or process.

Groups performing a given task have expectations, which in turn affect notions of satisfaction, and those expectations change over time. If the system, outcome, and process do not change over time, there will be a growing disconnect between the expectations and the actual experience or results. In the early stages of experience, there is little for a group to base its expectations and notions of satisfaction upon, so groups will report higher levels of system, outcome, and process satisfaction in the early stages of experience relative to later stages of experience. Therefore:

Hypothesis 2a: Experience will have an inverse relationship to system satisfaction such that groups with less experience will have higher scores of system satisfaction than groups with more experience.

Hypothesis 2b: Experience will have an inverse relationship to outcome satisfaction such that groups with less experience will have higher scores of outcome satisfaction than groups with more experience.

Hypothesis 2c: Experience will have an inverse relationship to process satisfaction such that groups with less experience will have higher scores of process satisfaction than groups with more experience.

We have recognized that the very purpose of CT is to provide groups the tools that are intended to help them perform better than they might without the aid of those tools. Recall DeSanctis and Gallupe (1987) wrote that CT such as GDSS, "combines communication, and decision support tools and processes to support problem formulation and solution." More specifically, Nunamaker, et al. (1991) described how "there are at least four theoretical mechanisms by which [CT] can affect the balance of gains and losses: process support, process structure, task structure, and task support." Both process and task support address infrastructure in the CT; both process and task structure address the techniques and/or rules that help the group achieve its goal.

In cases where CT structure may vary in terms of being "high" or "low" with respect to process structure, CT with high process structure will be relatively rigid compared to CT with low process structure. The high process structure is designed to help a group complete the task a specific way, which may not always be optimal for the group as it develops and understanding of the task and formulates its own strategy of how best to execute the task. This is to say that across time, CT with low process structure is likely allow groups formulate and employ strategies that are not available to groups working with CT with high process structure. Therefore:

Hypothesis 3: Structure will have a direct relationship to decision quality such that groups with low structure will have higher scores of decision quality than groups with high structure.

Now recall how Bhattacherjee (2001) proposed that the intention to continue use of an information system such as CT was, in part, dependant on a system user's sense of satisfaction. Festinger's (1954) social comparison theory can be helpful in explaining that people are regularly evaluating themselves relative to others and themselves and often for the purpose of confirmation or improvement. This consent evaluation and reevaluation is an example how through the TIP proposition of GIP (McGrath 1991), group members' expectations develop and change as a result of that experience. As the members of a group continue to perform a given task, they are more likely to perceive a disconnect between their situation and their evolving expectations if the situation remains static such that they will feel that they are working harder than they need to and will eventually become dissatisfied (Heiss 1981) with respect to the system, outcome, and process. Therefore:

Hypothesis 4a: Structure will have a direct relationship to system satisfaction such that groups with mixed structure will have higher scores of system satisfaction than groups with high structure or low structure.

Hypothesis 4b: Structure will have a direct relationship to outcome satisfaction such that groups with mixed structure will have higher scores of outcome satisfaction than groups with high structure or low structure.

Hypothesis 4c: Structure will have a direct relationship to process satisfaction such that groups with mixed structure will have higher scores of process satisfaction than groups with high structure or low structure.

We have discussed how experience directly leads people to have better performance. With respect to people working collectively on a given task, theories like TIP (McGrath 1991), argue that as groups gain experience they spend less time and energy solving problems or resolving conflicts and more time and energy executing the task. We have also acknowledge that the process structure of CT is designed to help groups be more productive, but the expectations of the group are likely to change with experience, via GIP (McGrath 1991). If skill level of the group using CT changes over time, it follows that the needs of groups using the CT will also change over time.

Groups that are unfamiliar performing a task will benefit from a high process structure, which will provide a form of best practices that the group may internalize. After the group has had sufficient experience to internalize the best practices and develop their own understanding of the task, they will either no longer need the high process structure, or find that it is restrictive to the point that it inhibits the groups from performing at their potential. In this way, it is expected that there is an interaction between experience and process structure, such that groups using CT with high process structure will have higher measure of decision quality than groups using CT with low process structure in the early stages of experience. As the groups gain experience however, groups working in a low process structure should approach and possibly exceed the performance measures of groups using CT with high process structure. Therefore:

Hypothesis 5: Experience will moderate the relationship between structure and decision quality, such that a) low structure groups will have lower quality decisions than high structure groups when these groups have less experience, and b) low structure groups will have decision quality at least as high as high structure groups with more experience.

We have discussed that though experience, groups change their expectations and that their expectations are linked to their sense of satisfaction. Social comparison theory (Festinger 1954) argues that people are always evaluating and reevaluating themselves relative to themselves and the people around them. Role stress argues that that people to tend to feel dissatisfied when they are locked into static roles (Heiss 1981). It follows then, that if CT process structure is configured in such a way that it meets the expectations of the system users at one point in the continuum of experience, the same process structure is not likely to meet a different set of expectations at a different point in the continuum of experience.

Groups that are unfamiliar performing a task are likely to find that CT with high process structure leads the groups to achieve their goals and expectations, which will in turn lead to higher levels of satisfaction over groups using CT with a low process structure that does not necessarily meet the goals and expectations of the group. However, as groups gain experience, the expectations of the groups change and so do their notions of goals and expectations of the CT. It is therefore expected that that there is an interaction between experience and process structure, such that groups using CT with high process structure will have higher measure of satisfaction than groups working using CT with low process structure in the early stages of experience. As the groups gain experience however, groups working with CT with low process structure should approach and possibly exceed the satisfaction measures of groups working with CT with high process structure. Therefore:

Hypothesis 6a: Experience will moderate the relationship between structure and system satisfaction, such that a) high structure groups will have higher system satisfaction than low structure groups when these groups have less experience, and b) low structure groups will have system satisfaction at least as high as high structure groups with more experience.

Hypothesis 6b: Experience will moderate the relationship between structure and outcome satisfaction, such that a) high structure groups will have higher outcome satisfaction than low structure groups when these groups have less experience, and b) low structure groups will have outcome satisfaction at least as high as high structure groups with more experience.

Hypothesis 6c: Experience will moderate the relationship between structure and process satisfaction, such that a) high structure groups will have higher process satisfaction than low structure groups when these groups have less experience, and b) low structure groups will have process satisfaction at least as high as high structure groups with more experience.

These hypotheses are intended to describe a naturally occurring phenomenon where experience, combined with the appropriate configuration CT process structure, lead groups to have optimal decision quality as well as measures of system, outcome and process satisfaction. The GIP proposition of TIP draws observations that as groups perform a given task, they learn and adopt their behavior based on feedback (McGrath 1991). Logic dictates that groups which are provided sufficient and appropriate structure are more likely to learn how to perform a given task faster than if provided no such support. Additionally, literature supports that groups learn how to perform a given task while in the process of performing it

(McGrath 1984; McGrath 1991; McGrath et al. 1993; O'Connor, Gruenfeld, and McGrath 1993), and those groups will do so without high support structure in place (Wheeler et al. 1996). This study then looks to issues of satisfaction to say that satisfaction is affected by performance feedback and is likely to affect attitudes toward continuance (Bhattacherjee 2001). The contribution of this study is to say that if groups benefit from CT which has high process structure, those groups are likely to lose satisfaction unless the process structure is released or reduced to allow for continued group interaction processes (Heiss 1981). The following chapter describes the method in which these hypotheses may be tested.

4. Research Method

This chapter reports on an experiment designed to collect data for the testing of the hypotheses of the previous chapter. A detailed explanation of the subjects, tasks, and conditions along with operationalization of the variables is provided so the reader may understand not only what transpired and why, but may have sufficient information to recreate the study if desired.

The study consisted of a controlled laboratory experiment to test the effects of experience on performance and reported measures of system, outcome, and process satisfaction. Further, the study was designed to test the effects of changing process structure on performance and reported measures of system, outcome, and process satisfaction.

4.1. Design

The overall research design for the study was 3 x 8 repeated measures design, with the three different process structure conditions (high, low, and mixed) described below, and the eight rounds of decision-making. The process structures were a between subjects condition, while the eight rounds of decision-making were a within subjects condition representing time/experience in using a web-based decision support system.

The function of the system was to emulate a university admissions process similar to the hidden profile task developed by Dennis (1996). The participants were each given identical booklets with information replicating fictional college applications. The participants were then asked to direct their web browsers to a URL where they were randomly assigned to groups of five. The groups of five were tasked with keying in the data of the fictional college applications, using predefined and published decision-making guidelines to select the best candidate (by unanimous vote) for admission, and then responding to a survey based on the feedback given for the candidate that was selected. This process of data entry, candidate selection, and survey response ran a maximum of eight rounds with each round limited to ten minutes.

The three treatment groups were labeled as being high process structure condition (HP), low process structure condition (LP), and mixed process structure condition (MP).

Participants in HP groups were each required to enter the relevant data for all of the candidates into the forms and then wait for the other team members to complete their data entry. Once all team members had completed data entry on all the candidates, they were free to move on to the voting.

In the LP groups, any member could enter the relevant data for any of the candidates into the forms. Once the team had completed data entry for the five candidates in that round, the group members were free to move on to the voting. Only one entry for each candidate was required with the LP groups, as compared to the HP groups where entries were required from all members for each candidate.

The MP groups first worked in the high process structure condition for three decision-making cycles, and then in the low process structure condition for five more decision-making cycles.

4.2. Pre-test

Three pretests were conducted to test the interface and provide the preliminary results. Those initial results were used to establish how long the rounds should last and when the process structure condition should change for the MP groups, as well as when tests for changes should take place. The pretest also helped demonstrate the efficacy of the experimental manipulations. Lastly, pretest revealed shortcomings in the initial application showing how an entire group’s work could be lost if a participant dropped from the study.

4.3. Sample

The sample consisted of undergraduate students enrolled in an introductory course in management information systems at Washington State University. This course is a requirement for all business students. The study was conducted over eleven distinct sessions with each session assigned to one of the three process structure conditions.

4.4. Procedures

The experiment took place in a classroom equipped with 50 networked workstations. Each station had a Dell Personal Computer running Windows XP and Internet Explorer 7, a 17-inch monitor (resolution 1024x768), a keyboard, and an optical mouse. Each computer was equipped with a 1.7 gigahertz Intel Pentium 4 processor, 256 MB RAM, a 37.2 GB hard drive, and a 10/100 Ethernet card. A Linux-based web server hosting the application was based in Texas (see Appendix for all screen shots).

Upon reporting to the classroom, each participant was given a booklet containing information replicating fictional college applications (see Appendix), then directed to sit at a workstation of their own choosing. Once all subjects had taken a seat, the experiment's host ran a PowerPoint presentation and read a script explaining the nature of the research study (see Appendix). Participants were then asked to log on to the classroom computers and direct their web browsers to a URL where they could read a statement regarding privacy and provide their informed consent to participation. If the participants chose to continue with the study, they followed a link at the bottom of the screen, indicating their consent to participate in the study.

The participants were then given a survey to collect information regarding the individual characteristics of the participants. When the initial survey was completed, they waited until all other participants had completed their survey. Once all the participants had completed their survey, the experiment's host began the session where each of the participants was randomly assigned to a group of five people. In the case where the number of participants did not neatly divide by five, the remainder were assigned to a group, e.g. a class of 43 participants would generate eight groups of five and one group of three.

4.5. Experiment

During the pretests, participants were co-located and distributed. Given the goal of the study was to understand the effect of process structure in decision-making technology, participants were asked to limit all communication to the chat dialog boxes that were included in the web site. This is not to suggest that the study applies to distributed groups; the restriction was for the purpose of experimental control only.

4.6. Measures

This section presents the independent, control, and dependant variables used in this study. All items and scales are included in Appendices B & C.

4.6.1. Independent Variables

The independent variables in this study consisted of the experimental manipulations and participant experience. While many factors may contribute to decision-making quality, e.g. complexity of the decision, participant familiarity with other group members, the amount of time allocated to decision-making, etc., the goal of the study is to determine if the process structure of collaborative technology can have a statistically significant impact on measures of decision quality and system, outcome and process satisfaction. The following paragraphs describe the experimental manipulation, namely the process structure in collaborative technology and experience.

4.6.1.1. Process Structure

Process structure refers to the combination of personnel and technical resources that help identify the group's strategy or agenda and cover the rules directing the pattern of communication to develop a strategy of what to do next and can be through social means by way of the facilitator (Dennis et al. 1999; Griffith et al. 1998; Nunamaker et al. 1991). Process structure was manipulated through written and verbal directions give to the participants, as well as enforced through coding of the system. Process structure controls were limited to the system's guidance in the data entry portion of the experiment. The three treatment groups were labeled as being high, mixed, and low process structure condition (as described above). The effect of the manipulation was assessed through ANOVA and t-tests.

4.6.1.2. Experience

In this study, a participant's experience was the effect of participating in subsequent rounds of decision-making activity within the same group. Rounds were defined as the data entry and decision-making activities, and were limited to ten-minute intervals. Each session was also limited to run no longer than forty-five minutes, so experience was further bound within an eight round/ 45 minute time constraint[6]. The effect of the manipulation was assessed through ANOVA and t-tests.

4.6.2. Control Variables

If the hypothesized relationships do not manifest, it would be important to suggest why events developed as they did. Information of control variables such as group satisfaction, task commitment, a participant's primary language, cultural identity, computer self efficacy,

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[6] It was possible for groups to use the entire 10 minutes per round on their first four full rounds as the study was brought to a close in the middle of their fifth round.

along with gender, and age were collected if it was necessary to determine if one or more group members could not communicate efficiently with the other group members.

4.6.2.1. Group satisfaction

Measures of group satisfaction were a control variable of interest because a system users' sense of satisfaction may be correlated to system satisfaction. This perspective comes from the extant literature(Karahanna et al. 1999). The notion that the group members and CT were evaluated in terms of providing content, accuracy, format, timeliness, and ease of use was in keeping with TIP theory in that a social aspect of the situation exists and needs to be taken into account when trying to evaluate if the group at large intends to continue to use the CT.

Group satisfaction was measured with a series of survey items asking participants to report their feelings about remaining a member of their current group. Items were adopted from more recent GSS literature (Srite, Galvin, Ahuja, and Karahanna 2007). Survey item responses were captured on a 7-point scale anchored at *1 - strongly disagree*, *4 – neither agree nor disagree*, and *7 – strongly agree*. Since the participants were gaining experience with each round of the decision-making process, group satisfaction was measured after each round to capture any changes in this attitude.

4.6.2.2. Task commitment

Measures of task commitment were captured to assess how committed the user was to continuing with the decision-making-task. Since the task was designed to be relatively simple to perform, it was anticipated that participants would develop a sense of fatigue. If the fatigue were great enough to cause the participant to drop from the study this would be important to identify, since it would represent a different reason for someone not using the collaborative technology.

Task commitment was measured with a series of survey items asking participants to report their intention to continue participation in the study. Survey items were developed specifically for this study. Item responses were captured on a 7-point scale anchored at *1 - strongly disagree*, *4 – neither agree nor disagree*, and *7 – strongly agree*. Since the participants were gaining experience with each round of the decision-making process, task commitment was measured after each round to capture any changes in this attitude.

4.6.2.3. Primary language

American English (English) was considered the standard language because the instructions and CT were developed and presented in English. A set of questions asked participants to report which language they primarily used for reading, writing, and speaking. Participants could select "English" or "other" for each of the questions. Items were developed specifically for this study. These survey items were administered at the beginning of the study when information regarding other measures of individual characteristics was captured.

4.6.2.4. Cultural identity

Cultural identity has been found to be a control variable with respect to communication and work ethic norms (Sarker and Sahay 2003; Sarker and Sahay 2004). The participants reported whether or not they claim "American" or "other" as the cultural identity they most closely identified themselves. Items were developed specifically for this study. These survey items were administered at the beginning of the study when information regarding other measures of individual characteristics was captured.

4.6.2.5. Computer self efficacy

Measures of computer self-efficacy, computer anxiety, years of computer use, and familiarity with chatting online were included to see if the system or treatment itself is confounding anticipated results. Survey items were adapted from existing literature (Compeau and Higgins 1995). Survey item responses were captured on a 7-point scale anchored at *1 - strongly disagree*, *4 – neither agree nor disagree*, and *7 – strongly agree*. These survey items were administered at the beginning of the study when information regarding other measures of individual characteristics was captured.

4.6.2.6. Gender and age

Measures of participants' respective gender and age were self-reported.

4.6.3. Dependant Variables

The dependant variables of this study consisted of decision quality, and system, outcome, and process satisfaction. The following paragraphs describe how these variables were operationalized for the study and testing of hypotheses.

4.6.3.1. Decision Quality

Decision quality needed to represent the rank of the selected candidate relative to other candidates as well as the time taken to select that candidate. Decision quality was calculated as the available time to perform a single round of data entry and candidate selection (10 minutes/600 seconds) divided by the time used by the group. That number was then divided by two raised to the rank of the candidate chosen. This provided a means of assigning a value to a decision not just on the quality relative of the decision options, but the time it took to reach that decision. Higher scores reflect a group selecting a better candidate in less time relative to lower scores. Scores for making a valid decision could theoretically range from 0.03125 to 300. If no valid decision was reached within the time limit, groups were awarded a score of zero (0) for that round of decision-making.

Example 1 – value of a timely decision: A group selecting the best candidate, a rank of 1, in two minutes would have a score of 2.5 (600/120/2^1); another group selecting the best candidate, a rank of 1, in two and a half minutes would have a score of 2.0 (600/150/2^1). This demonstrates the value of selecting an equally good option sooner rather than later.

Example 2 – value of selecting a better option: A group selecting the best candidate, a rank of 1, in two minutes would have a score of 2.5 (600/120/2^1); whereas another group selecting the second best candidate, a rank of 2, in two minutes as well would have a score of 1.25 (600/120/2^2). This demonstrates the value of making a better decision in the same amount of time.

In this calculation, an inferior decision would need to be made in half the time of the immediately superior decision to have an equal value, e.g. if a group selected the optimal candidate in five minutes, another group selecting the second most optimal candidate would need to do so in two and one half minutes to have a score of equal value.

4.6.3.2. Satisfaction

Satisfaction was a construct of interest because of its theorized influence on continuance (Bhattacherjee 2001). However there is a good deal of variance in how satisfaction has been conceptualized and measured (Fjermestad 2004; Fjermestad et al. 1998/1999). More recent studies suggest that a computer user's overall sense of satisfaction be viewed as a multi-ordered construct comprised of system satisfaction (Doll, Deng, Raghunathan, Torkzadeh, and Xia 2004; Doll and Torkzadeh 1988; Doll and Torkzadeh 1991), as well as outcome satisfaction, and process satisfaction (DeLone et al. 2003; Paul et al. 2004). The last two constructs have been added because longitudinal studies report process satisfaction has a negative relationship to system satisfaction (Paul et al. 2004). At the very least, the literature suggests that satisfaction is not a monolithic construct.

4.6.3.2.1. System satisfaction

Measures of system satisfaction were recorded to test hypotheses related to a participant's attitude toward the hardware and software interface used in the collaborative technology. Survey items regarding system satisfaction were developed from exiting survey items (Doll et al. 2004) however the response scale for these items were standardized to avoid errors or biases due to lack of continuity. Each item in this instrument was measured within a 7-point scale anchored at *1 - strongly disagree*, *4 – neither agree nor disagree*, and *7 – strongly agree*. Since the participants' attitudes were expected to change with each round of the decision-making process, measures of system satisfaction were measured at the end of each round.

4.6.3.2.2. Outcome satisfaction

Measures of outcome satisfaction were recorded to test hypotheses related to a participant's attitude toward the feedback received after going through a round of decision-making. Survey items regarding outcome satisfaction were developed from exiting survey items (Paul et al. 2004) however the response scale for these items were standardized to avoid errors or biases due to lack of continuity. Each item in this instrument was measured within a 7-point scale anchored at *1 - strongly disagree*, *4 – neither agree nor disagree*, and *7 – strongly agree*. Since the participants' attitudes were expected to change with each round of the decision-making process, measures of outcome satisfaction were measured at the end of each round.

4.6.3.2.3. Process satisfaction

Measures of process satisfaction were recorded to test hypotheses related to a participant's attitude toward the method and manner in which the group arrived at a decision. Survey items regarding process satisfaction were developed from exiting survey items (Paul et al. 2004) however the response scale for these items were standardized to avoid errors or biases due to lack of continuity. Each item in this instrument was measured within a 7-point scale anchored at *1 - strongly disagree*, *4 – neither agree nor disagree*, and *7 – strongly agree*. Since the participants' attitudes were expected to change with each round of the decision-making process, measures of process satisfaction were measured at the end of each round.

This concludes the chapter on the research method. The next chapter reports the findings derived through analysis of the data.

5. Results

This chapter covers the data analysis and results. First, a brief overview of the respondents will be provided, followed by a description of the strategy to minimize missing data. Then, the results of the hypothesis testing will be presented. Next, a summary of the findings is presented in a table format for easy reference. This chapter ends with a summary of how the support, or lack of support, furthers understanding of how technology and the group interaction process appear to interact in the realm of collaborative technology.

5.1. Subjects

The data collection took place over a period of three days toward the end of spring semester 2008. A total of 269 participants initially took part in the study. The study was conducted in 11 separate sessions with 17 to 29 participants in each session. The sessions were randomly assigned to one of three treatment conditions. Ultimately, eight subjects were dropped from the study when they failed to identify correctly the appropriate response to all three "lazy-subject" items. The participants were assigned to the three conditions as follows: high process structure (n = 70), low process structure (n = 78), and mixed process structure (n = 105) for a total of 253 participants in round one of the study.

One of the threats to internal validity is mortality. This is especially of concern in longitudinal studies such as this one. Pilot studies suggested that many of the measures of interest would manifest their anticipated changes by round four. The figures for participation are provided by treatment condition and first, fourth and eighth round. The final sample size for the study is presented below (Table 1).

In the high process structure (HP) condition 70 participants completed the decision-making and survey for round one. In round four 66 participants were still engaged in the study (94% retention). By round eight 50 participants finished the study (71% completion). In the low process structure (LP) condition 78 participants completed the decision-making and survey for round one. In round four 77 participants were still engaged in the study (99% retention). By round eight 55 participants finished the study (70% retention). In the mixed process structure (MP) condition 105 participants completed the decision-making and survey for round one. In round four 89 participants were still engaged in the study (85% retention). By round eight 63 participants finished the study (60% retention). A summary of the participation is provided in the table below.

Table 1 Participant retention through the study by treatment

	Round 1	Round 4	Round 8	Retention round 4	Retention round 8
High Process Structure	70	66	50	94%	71%
Low Process Structure	78	77	55	99%	70%
Mixed Process Structure	105	89	63	85%	60%

Of the 253 participants completing the first round of the study, 186 were male (73.5%), and 67 were female (26.4%). The average age of the participants was 20.31 years (ages ranged from 18 to 42). In an effort to provide full disclosure, it is noted that calculations are made at the group level. That being the case, groups that began with five members and finished the study with at least two were treated as valid groups.

5.2. Missing Data

There were no missing data points in that the web forms required participants to respond to each survey item before continuing on to the next round of decision-making. However, as discussed above there was attrition in that there were fewer participants making a decision and completing the survey in round eight than at round one. Pilot studies revealed that the significant changes in decision quality and measures of system, process and outcome satisfaction would develop by round four in the data collection process, and mortality of participants after round four would not be a significant threat to testing the hypotheses in this study.

5.3. Manipulation Checks

Manipulation checks were not performed per se. Theory suggests and pilot studies indicated that the groups had significantly different measures of decision quality, as well as system, process and outcome satisfaction between treatment conditions and experience. These differences are discussed in detail in the hypothesis testing section below.

5.4. Analysis of Measurement Model

The data was used to develop and test a measurement model to define the latent constructs and their respective variables through confirmatory factor analysis (CFA). Muthen & Muthen (1998-2007) and Brown (2006) provided the instructions on how to write the code for conducting the analysis and interpretation of results. Gefen, Straub and Boudreau's works (2000; Straub, Boudreau, and Gefen 2004) were used as a guides for validation of the model and the corresponding survey items. Mplus (version 5.1) was the statistical software package used to perform the calculations. Then next few sections will cover testing of model fit, proving convergent and discriminate validity of the survey items will be tested, followed by hypothesis testing.

5.4.1. Model fit

Model fit may be reported a number of ways depending on the statistical package used to perform the evaluation. Brown (2006) suggests using the RMSCA (root mean square error of approximation), the SRMR (standardized root mean square residual), the CFI (comparative fit index), and the TLI (Tucker-Lewis index) as indicators of overall model performance when using Mplus for the analysis. For absolute fit, the standardized root mean square residual (SRMR), is a typically interpreted as the average discrepancy between the correlations observed and those predicted. SRMR values range from 0.0 to 1.0 with smaller values indicating better fit. For SRMR, values less than 0.10 indicate good model fit. Model parsimony is measured with RMSCA, which is the distribution of the fitting function of the model and is sensitive to number of parameter in the model. When the model fit to the data is not perfect RMSCA values range from 0.0 to 1.0 with smaller values indicating better fit. Values of .05 or less are considered good fit statistics. Comparative fit indices, like CFI and TLI, refer to the fit of user-specified solutions in relation to more restricted, nested baseline models. The CFI and TLI are two indices that are considered popular and "well-behaved" (Brown 2006) and range from 0.0 to 1.0, but with values closer to 1.0 indicating better fit.

The next step is to show the proposed model fits the data, using a multistage confirmatory factor analysis. Straub (1989) recommends that any time an instrument is used, it should be validated in order to support the claims that the results of statistical analysis are the product of a valid model with good items for measurement.

The CFA for system satisfaction, as proposed by Doll et al. (Doll et al. 2004; Doll et al. 1988), is a four step process. Similar to prior studies (Doll et al. 2004; Somers, Nelson, and Karimi 2003) this tested four different models for fit to data while remaining faithful to the theory. The four models are: Model 1, a single first-order factor (Figure 1); Model 2, five uncorrelated first-order factors (Figure 2); Model 3, five correlated first-order factors (Figure 3); and Model 4, five uncorrelated first-order factors and one second order factor (Figure 4)

Figure 4 Model 1, a single first-order factor

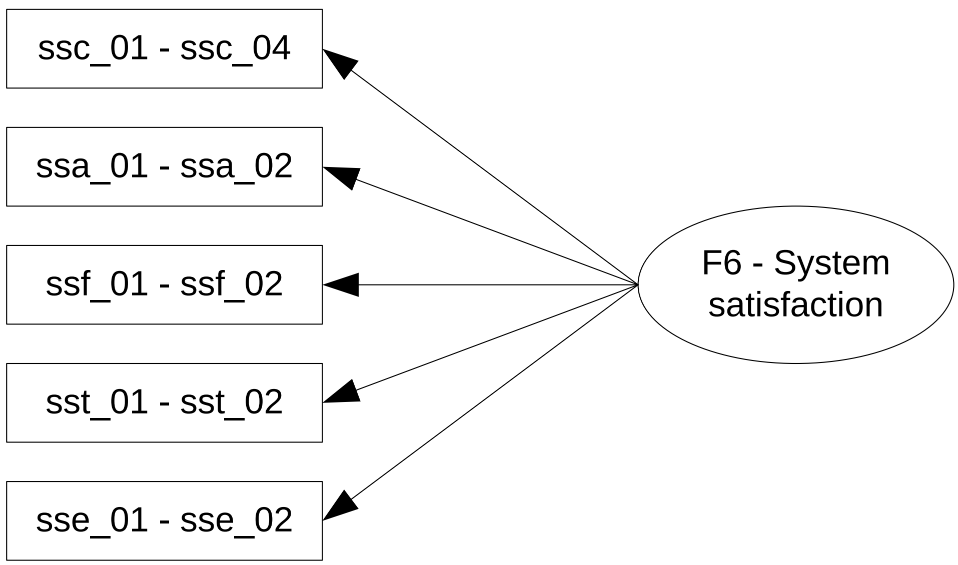


Figure 5: Model 2, five uncorrelated first-order factors

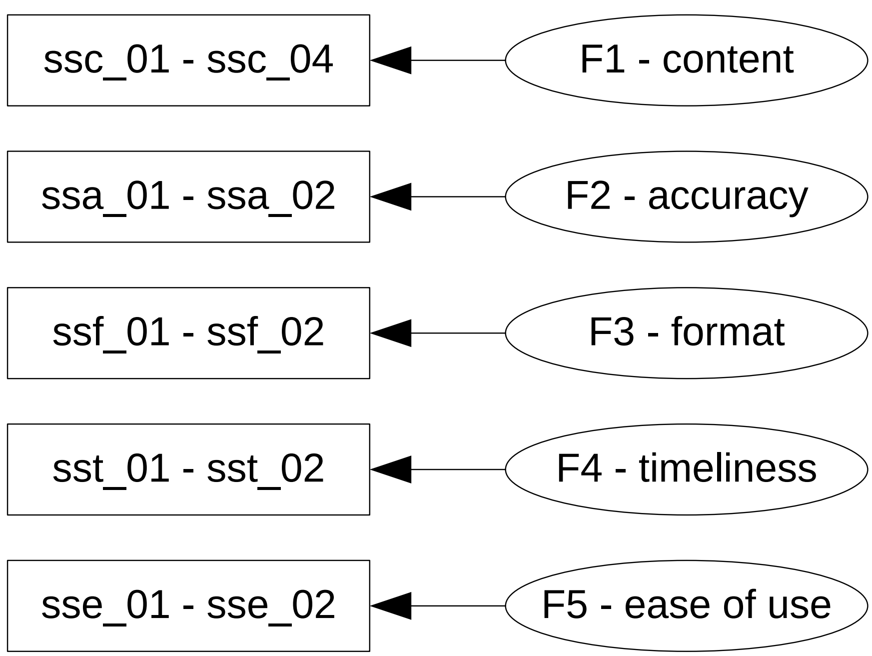


Figure 6: Model 3, five correlated first-order factors

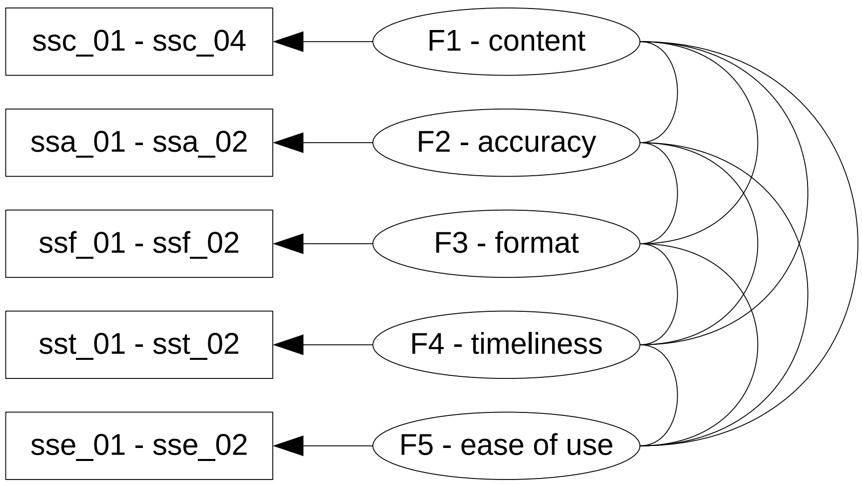
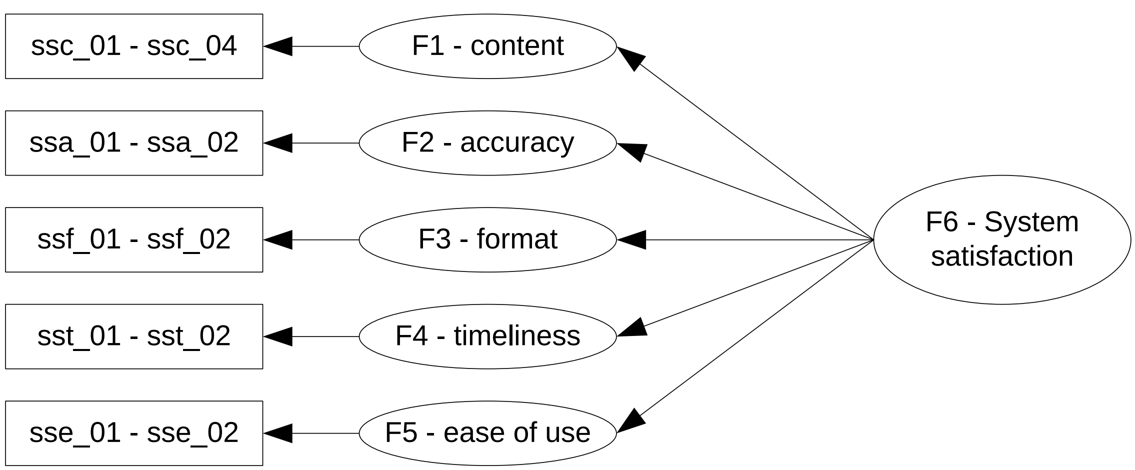


Figure 7: Model 4, five uncorrelated first-order factors and one second-order factor



The goodness-of-fit measures for the models are presented in the following table.

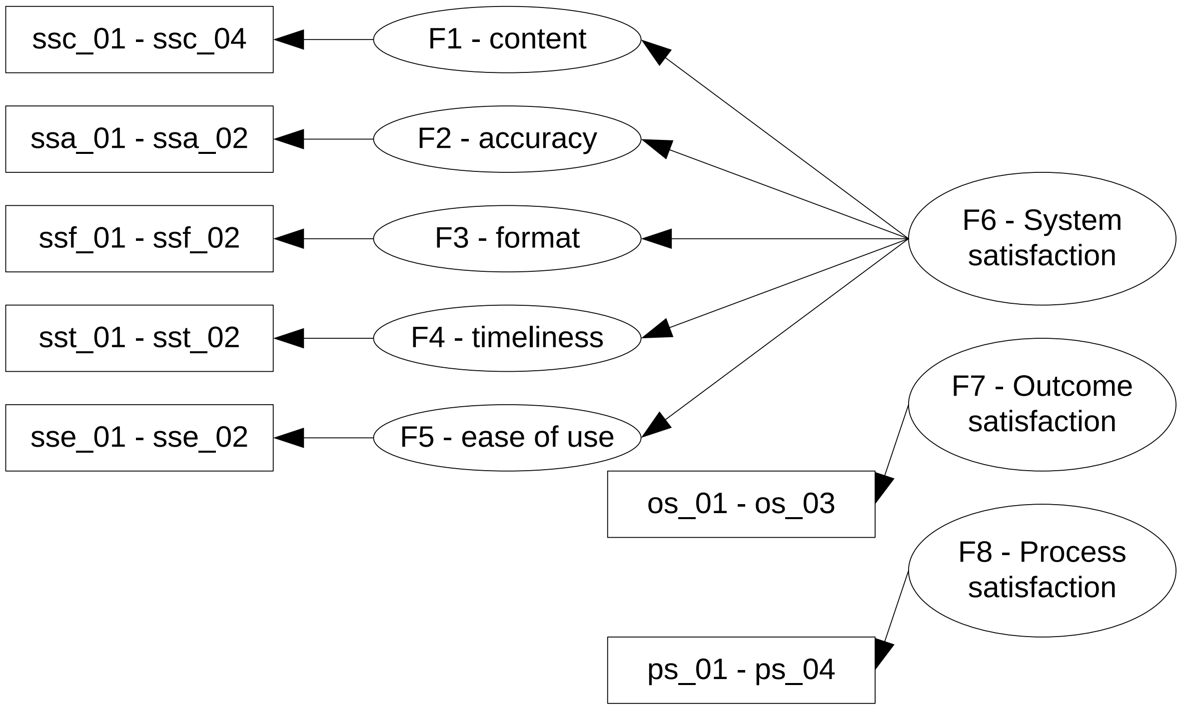
Table 2 Goodness-of-fit for alternate models of system satisfaction

	Measurement Models			
	Model 1	**Model 2**	**Model 3**	**Model 4**
SRMR	.038	.528	.017	.022
RMSEA (.90 CI)	.131 (.116 - .146)	.294 (.280 - .308)	.046 (.022 - .067)	.053 (.033 - .072)
CFI	.921	.605	.992	.988
TLI	.904	.517	.988	.984

These findings are similar to those of Doll et al. (2004) which suggested that though the simpler models may have relatively better fit statistics, the final model is both acceptable and representative of the theory, rather than purely data driven. Model 2 has very poor fit statistics, suggesting that the five factors (content, accuracy, format, timeliness, and ease of use) are correlated with respect to how the participants view system satisfaction. This is in keeping with Doll et al.'s literature (2004). A prior study showed that values for fit indices such as the Normed Fit Index, the Goodness-of-fit Index, and the Adjusted Goodness-of-fit Index were very different between the four models. Still, literature shows that though there is some variation in the values for the various fit indices (Doll et al. 1988; Somers et al. 2003), the final model here may be described as providing a reasonably good fit between the theoretical model and the data.

We now review the model fit when adding two more first order constructs, process satisfaction and outcome satisfaction (see Figure 8).

Figure 8: Model 5, seven uncorrelated first-order factors and one second-order factor



The collective goodness-of-fit indices from each category of fit are: $X^2(127) = 214.248$, $p<.001$, SRMR = 0.042, RMSEA = 0.052 (0.040 - 0.064), CFI = 0.981, and TLI = 0.977. Though the value of the RMSEA barely exceeds the recommended threshold of 0.05, the difference is so small it may be negligible. The results of this confirmatory analysis suggest an acceptable fit between the model and the data. The measurement model is presented tabular format below (see Table 3).

The table below displays the latent variables and the standardized (STDYX Standardization) calculation of their respective indicators as calculated by Mplus (5.1). The standardized estimate represents how large a portion of the observed indicator's correlation is due to the residuals co-varying.

The significance of the factor loadings is supported by the p-value. Furthermore, the items' reliability is assessed using the square of the standardized loadings. Values of .5 or more indicate that more of the variance is explained by the factor than by error in the term (Segars 1997), which is why one item, ps_04, was dropped from the final model despite it being statistically significant.

Table 3: Item loadings and standard errors

Latent Variable	Indicator	Estimate	S.E.	Est./S.E.	P-Value	Squared Correlation
Content	SSC_01	0.876	0.017	52.435	***	0.767
	SSC_02	0.919	0.012	74.124	***	0.845
	SSC_03	0.876	0.017	52.344	***	0.767
	SSC_04	0.889	0.015	57.878	***	0.790
Accuracy	SSA_01	0.894	0.017	51.723	***	0.800
	SSA_02	0.934	0.015	63.168	***	0.872
Format	SSF_01	0.908	0.014	62.898	***	0.825
	SSF_02	0.897	0.015	58.580	***	0.805
Timeliness	SST_01	0.881	0.020	44.455	***	0.776
	SST_02	0.801	0.026	30.944	***	0.641
Ease of Use	SSE_01	0.854	0.026	33.322	***	0.730
	SSE_02	0.812	0.028	28.857	***	0.659
System satisfaction[7]	Content	0.922	0.015	63.072	***	0.851
	Accuracy	0.885	0.020	44.668	***	0.783
	Format	0.980	0.012	83.848	***	0.961
	Timeliness	0.982	0.016	60.139	***	0.965
	Ease of Use	0.883	0.025	34.763	***	0.779
Process satisfaction	PS_01	0.880	0.019	47.498	***	0.774
	PS_02	0.886	0.018	48.730	***	0.785
	PS_03	0.815	0.025	32.756	***	0.663
	PS_04[8]	0.498	0.050	9.896	***	0.248
Outcome satisfaction	OE_01	0.829	0.021	40.062	***	0.688
	OE_02	0.971	0.007	143.884	***	0.943
	OE_03	0.965	0.007	134.597	***	0.931
*** p<.001 in a two-tailed test						

[7] System satisfaction is a second order construct in this model.

[8] This item was dropped from the final mode due to the low loading and correlation score.

Now that model fit has been established, the next step will be to test the items for reliability.

5.4.2. Validity testing

Construct reliability is demonstrated by showing discriminant validity and convergent validity of the items that are thought to best measure that construct. Paraphrasing Straub, et al. (2004), they say that construct validity addresses the issue of whether the measures chosen fit together in such a way as to capture the essence of the construct. Discriminant validity shows that the measures, or items used, measure the target factor more accurately and consistently than other factors that may, or may not, exist in the larger research model. Convergent validity, on the other hand, shows that multiple measures or items have a similarity or agreement in how they describe the construct of interest. Measures that demonstrate discriminant and convergent validity also need to demonstrate reliability in that the measures can be used several times with different but applicable observations and achieve consistent results.

Gefen Straub and Boudreau (2000) write that discriminant validity may be assessed by calculating that each item has a higher loading (calculated as the correlation between the factor scores and the standardized measures) on its assigned construct than on the other constructs the average variance extracted (AVE) and comparing it to the correlation of the other constructs in the model. Fornell and Larcker (1981) suggest that if the AVE is greater than .50 the latent construct has convergent validity, i.e. the variance explained by the construct is greater than measurement error. Construct reliability can be asses with Cronbach's alpha. The heuristic for Cronbach's alpha is that if the value is greater than .70, the collective items that measure that construct do so reliably.

When using Mplus (v5.1), AVE is calculated by taking the standardized estimated loadings for each item within its respective construct (see Table 3). The value of the estimate is squared, and then summed to create the numerator of the AVE statistic. The same value for the estimate is used in the denominator, only this time the estimate and 1 minus the estimate are used. Gefen et al. (2000) use the symbol lowercase lambda, λ, to represent the value of the estimate. The formula for generating the AVE statistic is then AVE = $(\Sigma\lambda_i^2)/((\Sigma\lambda_i^2)+(\Sigma 1-\lambda_i^2))$. One then takes square root of the resulting value and places it within the correlation table of the latent constructs, which is generated using the "tech4" option in the Mplus output command. That value is compared to the correlations of that construct to the other constructs in the model. If the square root of the AVE for a construct is above .50 and larger than its correlation with other constructs, convergent and discriminant validity are said to be shown (Gefen et al. 2000).

Table 4 provides the mean value, standard deviation, Cronbach's alpha and AVE to demonstrate convergent and discriminant validity. Table 5 provides the correlation matrix.

Table 4: Descriptives statistics of latent variables of satisfaction

	Mean	SD	alpha	AVE
CONTENT	3.692	1.394	0.920	0.792
ACCURACY	3.688	1.412	0.911	0.836
FORMAT	3.785	1.402	0.905	0.815
TIMELY	3.464	1.415	0.912	0.708
EOU	3.600	1.312	0.889	0.694
OUT_SAT	4.123	1.390	0.921	0.854
PRO_SAT	3.344	1.463	0.935	0.776

Table 5: Correlations of latent variables of satisfaction

	CONTENT	ACCURACY	FORMAT	TIMELY	EOU	OUT_SAT	PRO_SAT
CONTENT	1.000						
ACCURACY	-0.028	1.000					
FORMAT	0.062	-0.045	1.000				
TIMELY	0.023	0.154	-0.042	1.000			
EOU	-0.068	0.165	0.142	0.068	1.000		
OUT_SAT	0.048	0.114	0.003	0.231	0.034	1.000	
PRO_SAT	0.079	0.077	0.106	0.179	0.047	0.206	1.000

Now that the structural model fit as well as convergent and discriminant validity have been established, it is time to move to hypothesis testing within the research model.

5.5. Hypothesis Testing

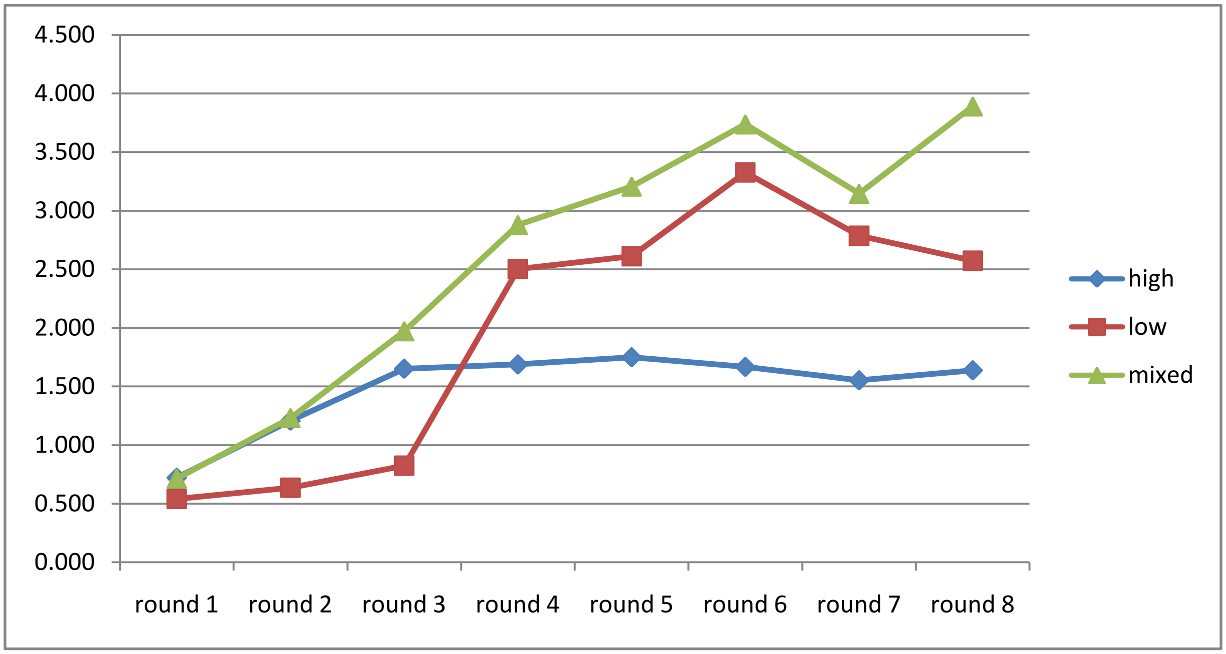
The hypotheses were tested using SPSS (v16.0.1), with the aid of the Green and Salkind manual (2005). The individual hypotheses, their tests, the results, are provided below, with a summary of the findings presented in a single table at the end. The research model is re-presented below to help organize the information.

The beginning of this section is intended to assess hypotheses regarding the anticipated effects two main and one interaction effect on decision-making, and process structure will lead to significant changes in decision quality, system satisfaction, outcome satisfaction, and outcome satisfaction. The hypotheses addressing the main effects were that experience, vis-à-vis rounds of decision-making, and process structure will lead to significant changes in decision quality, system satisfaction, outcome satisfaction, and outcome satisfaction. The hypotheses addressing the interaction was that product of experience by process structure will lead to more significant changes in decision quality than the main effects themselves. To test the hypotheses, the questions needed to be phrased in terms of difference among means using two-way repeated measures analysis of variance, with specific difference between means identified using Tukey's HSD adjusted t-tests in pot hoc analysis. The support of the following hypotheses will provide opportunity to perform additional analysis to identify when and how experience, vis-à-vis rounds of decision-making, and process structure will lead to significant changes in decision quality, system satisfaction, outcome satisfaction, and outcome satisfaction.

5.5.1. Tests of addressing measures of decision quality

A 3 x 8 ANOVA was conducted to evaluate the effects of the three process structure conditions and experience, vis-à-vis rounds of decision-making, on decision quality. The graphic below presents an interesting depiction of how the groups' decision quality was affected by both treatment condition and experience. We see that the groups in the high process structure (HP) and mixed process structure (MP) condition have a positive trend in decision quality, and that that trend is greater than the groups in the low process structure (LP) condition. Between rounds 3 and 4 a lot changes however, groups in the low process structure condition show a radical increase in scores for decision quality, and the mixed process structure condition transition from the high process structure to the low process structure condition.

Figure 9: Mean values for decision quality



The mean and standard deviations for decision quality as a function of treatment and round of decision-making are presented in the table below.

Table 6: Descriptive statistics for decision quality

treatment		round 1	round 2	round 3	round 4	round 5	round 6	round 7	round 8
high	Mean	0.722	1.208	1.651	1.688	1.749	1.667	1.552	1.637
N = 18	SD	0.473	0.589	0.626	0.554	0.767	0.847	0.775	1.072
low	Mean	0.540	0.634	0.824	2.502	2.611	3.326	2.786	2.573
N = 19	SD	0.459	0.656	0.809	0.979	1.472	1.458	1.401	1.740
mixed	Mean	0.715	1.232	1.972	2.878	3.207	3.738	3.145	3.891
N = 22	SD	0.488	0.741	0.730	1.070	1.246	1.219	1.541	2.126
Total	Mean	0.661	1.032	1.505	2.394	2.570	2.973	2.544	2.779
N = 59	SD	0.474	0.715	0.867	1.024	1.331	1.483	1.451	1.949

A two-way within-subjects repeated measures analysis of variance was conducted to evaluate the effects of experience (round) and process structure condition treatment

(treatment) on measures of decision quality. The dependant variable was a report of decision quality. Mauchly's Test of Sphericity statistic was significant, p>0.05, therefore we conclude that the condition of sphericity has not been met for tests within subjects. The degrees of freedom were adjusted using the Greenhouse-Geisser correction to compensate for the violation of the assumption of sphericity.

There were tests on two main effects and experience and treatment, as well as an experience x treatment interaction using the Greenhouse-Geisser correction of .569. The within subjects experience main effect was significant, Greenhouse-Geisser = .569, F(3.985, 223.183) = 42.858, p<.001. The between subjects treatment main effect was significant, F(2, 56) = 17.392, p<.001. The experience by treatment (round x treatment) interaction effect was also significant, Greenhouse-Geisser = .569, F(7.971, 223.183) = 5.794, p<.001.

Now that experience and process structure have been shown to have both main effects and an interaction effect, we move on to identifying how and when their effects were realized in this study. The following tests are paired sample *t-test*s conducted using the Tukey's highly significant difference (HSD) statistic. Tukey's HSD (q) is intended provide a means of conducting post hoc analysis without inflating the Type I error rate. The value for *q* was found by identifying the number of conditions (3) and the number of observations (8); the resulting critical value was identified as 4.05 for a p<.05 this means. The relationship between *t* and q is $t = q/\sqrt{2}$, therefore the critical value for the *t-test*s is $t = \frac{q}{\sqrt{2}} = \frac{4.05}{\sqrt{2}} = 2.864$. We reject the null hypothesis when the computed value of t is greater than 2.864.

5.5.2. Post hoc tests addressing measures of decision quality

Two paired-samples t-tests compared against Tukey's HSD statistic, q = 2.864, were conducted to evaluate the effect experience on decision quality. The independent variable, experience vis-à-vis round, consisted of eight levels, rounds 1 through 8. Decision quality was averaged through the three treatment conditions for process structure. The dependant variable was decision quality. The results indicate that that the mean score for decision quality at round one (M = 0.661, SD = 0.474) was significantly less than the mean score for decision quality at round two (M = 1.032, SD = 0.715), t(58) = -3.773, p<.001. Similarly, the mean score for decision quality at round two (M = 1.032, SD = 0.715) was significantly less than the mean score for decision quality at round three (M = 1.505, SD = 0.867), t(58) = -4.063, p<.001. The figure for mean values of decision quality clearly show a general overall trend of decision quality improving after round three for groups in the low and mixed process structure condition; the trend for groups in the high process structure remains relatively the same to the end of the study. Therefore, these results support hypothesis 1, stating that experience will have a direct relationship to decision quality such that groups with less experience will have lower scores of decision quality than groups with more experience.

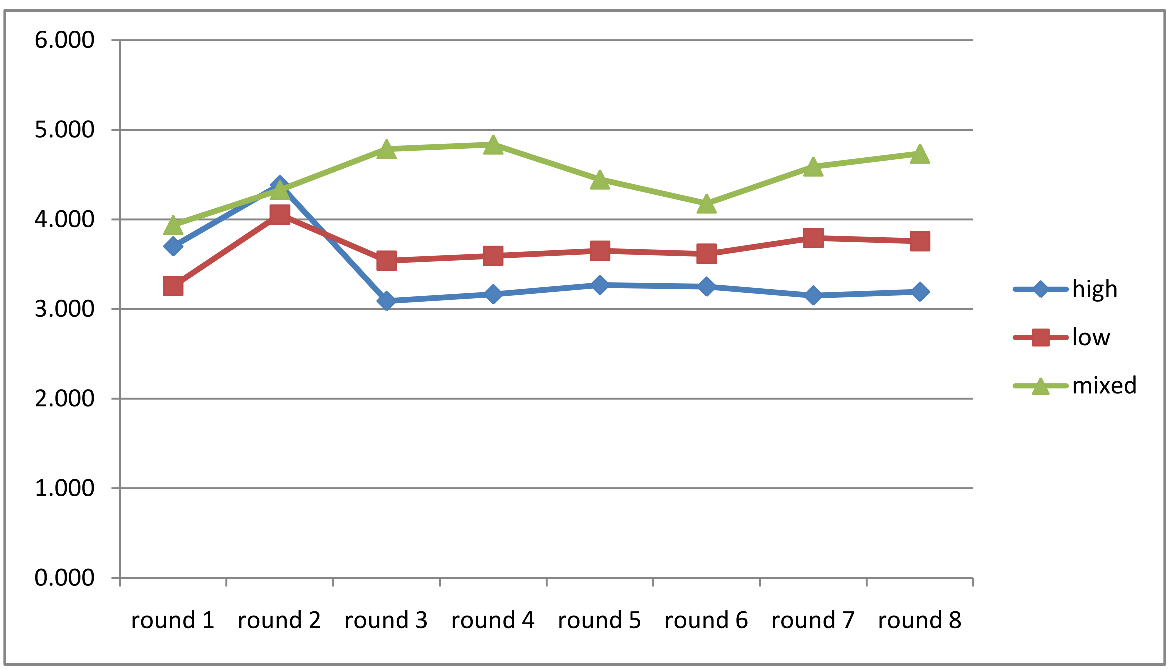
A paired-samples t-test compared against Tukey's HSD statistic, q = 2.864, was conducted to evaluate the effect of treatment on decision quality. The independent variable, treatment vis-à-vis process structure, consisted of two levels, high and low. Decision quality was averaged through the eight rounds of decision-making. The dependant variable was decision quality. The results indicate that that the mean score for decision quality for groups in the high process structure condition (M = 1.484, SD = 0.789) was significantly less than the mean score for groups in the low process structure condition (M = 1.979, SD = 1.604), t(143) = -3.718, p<.001. Therefore, these results support hypothesis 3, stating that structure will have a direct relationship to decision quality such that groups with low structure will have higher scores of decision quality than groups with high structure.

Finally, A paired-samples t-test compared against Tukey's HSD statistic, q = 2.864, was conducted to evaluate the effect of the interaction of experience x treatment on decision quality. The independent variable, treatment vis-à-vis process structure, consisted of two levels, high and low. Decision quality was averaged through the eight rounds of decision-making. The dependant variable was decision quality. The difference between HP and LP groups at round 3 was compared against the difference between HP and LP groups at round 4. Because the mean values for decision quality clearly show that between rounds 1 and 3 HP groups had higher levels of decision quality. Between rounds 3 and 4, groups in the LP condition clearly have higher levels of decision quality until the end of the study. The MP groups were in an HP condition from rounds 1 to 3 and in an LP condition from rounds 4 to 8. The scores of the MP condition were always the best. The difference between HP to LP at round 3 (M = 0.880, SD = 1.023) was significantly different from the difference between HP to LP at round 4 (M = -0.856, SD = 1.292), $t(17) = 4.081$, $p<.01$. Indicating that the HP condition contributed to higher measures of decision quality in earlier rounds of decision-making, but the LP condition contributed to higher measures of decision quality in later rounds of decision-making. These results support hypothesis 5, stating that experience will moderate the relationship between structure and decision quality, such that a) low structure groups will have lower quality decisions than high structure groups when these groups have less experience, and b) low structure groups will have decision quality at least as high as high structure groups with more experience. The results of these tests support the hypotheses that the main effects of experience, process structure, as well as their interaction affect measures of decision quality.

5.5.3. Tests of addressing measures of system satisfaction

A 3 x 8 ANOVA was conducted to evaluate the effects of the three process structure conditions and experience, vis-à-vis rounds of decision-making, on system satisfaction. The graphic below presents an interesting illustration of how the groups' report values of system satisfaction were influenced by both treatment condition and experience. We see that the groups in the high process structure (HP) and mixed process structure (MP) and low process structure (LP) condition have a relatively similar sense of system satisfaction at round 1, and that sense of system satisfaction grows between round 1 to round 2. At round 3, the LP groups report lower a lower, nearly neutral, sense of satisfaction; the HP groups report a relatively low sense of system satisfaction. On the other hand, the MP groups report an even higher sense of satisfaction. For the remainder of the study HP groups report the same relatively low level of system satisfaction, LP groups stay relatively neutral in reports of system satisfaction. MP groups, who have transition from high process structure at round 3 to low process structure at round 4 and for the remainder of the study, report relatively positive levels of satisfaction.

Figure 10: Mean values for system satisfaction



The mean and standard deviations for system satisfaction as a function of treatment and round of decision-making are presented in the table below.

Table 7: Descriptive statistics for system satisfaction

treatment		round 1	round 2	round 3	round 4	round 5	round 6	round 7	round 8
high N = 12	Mean SD	3.693 0.247	4.421 0.295	3.116 0.148	3.192 0.216	3.224 0.204	3.314 0.239	3.139 0.187	3.192 0.170
low N = 14	Mean SD	3.251 0.225	4.048 0.196	3.545 0.194	3.570 0.218	3.680 0.157	3.633 0.191	3.810 0.205	3.756 0.186
mixed N = 16	Mean SD	3.933 0.229	4.319 0.276	4.813 0.154	4.820 0.216	4.449 0.197	4.172 0.240	4.596 0.181	4.734 0.181
Total N = 42	Mean SD	3.637 0.371	4.258 0.296	3.905 0.758	3.938 0.746	3.842 0.546	3.747 0.422	3.918 0.629	3.967 0.672

A two-way within-subjects repeated measures analysis of variance was conducted to evaluate the effects of experience (round) and process structure condition treatment (treatment) on measures of system satisfaction. The dependant variable was a report of system satisfaction. Mauchly's Test of Sphericity statistic was not significant, $p<0.05$, therefore we conclude that the condition of sphericity had been met for test within subjects. The Wilks's lambda (Λ) correction was used to interpret within subjects contrasts.

There were tests on two main effects and Experience and Treatment, as well as an Experience x Treatment interaction using the multivariate criterion of Wilks's lambda (Λ) as well as the experience main effect, $\Lambda = .196$, $F(7, 33) = 19.323$, $p<.001$, as well as process structure condition, $F(2, 39) = 781.030$, $p<.001$. The experience by process structure condition treatment (round x treatment) interaction effect was also significant, $\Lambda = .021$, $F(14, 66) = 127.906$, $p<.001$.

5.5.4. Post hoc tests addressing measures of system satisfaction

Two paired-samples t-tests compared against Tukey's HSD statistic, $q = 2.864$, were conducted to evaluate the effect experience on system satisfaction. The independent variable, experience vis-à-vis round, consisted of eight levels, rounds 1 through 8. System satisfaction was averaged through the three treatment conditions for process structure. The dependant variable was system satisfaction. The results indicate that that the mean score for system satisfaction at round one (M = 3.660, SD = 0.371) was significantly less than the mean score for decision quality at round two (M = 4.257, SD = 0.301), t(56) = -10.969, p<.001. However, the mean score for system satisfaction at round two (M = 4.257, SD = 0.301) was significantly more than the mean score for system satisfaction at round three (M = 3.869, SD = 0.755), t(55) = 3.595, p<.01. The figure for mean values of system satisfaction clearly show that measures for system satisfaction remain largely. These findings support hypothesis 2a, stating that experience will have an inverse relationship to system satisfaction such that groups with less experience will have higher scores of system satisfaction than groups with more experience.

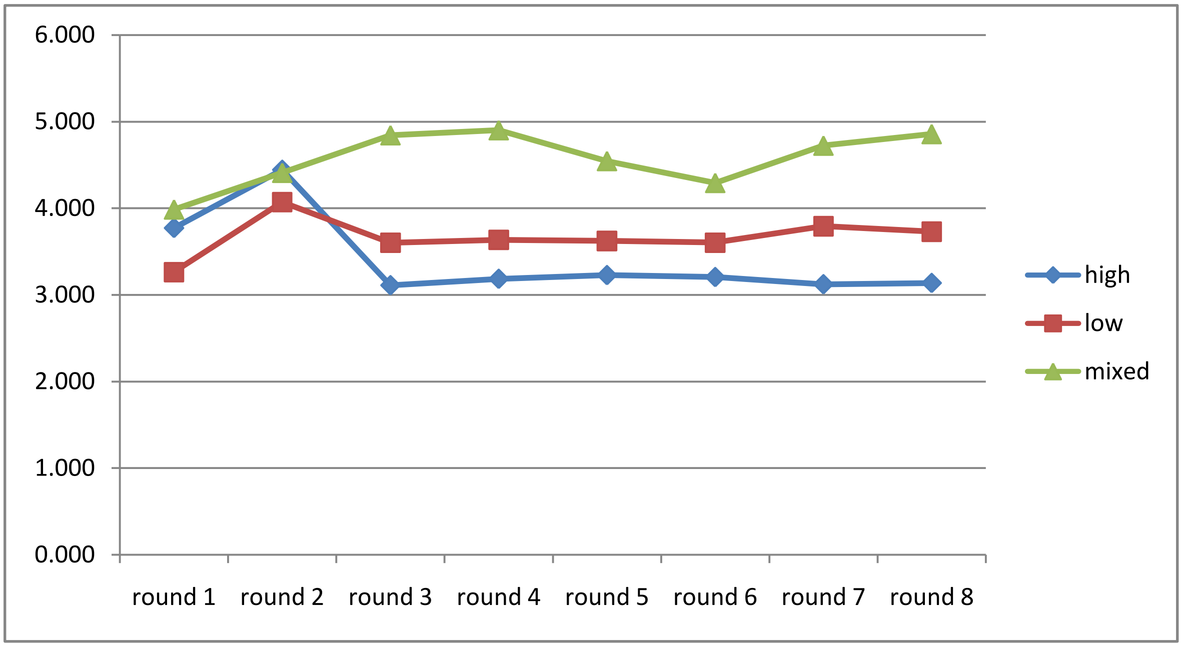
Two paired-samples t-tests compared against Tukey's HSD statistic, q = 2.864, were conducted to evaluate the effect treatment on system satisfaction. The independent variable, treatment vis-à-vis process structure condition, consisted of three levels, high, low and mixed. System satisfaction was averaged through the eight round of decision-making for system satisfaction. The dependant variable was system satisfaction. The results indicate that that the mean score for system satisfaction for groups in the high process structure condition (M = 3.408, SD = 0.468) was significantly less than the mean score for system satisfaction for group in the mixed process structure condition (M = 4.486, SD = 0.373), t(102) = -15.313, p<.001. Additionally, the mean score for system satisfaction for groups in the low process structure condition (M = 3.661, SD = 0.294) was significantly less than the mean score for system satisfaction for group in the mixed process structure condition (M = 4.486, SD = 0.373), t(102) = -18.807, p<.001. The figure for mean values of system satisfaction clearly show that measures for system satisfaction remain largely consistent in showing groups in the mixed process structure condition reporting higher levels of system satisfaction than groups in the high or low process structure. These findings support hypothesis 4a, stating that structure will have a direct relationship to system satisfaction such that groups with mixed structure will have higher scores of system satisfaction than groups with high structure or low structure.

Finally, A paired-samples t-test compared against Tukey's HSD statistic, $q = 2.864$, was conducted to evaluate the effect of the interaction of experience x treatment on system satisfaction. The independent variable, treatment vis-à-vis process structure, consisted of two levels, high and low; experience was limited to data take at rounds 2 and 3. The difference between HP and LP groups at round 2 was compared against the difference between HP and LP groups at round 3. Because the mean values for decision quality clearly show that between rounds 2 and 3 the HP and LP groups' measures of system satisfaction crossover, indicating a significant interaction. For rounds 1 and 2 HP groups have higher levels of system satisfaction. Between rounds 2 and 3, groups in the LP condition clearly have higher levels of system until the end of the study. The MP groups were in an HP condition from rounds 1 to 3 and in an LP condition from rounds 4 to 8. The scores of the MP condition were always the highest. The difference between HP to LP at round 2 ($M = 0.488$, $SD = 0.709$) was significantly different from the difference between HP to LP at round 3 ($M = -0.436$, $SD = 0.503$), $t(74) = 9.975$, $p<.001$. This indicates that the HP condition contributed to higher measures of system satisfaction earlier rounds of decision-making, but the LP condition contributed to higher measures of system satisfaction in later rounds of decision-making. These results support hypothesis 6a, stating that experience will moderate the relationship between structure and system satisfaction, such that a) high structure groups will have higher system satisfaction than low structure groups when these groups have less experience, and b) low structure groups will have system satisfaction at least as high as high structure groups with more experience. The results of these tests support the hypotheses that the main effects of experience, process structure, as well as their interaction affect measures of system satisfaction.

5.5.5. Tests of addressing measures of outcome satisfaction

A 3 x 8 ANOVA was conducted to evaluate the effects of the three process structure conditions and experience, vis-à-vis rounds of decision-making, on outcome satisfaction. The graphic below presents an interesting illustration of how the groups' report values of outcome satisfaction were influenced by both treatment condition and experience. We see that the groups in the high process structure (HP) and mixed process structure (MP) and low process structure (LP) condition have a relatively similar sense of outcome satisfaction at round 1, and that sense of outcome satisfaction grows between round 1 to round 2. At round 3, the LP groups report lower a lower, nearly neutral, sense of satisfaction; the HP groups report a relatively low sense of outcome satisfaction. On the other hand, the MP groups report an even higher sense of satisfaction. For the remainder of the study HP groups report the same relatively low level of outcome satisfaction, LP groups stay relatively neutral in reports of outcome satisfaction. MP groups, who have transition from high process structure at round 3 to low process structure at round 4 and for the remainder of the study, report relatively positive levels of satisfaction.

Figure 11: Mean values for outcome satisfaction



The mean and standard deviations for outcome satisfaction as a function of treatment and round of decision-making are presented in the table below.

Table 8: Descriptive statistics for outcome satisfaction

treatment		round 1	round 2	round 3	round 4	round 5	round 6	round 7	round 8
high	Mean	3.768	4.493	3.130	3.206	3.192	3.252	3.124	3.136
N = 12	SD	0.248	0.300	0.133	0.205	0.201	0.235	0.177	0.150
low	Mean	3.252	4.060	3.610	3.613	3.653	3.617	3.805	3.728
N = 14	SD	0.222	0.215	0.191	0.221	0.164	0.185	0.174	0.187
mixed	Mean	3.965	4.392	4.865	4.893	4.552	4.283	4.727	4.857
N = 16	SD	0.205	0.272	0.147	0.211	0.194	0.228	0.161	0.175
Total	Mean	3.671	4.310	3.951	3.984	3.864	3.767	3.962	3.989
N = 42	SD	0.380	0.316	0.766	0.768	0.604	0.483	0.685	0.747

A two-way within-subjects repeated measures analysis of variance was conducted to evaluate the effects of experience (round) and process structure condition treatment (treatment) on measures of outcome satisfaction. The dependant variable was a report of outcome satisfaction. Mauchly's Test of Sphericity statistic was significant, $p > 0.05$, therefore we conclude that the condition of sphericity has not been met for test within subjects. The degrees of freedom were adjusted using the Greenhouse-Geisser correction to compensate for the violation of the assumption of sphericity.

There were tests on two main effects and Experience and Treatment, as well as an Experience x Treatment interaction using the Greenhouse-Geisser correction of .771. The experience main effect was significant, Greenhouse-Geisser = .771, $F(5.396, 210.425) = 39.062$, $p<.001$, as well as process structure condition, $F(2, 39) = 995.214$, $p<.001$. The experience by process structure condition treatment (round x treatment) interaction effect was also significant, Greenhouse-Geisser = .771, $F(10.791, 210.425) = 46.527$, $p<.001$.

5.5.6. Post hoc addressing measures of outcome satisfaction

Two paired-samples t-tests compared against Tukey's HSD statistic, $q = 2.864$, were conducted to evaluate the effect experience on outcome satisfaction. The independent variable, experience vis-à-vis round, consisted of eight levels, rounds 1 through 8. Outcome satisfaction was averaged through the three treatment conditions for process structure. The dependant variable was outcome satisfaction. The results indicate that that the mean score for outcome satisfaction at round one ($M = 3.700$, $SD = 0.380$) was significantly less than the mean score for decision quality at round two ($M = 4.311$, $SD = 0.317$), $t(56) = -11.740$, $p<.001$. However, the mean score for outcome satisfaction at round two ($M = 4.311$, $SD = 0.317$) was significantly more than the mean score for outcome satisfaction at round three ($M = 3.917$, $SD = 0.765$), $t(55) = 3.637$, $p<.01$. The figure for mean values of outcome satisfaction clearly show that measures for outcome satisfaction remain largely. These findings support hypothesis 2b, stating that experience will have an inverse relationship to outcome satisfaction such that groups with less experience will have higher scores of outcome satisfaction than groups with more experience.

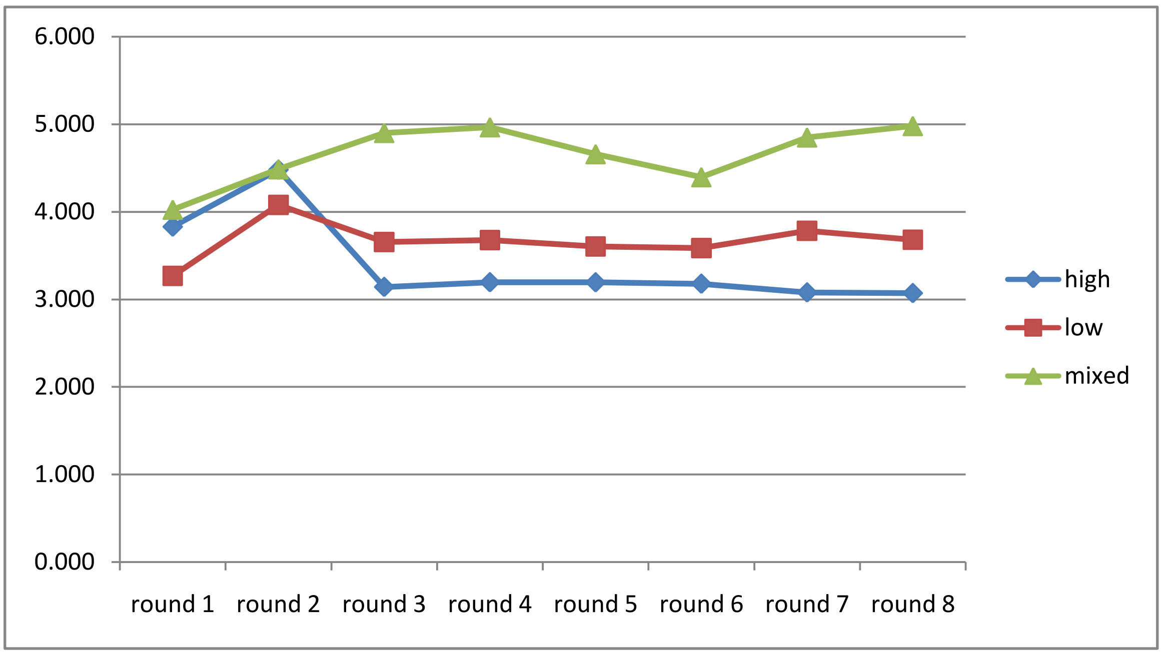
Two paired-samples t-tests compared against Tukey's HSD statistic, q = 2.864, were conducted to evaluate the effect treatment on outcome satisfaction. The independent variable, treatment vis-à-vis process structure condition, consisted of three levels, high, low and mixed. Outcome satisfaction was averaged through the eight round of decision-making for outcome satisfaction. The dependant variable was outcome satisfaction. The results indicate that that the mean score for outcome satisfaction for groups in the high process structure condition (M = 3.412, SD = 0.502) was significantly less than the mean score for outcome satisfaction for group in the mixed process structure condition (M = 4.559, SD = 0.377), t(128) = -17.408, p<.001. Additionally, the mean score for outcome satisfaction for groups in the low process structure condition (M = 3.658, SD = 0.285) was significantly less than the mean score for outcome satisfaction for group in the mixed process structure condition (M = 4.559, SD = 0.377), t(138) = -25.396, p<.001. The figure for mean values of outcome satisfaction clearly show that measures for outcome satisfaction remain largely consistent in showing groups in the mixed process structure condition reporting higher levels of outcome satisfaction than groups in the high or low process structure. These findings support hypothesis 4b, stating that structure will have a direct relationship to outcome satisfaction such that groups with mixed structure will have higher scores of outcome satisfaction than groups with high structure or low structure.

Finally, A paired-samples t-test compared against Tukey's HSD statistic, q = 2.864, was conducted to evaluate the effect of the interaction of experience x treatment on outcome satisfaction. The independent variable, treatment vis-à-vis process structure, consisted of two levels, high and low; experience was limited to data take at rounds 2 and 3. The difference between HP and LP groups at round 2 was compared against the difference between HP and LP groups at round 3. Because the mean values for decision quality clearly show that between rounds 2 and 3 the HP and LP groups' measures of outcome satisfaction crossover, indicating a significant interaction. For rounds 1 and 2 HP groups have higher levels of outcome satisfaction. Between rounds 2 and 3, groups in the LP condition clearly have higher levels of system until the end of the study. The MP groups were in an HP condition from rounds 1 to 3 and in an LP condition from rounds 4 to 8. The scores of the MP condition were always the highest. The difference between HP to LP at round 2 ($M = 1.671$, $SD = 1.442$) was significantly different from the difference between HP to LP at round 3 ($M = -0.449$, $SD = 1.470$), $t(74) = 10.010$, $p<.001$. This indicates that the HP condition contributed to higher measures of outcome satisfaction earlier rounds of decision-making, but the LP condition contributed to higher measures of outcome satisfaction in later rounds of decision-making. These results support hypothesis 6b, stating that experience will moderate the relationship between structure and outcome satisfaction, such that a) high structure groups will have higher outcome satisfaction than low structure groups when these groups have less experience, and b) low structure groups will have outcome satisfaction at least as high as high structure groups with more experience. The results of these tests support the hypotheses that the main effects of experience, process structure, as well as their interaction affect measures of outcome satisfaction.

5.5.7. Tests of addressing measures of process satisfaction

A 3 x 8 ANOVA was conducted to evaluate the effects of the three process structure conditions and experience, vis-à-vis rounds of decision-making, on process satisfaction. The graphic below presents an interesting illustration of how the groups' report values of process satisfaction were influenced by both treatment condition and experience. We see that the groups in the high process structure (HP) and mixed process structure (MP) and low process structure (LP) condition have a relatively similar sense of process satisfaction at round 1, and that sense of process satisfaction grows between round 1 to round 2. At round 3, the LP groups report lower a lower, nearly neutral, sense of satisfaction; the HP groups report a relatively low sense of process satisfaction. On the other hand, the MP groups report an even higher sense of satisfaction. For the remainder of the study HP groups report the same relatively low level of process satisfaction, LP groups stay relatively neutral in reports of process satisfaction. MP groups, who have transition from high process structure at round 3 to low process structure at round 4 and for the remainder of the study, report relatively positive levels of satisfaction.

Figure 12: Mean values for process satisfaction



The mean and standard deviations for process satisfaction as a function of treatment and round of decision-making are presented in the table below.

Table 9: Descriptive statistics for process satisfaction

treatment		round 1	round 2	round 3	round 4	round 5	round 6	round 7	round 8
high	Mean	3.824	4.550	3.152	3.211	3.170	3.211	3.097	3.069
N = 12	SD	0.252	0.322	0.130	0.196	0.201	0.230	0.163	0.148
low	Mean	3.245	4.065	3.666	3.650	3.631	3.601	3.791	3.679
N = 14	SD	0.236	0.260	0.175	0.231	0.168	0.202	0.161	0.211
mixed	Mean	3.987	4.455	4.918	4.967	4.666	4.384	4.854	4.980
N = 16	SD	0.186	0.286	0.150	0.227	0.197	0.232	0.162	0.179
Total	Mean	3.693	4.352	3.996	4.026	3.893	3.788	3.997	4.000
N = 42	SD	0.393	0.350	0.774	0.796	0.666	0.543	0.750	0.834

A two-way within-subjects repeated measures analysis of variance was conducted to evaluate the effects of experience (round) and process structure condition treatment (treatment) on measures of process satisfaction. The dependant variable was a report of process satisfaction. Mauchly's Test of Sphericity statistic was significant, $p > 0.05$, therefore we conclude that the condition of sphericity has not been met for test within subjects. The degrees of freedom were adjusted using the Greenhouse-Geisser correction to compensate for the violation of the assumption of sphericity.

There were tests on two main effects and Experience and Treatment, as well as an Experience x Treatment interaction using the Greenhouse-Geisser correction of .746. The experience main effect was significant, Greenhouse-Geisser = .746, $F(5.221, 203.608) = 39.1999$, $p<.001$, as well as process structure condition, $F(2, 39) = 176.692$, $p<.001$. The experience by process structure condition treatment (round x treatment) interaction effect was also significant, Greenhouse-Geisser = .746, $F(10.441, 203.608) = 49.500$, $p<.001$.

Two paired-samples t-tests compared against Tukey's HSD statistic, $q = 2.864$, were conducted to evaluate the effect experience on process satisfaction. The independent variable, experience vis-à-vis round, consisted of eight levels, rounds 1 through 8. Process satisfaction was averaged through the three treatment conditions for process structure. The dependant variable was process satisfaction. The results indicate that that the mean score for process satisfaction at round one (M = 3.730, SD = 0.398) was significantly less than the mean score for decision quality at round two (M = 4.355, SD = 0.352), t(56) = -11.740, p<.001. However, the mean score for process satisfaction at round two (M = 4.355, SD = 0.352) was significantly more than the mean score for process satisfaction at round three (M = 3.966, SD = 0.775), t(55) = 3.562, p<.01. The figure for mean values of process satisfaction clearly show that measures for process satisfaction remain largely. These findings support hypothesis 2c, stating that experience will have an inverse relationship to process satisfaction such that groups with less experience will have higher scores of process satisfaction than groups with more experience.

Two paired-samples t-tests compared against Tukey's HSD statistic, q = 2.864, were conducted to evaluate the effect treatment on process satisfaction. The independent variable, treatment vis-à-vis process structure condition, consisted of three levels, high, low and mixed. Process satisfaction was averaged through the eight round of decision-making for process satisfaction. The dependant variable was process satisfaction. The results indicate that that the mean score for process satisfaction for groups in the high process structure condition (M = 3.411, SD = 0.527) was significantly less than the mean score for process satisfaction for group in the mixed process structure condition (M = 4.645, SD = 0.392), t(128) = -18.212, p<.001. Additionally, the mean score for process satisfaction for groups in the low process structure condition (M = 3.662, SD = 0.292) was significantly less than the mean score for process satisfaction for group in the mixed process structure condition (M = 4.645, SD = 0.392), t(138) = -26.198, p<.001. The figure for mean values of process satisfaction clearly show that measures for process satisfaction remain largely consistent in showing groups in the mixed process structure condition reporting higher levels of process satisfaction than groups in the high or low process structure. These findings support hypothesis 4c, stating that structure will have a direct relationship to process satisfaction such that groups with mixed structure will have higher scores of process satisfaction than groups with high structure or low structure.

Finally, A paired-samples t-test compared against Tukey's HSD statistic, q = 2.864, was conducted to evaluate the effect of the interaction of experience x treatment on process satisfaction. The independent variable, treatment vis-à-vis process structure, consisted of two levels, high and low; experience was limited to data take at rounds 2 and 3. The difference between HP and LP groups at round 2 was compared against the difference between HP and LP groups at round 3. Because the mean values for decision quality clearly show that between rounds 2 and 3 the HP and LP groups' measures of process satisfaction crossover, indicating a significant interaction. For rounds 1 and 2 HP groups have higher levels of process satisfaction. Between rounds 2 and 3, groups in the LP condition clearly have higher levels of system until the end of the study. The MP groups were in an HP condition from rounds 1 to 3 and in an LP condition from rounds 4 to 8. The scores of the MP condition were always the highest. The difference between HP to LP at round 2 (M = 1.5000, SD = 1.769) was significantly different from the difference between HP to LP at round 3 (M = 0.103, SD = 1.332), $t(74) = 5.347$, $p<.001$. This indicates that the HP condition contributed to higher measures of process satisfaction earlier rounds of decision-making, but the LP condition contributed to higher measures of process satisfaction in later rounds of decision-making. These results support hypothesis 6c, stating that experience will moderate the relationship between structure and process satisfaction, such that a) high structure groups will have higher process satisfaction than low structure groups when these groups have less experience, and b) low structure groups will have process satisfaction at least as high as high structure groups with more experience. The results of these tests support the hypotheses that the main effects of experience, process structure, as well as their interaction affect measures of process satisfaction.

The preceding sections have discussed the data analysis strategies, the testing of the measurement model and the structural model, as well as the results of the hypothesis checks. These results will be discussed in the following chapter.

Table 10: Summary of findings

Hypotheses		Supported?
1	Experience will have a direct relationship to decision quality such that groups with less experience will have lower scores of decision quality than groups with more experience.	Yes
2a	Experience will have an inverse relationship to system satisfaction such that groups with less experience will have higher scores of system satisfaction than groups with more experience.	Yes
2b	Experience will have an inverse relationship to outcome satisfaction such that groups with less experience will have higher scores of outcome satisfaction than groups with more experience.	Yes
2c	Experience will have an inverse relationship to process satisfaction such that groups with less experience will have higher scores of process satisfaction than groups with more experience.	Yes
3	Structure will have a direct relationship to decision quality such that groups with low structure will have higher scores of decision quality than groups with high structure.	Yes
4a	Structure will have a direct relationship to system satisfaction such that groups with mixed structure will have higher scores of system satisfaction than groups with high structure or low structure.	Yes
4b	Structure will have a direct relationship to outcome satisfaction such that groups with mixed structure will have higher scores of outcome satisfaction than groups with high structure or low structure.	Yes
4c	Structure will have a direct relationship to process satisfaction such that groups with mixed structure will have higher scores of process satisfaction than groups with high structure or low structure.	Yes
5	Experience will moderate the relationship between structure and decision quality, such that a) low structure groups will have lower quality decisions than high structure groups when these groups have less experience, and b) low structure groups will have decision quality at least as high as high structure groups with more experience.	Yes
6a	Experience will moderate the relationship between structure and system satisfaction, such that a) high structure groups will have higher system satisfaction than low structure groups when these groups have less experience, and b) low structure groups will have system satisfaction at least as high as high structure groups with more experience.	Yes
6b	Experience will moderate the relationship between structure and outcome satisfaction, such that a) high structure groups will have higher outcome satisfaction than low structure groups when these groups have less experience, and b) low structure groups will have outcome satisfaction at least as high as high structure groups with more experience.	Yes
6c	Experience will moderate the relationship between structure and process satisfaction, such that a) high structure groups will have higher process satisfaction than low structure groups when these groups have less experience, and b) low structure groups will have process satisfaction at least as high as high structure groups with more experience.	Yes

6. Discussion

This chapter provides a discussion of the implications of the findings. The discussion begins with a review of the purpose of the study, and then covers the significance in terms of decision quality and satisfaction. Finally, this chapter generalizes the support of hypotheses to explain the broader significance of the findings.

The hypotheses of this study are intended to establish the context in which agents, actions, and interactions take place. Three groups were exposed to two experimental conditions. The high process (HP) structure groups worked with a collaborative technology (CT) that forced group members to follow a specific method of data entry for eight rounds of data entry and decision-making. The low process (LP) structure groups worked with the same CT, but these groups were free to develop a method of data entry of their choosing for eight rounds of data entry and decision-making. The mixed process (MP) structure groups worked in the HP condition for three rounds, then worked in the LP condition for the remaining five rounds of data entry and decision-making.

Hypotheses 1 argued that experience would have a direct relationship to decision quality such that groups with less experience will have lower scores of decision quality than groups with more experience. This hypothesis was supported, implying that the experience of going through the decision-making process, learning to perform the task, would in itself lead to increased decision quality.

Hypothesis 2a,b,c argued that experience would have a negative relationship measures of system, outcome, and process satisfaction. In general, people are dynamic – learning and changing in order to better cope with their environment. When a condition of some form of stasis is imposed, it can make it difficult for people to make the adjustments that come naturally to them. In this study, the process structure and task were designed to bring about that tension which might lead to changes in satisfaction. In the case where participants were able to adapt to their changes, they reported higher levels of satisfaction relative to participants who were locked into a rather constrained environment.

Following the logic that people learn and grow while performing a task, hypothesis 3 argued that structure would have a direct relationship to decision quality such that groups with less process support structure would have higher scores of decision quality than groups with more high process support structure. This hypothesis was supported, generally implying CT that allows people to implement their own best practices may ultimately lead to higher levels of system, outcome, and process satisfaction

Hypothesis 4a,b,c argued that structure would have a direct relationship measures of system, outcome, and process satisfaction such that groups with mixed structure will have higher scores of system, outcome, and process satisfaction than groups with high structure or low structure. The logic was simple in that if a system can help users learn how to perform a task, then allow them to explore and use their own best practices, the people will be more satisfied using that system

Hypotheses 5 and 6a,b,c addressed the interaction of experience and structure on decision quality and measures of system, outcome, and process satisfaction. The testes the notion that in early stages of experience, people benefit from a high process structure in terms of decision quality and satisfaction. After people gain some sufficient amount of experience however, people generally prefer to have the freedom afforded by a system with low process structure.

The support of hypotheses 1 though 6a,b,c provide a basis to develop generalities that argue groups using CT can experience improvement in their measures of performance and satisfaction as a result of experience and not just configuration of process structure mechanisms. The high structure mechanisms can simply help those in a highly structured configuration reach higher levels of performance and satisfaction sooner than groups in a low process structure condition.

The task for this study was relatively simple and consequence for making mistakes in decision quality was small. Data entry for a college admissions program may not require five people performing the same task to ensure high data quality for the purposes of making a decision. LP groups were expected to do better than HP groups to show that in some cases the benefit of the process structure is relatively short lived. It would be incorrect and irresponsible to generalize this to all situations where CT is used however. In cases where the task is very complicated/difficult or the consequence for making mistakes in decision quality may be high, it would make sense to instantiate and maintain HP conditions.

Referring back to the analogy of people learning to ride bicycles, the groups that had training wheels only as long as they needed them learned to ride well faster than those who did not have training wheels. After the people learning to ride learned to ride well, the training wheels came off and they continued to ride well. Finally, those riders who only had the training wheels as long as they needed them were much happier than the people who had to keep the training wheels on. The logical conclusion is that the people who had training wheels only as long as they needed them are more likely to continue riding as compared to the people who must continue to ride with training wheels on their bicycles.

This chapter has summarized the implications of the analysis of data as it related to the hypotheses. From a theoretical perspective, the theories used in this study predicted group behavior and reactions that were exhibited in the laboratory experiment. The longitudinal study provided a way to watch TIP, and more specifically GIP, manifest itself in the way of performance and satisfaction. From a practical perspective, the study provides empirical support that the process support structure configuration for collaborative technology should be adaptive, or flexible, in some situations. To date, there are no known references that look at CT, e.g. group support systems or group decision support systems, as needing to adjust their configuration based on user performance. This study may be the beginning of such a stream of research. The following chapter provides a general discussion of this study along with its limitations. The last chapter ends buy suggests where and how additional studies can add to this line of research.

7. General discussion, limitations, and conclusion

This study was inspired by the need to better understand the role and impact of collaborative technologies (CT) in the face of increasingly complex projects (Bennis et al. 1998). It takes the collaboration of multiple people with specialized knowledge to identify problems and allocate resources that will eventually help these projects reach completion (Bennis et al. 1998). CT refers to a class of information system designed to assist people in the development of an idea, the creation of a design, or the achievement of a shared goal. Two examples of CT are group support system (GSS) and group decision support system (GDSS) (DeSanctis et al. 1984; DeSanctis et al. 1987). If CT is to be effective in helping people complete these complex projects then the technical and social components of the systems and their users should be identified and understood in terms of how they interact and influence one another.

One critical review of CT literature (Arnott et al. 2005) claims the research addressing CT reached its peak in publication popularity in 1994 and has fallen since. The implications of this are that given the changes in technology, many published assumptions or discoveries may no longer help researchers or managers design or implement appropriate systems. One suggested reason for the decline was the possibility of finding conflicting or inconsistent results within the literature (Arnott et al. 2005). Other scholars have complied comprehensive literature reviews and meta-analyses (Dennis et al. 2001; Fjermestad et al. 1998/1999) showing the literature is consistent, when the reader approaches the information from an appropriate perspective (Dennis et al. 2001).

This raised the first research question of the study asked, “why would scholars reach conflicting conclusions when looking at the similar issues in CT research?” There are at least two ways to respond to this question. The first is to say that the dependant variable of satisfaction has been defined and measured in different ways depending on the specific question(s) of the researcher as reported in meta-analysis and comprehensive literature reviews (Dennis et al. 2001; Fjermestad et al. 1998/1999). The second reason for the difference may also be due to the fact that the majority of research is cross-sectional in nature which could lead to type I and type II errors in conclusions (Harrison et al. 2003).

The second research question asked, "would a techno-social perspective add to the understanding of how work groups' use of CT benefits or changes over time?" Theories such as adaptive structuration theory (AST) by Poole and DeSanctis (1990), supported by the research of Wheeler and Valacich (1996), show that users are adaptive when using CT, so a techno-social perspective would be appropriate in developing an understanding of how CT may be adopted and used over a period of time, especially in a longitudinal study.

The third research question asked, "would a longitudinal study of CT usage add to the understanding of how work groups' use of CT benefits or changes over time?" Given that literature warns of the threat of type I and type II errors in conclusions when one relies on cross-sectional data (Harrison et al. 2003), the findings of this study show that measures of performance and system, outcome, and process satisfaction change over time. This suggests that longitudinal studies not only do add to our understanding of how work groups' use CT benefits or changes over time, it creates an opportunity to understand why it changes over time.

The fourth, and final, research questions asked, "can changing CT process structure allow system users to maintain high performance and high satisfaction with the CT experience?" The answer to this question takes from in McGrath's TIP theory (1991), which offers a group interaction process (GIP) model explaining both the technical and social challenges groups must negotiate to be productive over time. Prior research (Wheeler et al. 1996) had demonstrated that groups could internalize the structure of CT and remain highly productive without that external structure. The experiment used in this study supported the findings of

Wheeler and Valacich (1996) and the data analysis showed significant difference in measures of system, outcome, and process satisfaction based on the process structure of the CT and the experience the group has in terms of using the CT on a specific task. It was clear in the data analysis that groups in the mix process structure were able to reach significantly better performance and attain higher levels of satisfaction than groups that only operated in the low or high process structure conditions. In short, this study supports the notion that the process structure of a CT may be thought of as training wheels on a bicycle. With process structure of a CT, just as with training wheels on a bicycle, they are a benefit in the early stages of experience and can/should be removed when sufficient skill is demonstrated. By not removing the external structure, users are likely to lose satisfaction, which may lead to discontinuance (Bhattacherjee 2001).

The findings of this study do support existing studies and add to the literature however, there are limitations that should be acknowledged. These limitations are discussed in the next section.

7.1. Limitations

Theory, literature, and experimental findings support the notion that groups can learn to perform a given task better through the added experience of performing that task. Additionally, external structure mechanisms, e.g. the high process structure in CT, can help groups perform better sooner than groups who do have low or no external structure mechanisms, e.g. the low process structure in CT. There is no claim, however, that this is true in all situations.

It is conceivable that some task are simply too difficult to perform without high process structure, e.g. launching and retrieval of space craft, just as there may be some tasks so simple that high process structure stifle the process, e.g. giving loved ones a hug. This study proposed a rather simple task of data entry and decision-making, which suggests that task complexity needs to be taken into consideration when applying the findings of this study. Additionally, the participants of the study were college students whose incentive to participate and perform was largely due to their desire to earn class credit for participation as well as earn a little cash. Though this was a longitudinal study in the sense that a pattern was able to develop and "play out," it pales in comparison to situations where groups have worked together for years or the outcome affects whether or not people live or die.

The amount of time people are assembled as an intact group, the complexity of the task(s), as well as the significance of the outcome of the group's performance are factors which should be considered when managers and designers are considering how to configure the structure mechanisms of CT. These considerations can and should be included in future studies of this topic.

7.2. Conclusion

The goal of this study was to test how changes in the process structure condition of collaborative technology influence performance and satisfaction. This study has accomplished this goal by demonstrating how a mixed process structure, i.e. high-low process structure, can influence both influence performance and satisfaction. Further, this study has helped to reconcile further reported discrepancies in IS literature in the area of CT research by pointing out that there are multiple measures for satisfaction and the values of those measures, as well as measures of performance can/may change over time as a result of a group's experience performing a given task.

For system designers and managers, the findings of this study provide evidence of a phenomenon that that is evident in everyday life: support structures should be in place only as long as they are needed. The task for research then is to help system designers and managers identify what those support structures are as well as how they may be reduced or removed. It also follows that there be measures that help managers and users know when it as appropriate to reduce or remove those structures. The high structures help groups meet performance measures, but reducing or reducing those measures seems to preserve higher measures of satisfaction, which are important for continuance.

For researchers, this study provides an example of how to configure and run a longitudinal study. McGrath et al. (Arrow and McGrath 1993; Hollingshead, McGrath, and O'Connor 1993; McGrath 1993; McGrath et al. 1993; O'Connor et al. 1993) point out that longitudinal studies are largely avoided because they are difficult to conduct. He and his co-authors point out however, that the findings of such studies can pay dividends in terms of providing insights that are difficult, if not impossible, to find in cross-sectional studies.

While having answered the research questions, this research has also opened up avenues for future research. First of all, future research should revisit the issue process structure in varying degrees of task complexity and specialization, cf. integrative complexity (Baker-Brown, Ballard, Susan Bluck, Vries, Suedfeld, and Tetlock 1990; Gruenfeld and Hollingshead 1993; Suedfeld, Tetlock, and Streufert 1992; Tetlock 1992). There are a myriad of factors related to what motivates the group to perform well from intrinsic and extrinsic motivation to the consequence of an outcome. In conclusion, more studies can come from this theoretical model and experimental design that can sever researchers and practitioners alike.

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Appendix A – Screen shots and text

This collection of screen shots and text demonstrates what information the participants were given and what the interface looked like.

1. Data booklet

ROUND 1

	GPA: 3.2	
SSN: 821-98-7421	SAT-M: 643 SAT-V: 521	
ID: 1 Round: 1 Rank: 5		

	GPA: 4.0	
SSN: 678-00-7412	SAT-M: 621 SAT-V: 648	
ID: 2 Round: 1 Rank: 1		

	GPA: 3.7	
SSN: 527-57-9165	SAT-M: 550 SAT-V: 695	
ID: 3 Round: 1 Rank: 3		

	GPA: 3.5	
SSN: 524-30-6659	SAT-M: 583 SAT-V: 497	
ID: 4 Round: 1 Rank: 4		

	GPA: 4.0	
SSN: 082-00-9198	SAT-M: 477 SAT-V: 692	
ID: 5 Round: 1 Rank: 2		

ROUND 2

	GPA: 4.0	
SSN: 656-47-7283	SAT-M: 536 SAT-V: 622	
ID: 6 Round: 2 Rank: 1		

	GPA: 3.8	
SSN: 745-14-8412	SAT-M: 701 SAT-V: 728	
ID: 7 Round: 2 Rank: 2		

	GPA: 3.8	
SSN: 646-32-0793	SAT-M: 460 SAT-V: 677	
ID: 8 Round: 2 Rank: 3		

	GPA: 3.2	
SSN: 336-25-6037	SAT-M: 619 SAT-V: 704	
ID: 9 Round: 2 Rank: 4		

	GPA: 3.2	
SSN: 485-71-2300	SAT-M: 663 SAT-V: 549	
ID: 10 Round: 2 Rank: 5		

ROUND 3

	GPA: 3.6	
SSN: 310-36-5408	SAT-M: 717 SAT-V: 697	
ID: 11 Round: 3 Rank: 1		

	GPA: 3.3	
SSN: 985-90-1811	SAT-M: 467 SAT-V: 644	
ID: 12 Round: 3 Rank: 3		

	GPA: 3.0	
SSN: 127-91-4743	SAT-M: 728 SAT-V: 734	
ID: 13 Round: 3 Rank: 4		

	GPA: 3.6	
SSN: 838-21-0963	SAT-M: 543 SAT-V: 546	
ID: 14 Round: 3 Rank: 2		

	GPA: 2.7	
SSN: 014-55-8794	SAT-M: 642 SAT-V: 527	
ID: 15 Round: 3 Rank: 5		

ROUND 4

	GPA: 2.8	
SSN: 371-96-3204	SAT-M: 680 SAT-V: 523	
ID: 16 Round: 4 Rank: 4		

	GPA: 3.4	
SSN: 487-72-4731	SAT-M: 723 SAT-V: 470	
ID: 17 Round: 4 Rank: 2		

	GPA: 2.5	
SSN: 151-39-0805	SAT-M: 693 SAT-V: 649	
ID: 18 Round: 4 Rank: 5		

	GPA: 3.7	
SSN: 243-13-8369	SAT-M: 523 SAT-V: 602	
ID: 19 Round: 4 Rank: 1		

	GPA: 3.2	
SSN: 502-22-3383	SAT-M: 462 SAT-V: 493	
ID: 20 Round: 4 Rank: 3		

ROUND 5

	GPA: 3.8	
SSN: 402-48-2582	SAT-M: 783 SAT-V: 785	
ID: 21 Round: 5 Rank: 1		

	GPA: 3.8	
SSN: 237-64-4517	SAT-M: 549 SAT-V: 626	
ID: 22 Round: 5 Rank: 2		

	GPA: 3.7	
SSN: 583-37-3629	SAT-M: 589 SAT-V: 615	
ID: 23 Round: 5 Rank: 3		

	GPA: 3.4	
SSN: 990-47-4930	SAT-M: 717 SAT-V: 734	
ID: 24 Round: 5 Rank: 4		

	GPA: 2.5	
SSN: 894-62-1751	SAT-M: 605 SAT-V: 624	
ID: 25 Round: 5 Rank: 5		

ROUND 6

	GPA: 3.5	
SSN: 814-76-2835	SAT-M: 677 SAT-V: 556	
ID: 26 Round: 6 Rank: 3		

	GPA: 3.9	
SSN: 670-82-4651	SAT-M: 697 SAT-V: 678	
ID: 27 Round: 6 Rank: 1		

	GPA: 3.2	
SSN: 442-30-2063	SAT-M: 498 SAT-V: 736	
ID: 28 Round: 6 Rank: 4		

	GPA: 3.6	
SSN: 328-22-1636	SAT-M: 582 SAT-V: 772	
ID: 29 Round: 6 Rank: 2		

	GPA: 2.7	
SSN: 429-05-7064	SAT-M: 567 SAT-V: 609	
ID: 30 Round: 6 Rank: 5		

ROUND 7

	GPA: 3.8	
SSN: 540-30-1654	SAT-M: 565 SAT-V: 579	
ID: 31 Round: 7 Rank: 3		

	GPA: 3.8	
SSN: 949-85-3904	SAT-M: 740 SAT-V: 552	
ID: 32 Round: 7 Rank: 1		

	GPA: 3.8	
SSN: 829-46-1602	SAT-M: 600 SAT-V: 569	
ID: 33 Round: 7 Rank: 2		

	GPA: 2.6	
SSN: 815-69-0672	SAT-M: 749 SAT-V: 757	
ID: 34 Round: 7 Rank: 5		

	GPA: 3.5	
SSN: 652-43-4798	SAT-M: 769 SAT-V: 629	
ID: 35 Round: 7 Rank: 4		

ROUND 8

	GPA: 3.6	
SSN: 756-64-4923	SAT-M: 682 SAT-V: 583	
ID: 36 Round: 8 Rank: 1		

	GPA: 3.5	
SSN: 795-22-3901	SAT-M: 524 SAT-V: 705	
ID: 37 Round: 8 Rank: 3		

	GPA: 3.6	
SSN: 703-55-0462	SAT-M: 644 SAT-V: 488	
ID: 38 Round: 8 Rank: 2		

	GPA: 3.4	
SSN: 960-37-7923	SAT-M: 558 SAT-V: 494	
ID: 39 Round: 8 Rank: 4		

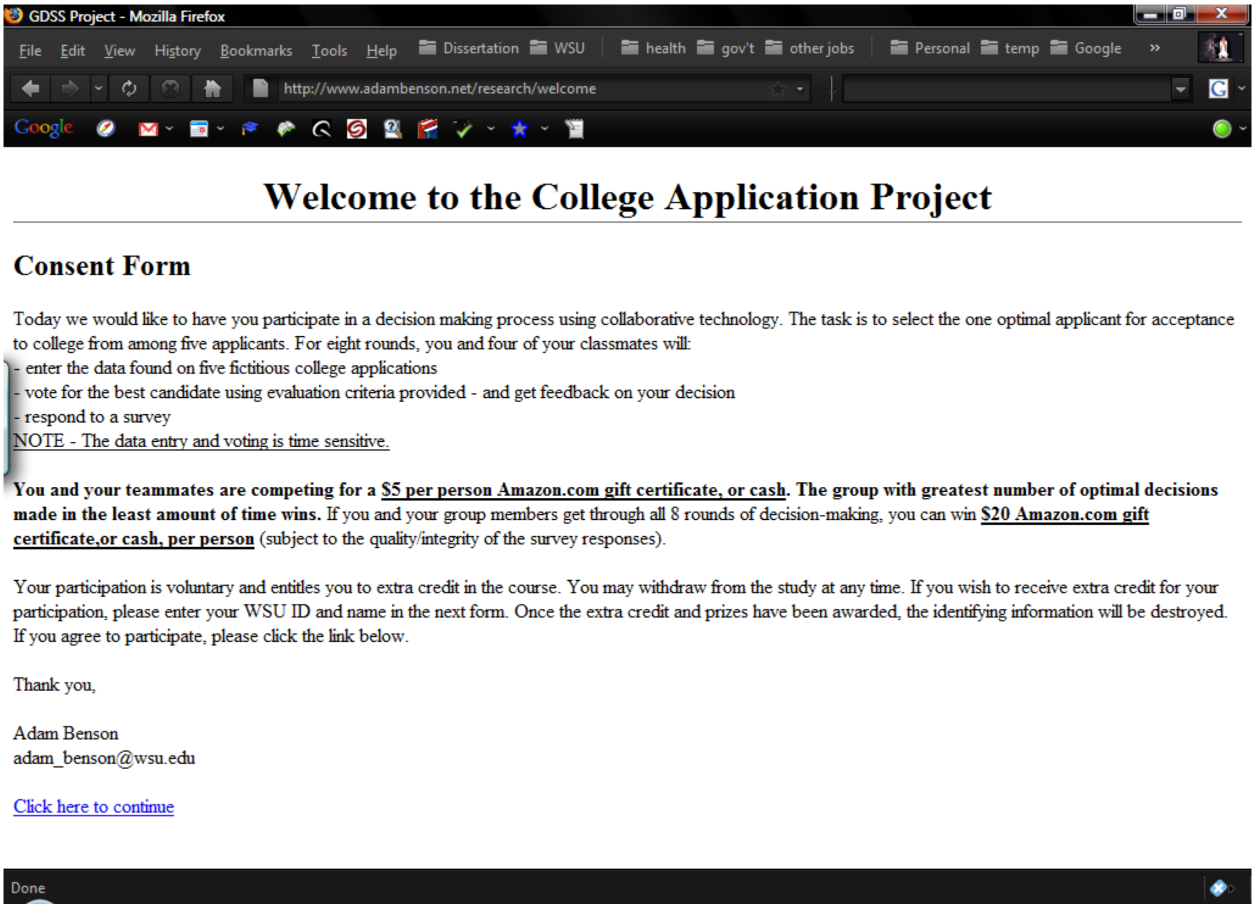
	GPA: 2.6	
SSN: 783-50-5821	SAT-M: 603 SAT-V: 454	
ID: 40 Round: 8 Rank: 5		

2. Screen shots

The following pages include screen shots of the application. Text accompanies the image when it is thought to be appropriate, otherwise a general summary or reference is made regarding the content.

2.1. Participant Log in (screen shot):

The participants when to the URL www.adambenson.net and found a link that lead to the directions and consent form.



Welcome to the College Application Project

Consent Form

Today we would like to have you participate in a decision making process using collaborative technology. The task is to select the one optimal applicant for acceptance to college from among five applicants. For eight rounds, you and four of your classmates will:
- enter the data found on five fictitious college applications
- vote for the best candidate using evaluation criteria provided - and get feedback on your decision
- respond to a survey
NOTE - The data entry and voting is time sensitive.

You and your teammates are competing for a $5 per person Amazon.com gift certificate, or cash. The group with greatest number of optimal decisions made in the least amount of time wins. If you and your group members get through all 8 rounds of decision-making, you can win **$20 Amazon.com gift certificate,or cash, per person** (subject to the quality/integrity of the survey responses).

Your participation is voluntary and entitles you to extra credit in the course. You may withdraw from the study at any time. If you wish to receive extra credit for your participation, please enter your WSU ID and name in the next form. Once the extra credit and prizes have been awarded, the identifying information will be destroyed. If you agree to participate, please click the link below.

Thank you,

Adam Benson
adam_benson@wsu.edu

Click here to continue

2.2. Participant Log in (text):

“Welcome to the College Application Project
Consent Form
Today we would like to have you participate in a decision-making process using collaborative technology. The task is to select the one optimal applicant for acceptance to college from among five applicants. For eight rounds, you and four of your classmates will:
- enter the data found on five fictitious college applications
- vote for the best candidate using evaluation criteria provided - and get feedback on your decision
- respond to a survey
NOTE - The data entry and voting is time sensitive.

You and your teammates are competing for a $5 per person Amazon.com gift certificate, or cash. The group with greatest number of optimal decisions made in the least amount of time wins. If you and your group members get through all 8 rounds of decision-making, you can win $20 Amazon.com gift certificate, or cash, per person (subject to the quality/integrity of the survey responses).

Your participation is voluntary and entitles you to extra credit in the course. You may withdraw from the study at any time. If you wish to receive extra credit for your participation, please enter your WSU ID and name in the next form. Once the extra credit and prizes have been awarded, the identifying information will be destroyed. If you agree to participate, please click the link below.

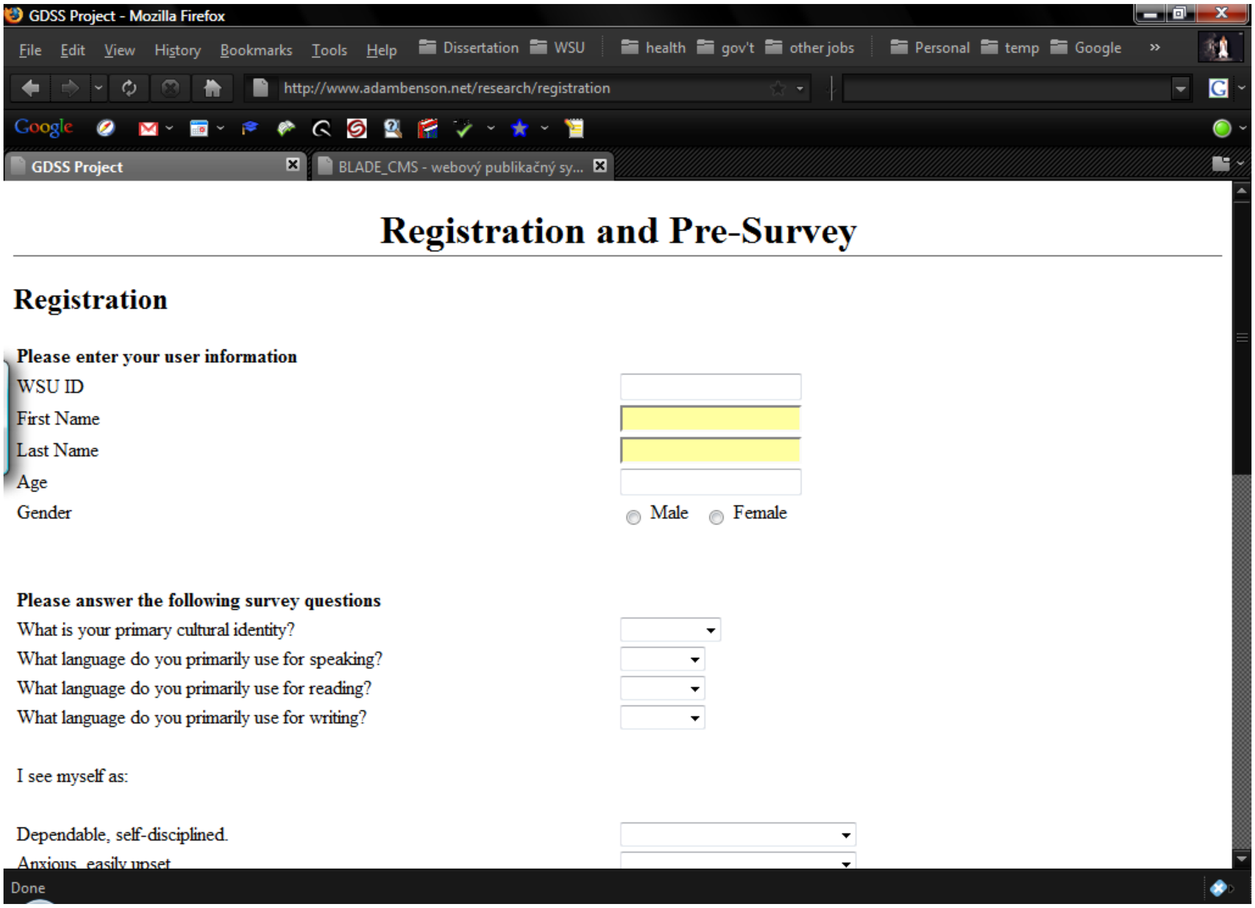
Thank you,

Adam Benson
adam_benson@wsu.edu

Click here to continue”

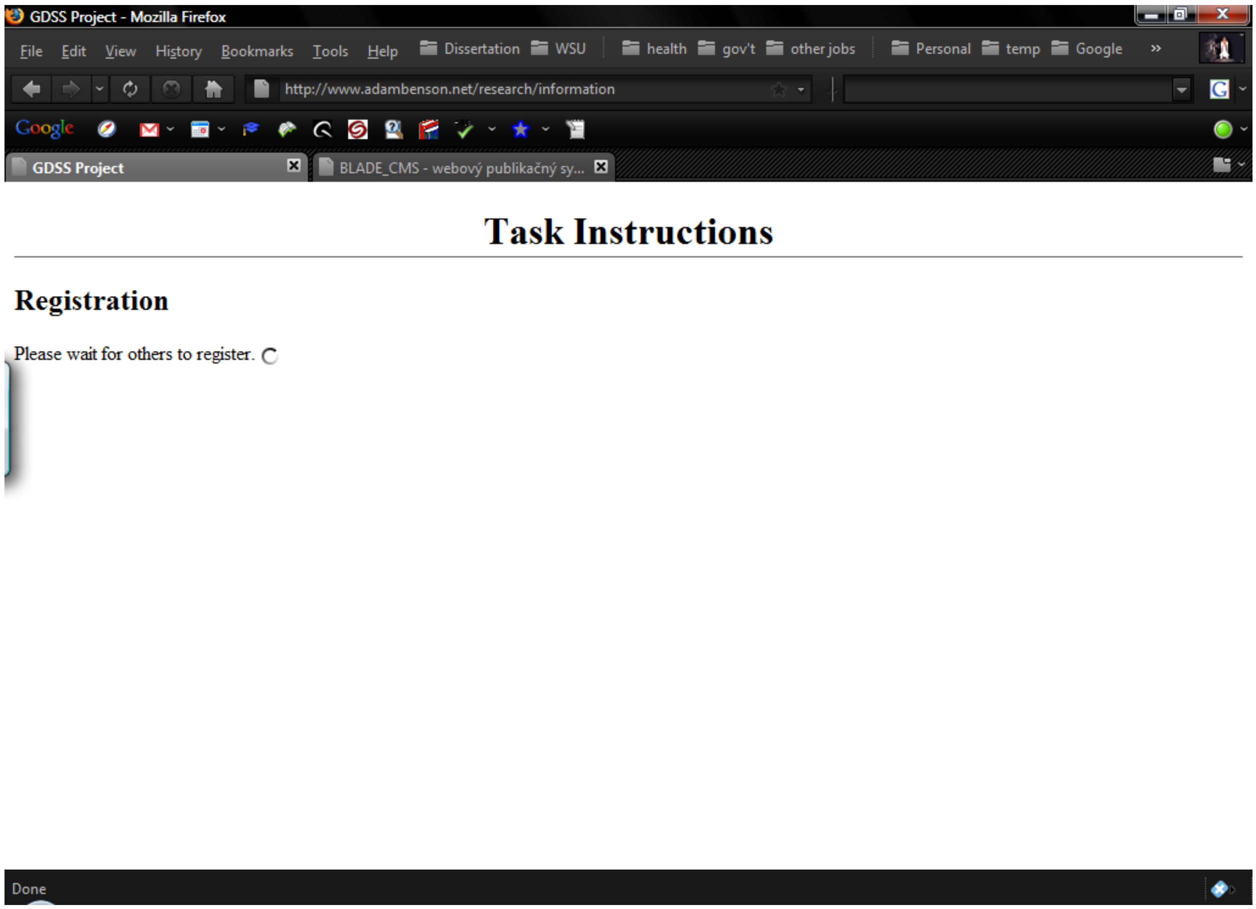
After the participants give informed consent by clicking on the link, they are taken to the “registration and pre-survey” screen.

2.3. Registration and pre-survey (screen shot)



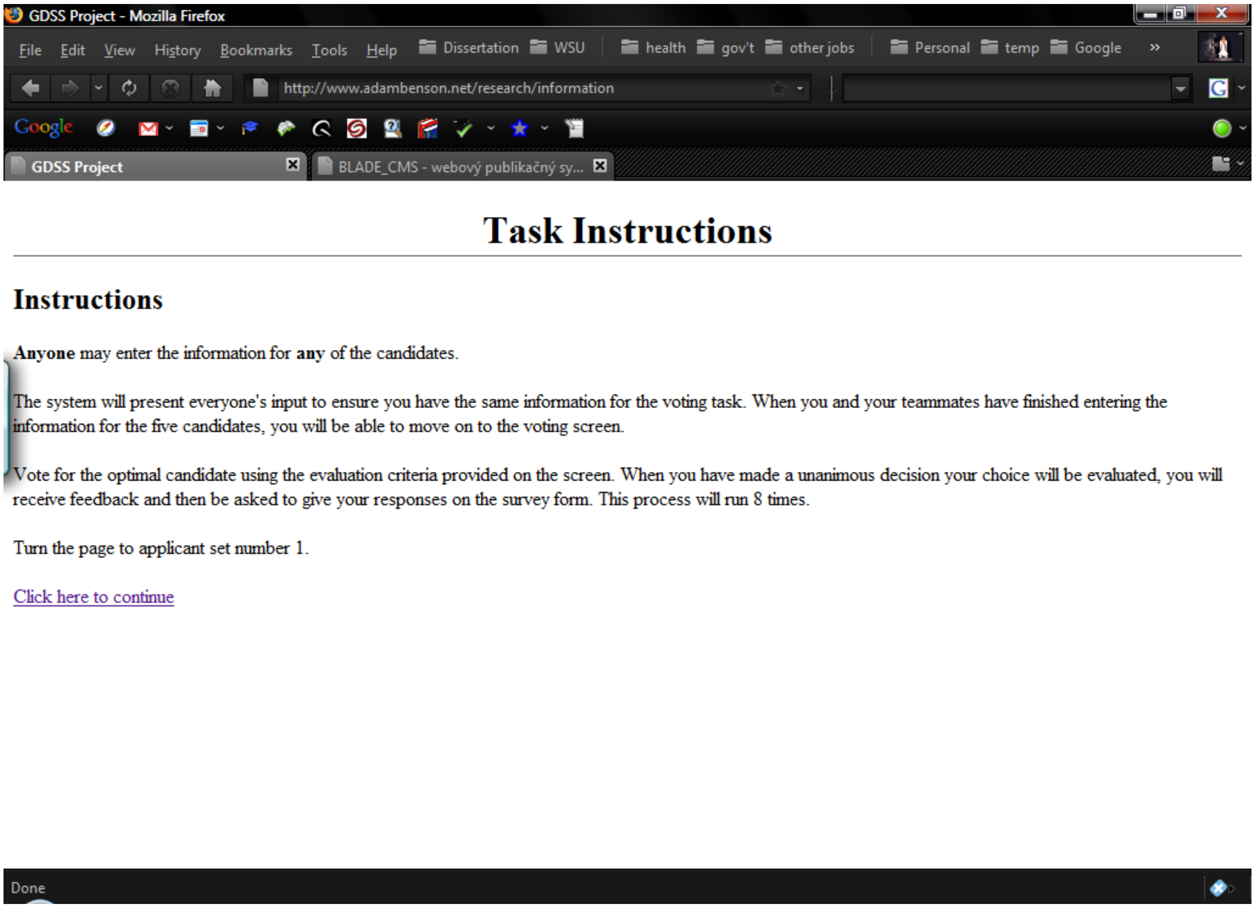
This screen is used to collect information related to the individual characteristics of the participant. The text for this screen is found in Appendix B. After completing this form, the participants go to a page that asks them to wait.

2.4. Wait screen



This screen is what showed after participants had completed the form on the Registration and pre-survey page and were left waiting for the rest of the participants in that session to complete the form. After this screen, participants were shown the appropriate instructions.

2.5. Task instructions – Low (screen shot and text)



Task Instructions
Instructions
Anyone may enter the information for **any** of the candidates.

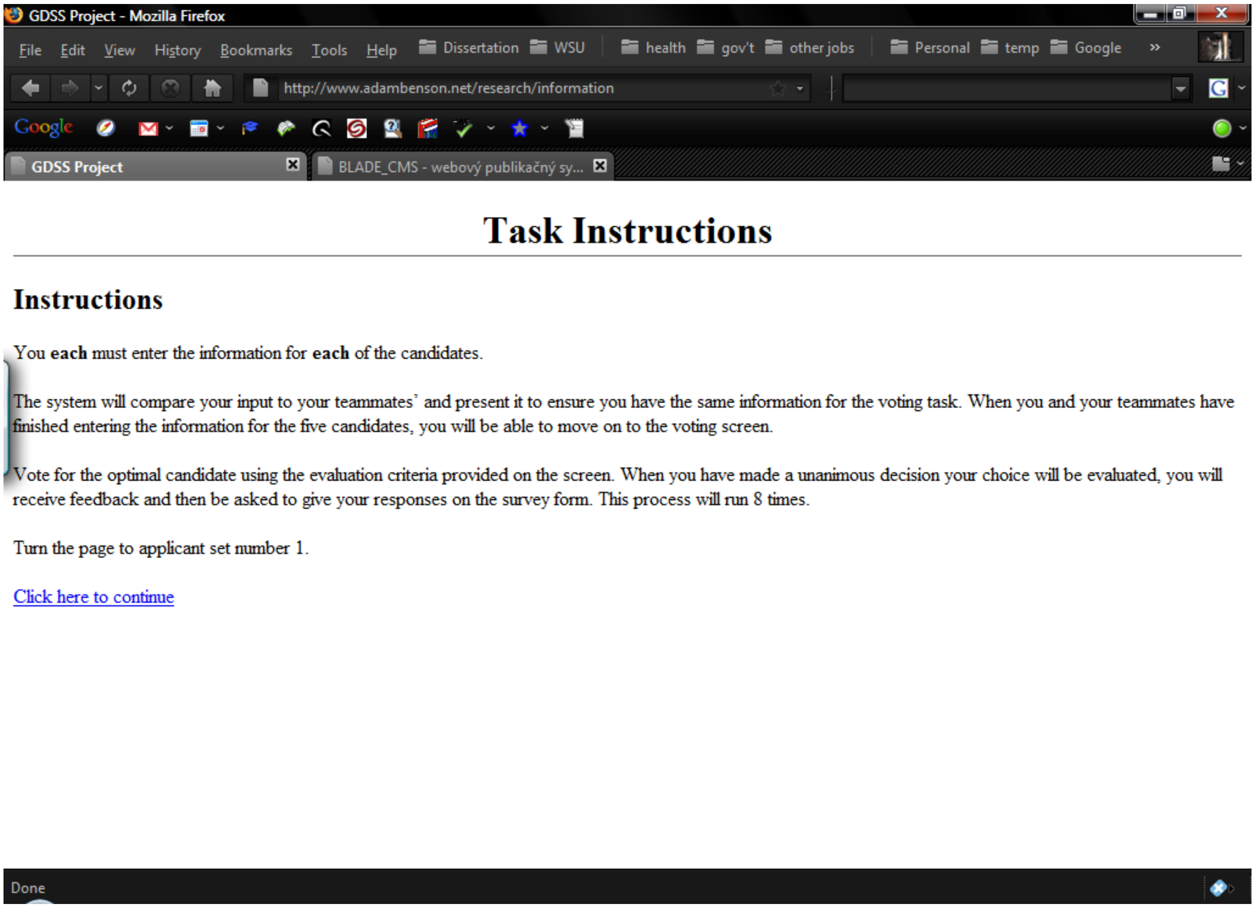
The system will present everyone's input to ensure you have the same information for the voting task. When you and your teammates have finished entering the information for the five candidates, you will be able to move on to the voting screen.

Vote for the optimal candidate using the evaluation criteria provided on the screen. When you have made a unanimous decision your choice will be evaluated, you will receive feedback and then be asked to give your responses on the survey form. This process will run 8 times.

Turn the page to applicant set number 1.

Click here to continue

2.6. Task instructions - High (screen shot and text)



Task Instructions
Instructions
You **each** must enter the information for **each** of the candidates.

The system will compare your input to your teammates' and present it to ensure you have the same information for the voting task. When you and your teammates have finished entering the information for the five candidates, you will be able to move on to the voting screen.

Vote for the optimal candidate using the evaluation criteria provided on the screen. When you have made a unanimous decision your choice will be evaluated, you will receive feedback and then be asked to give your responses on the survey form. This process will run 8 times.

Turn the page to applicant set number 1.

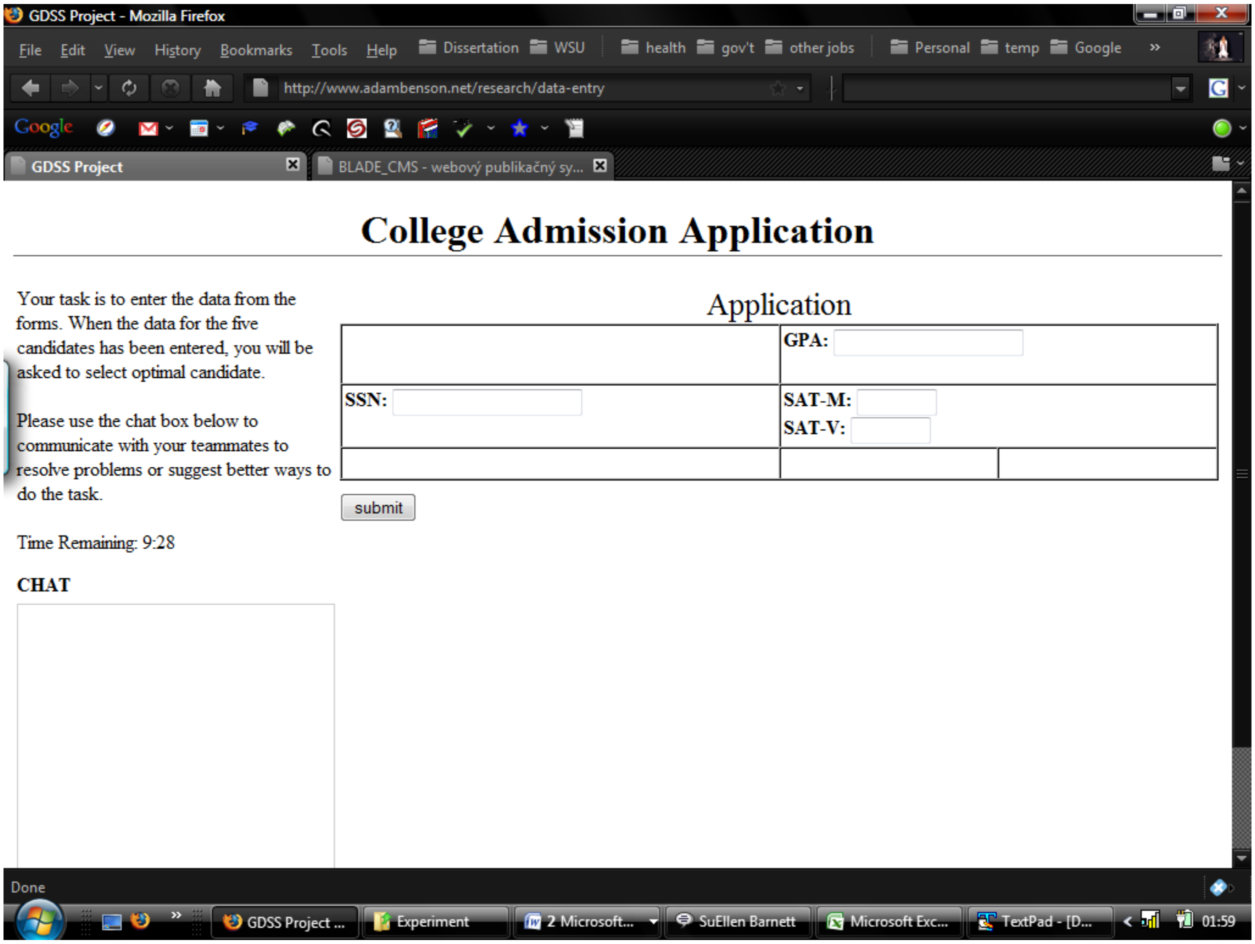
Click here to continue

2.7. Task instructions - Mixed

The screens for the mixed process structure group was the same as the one for the high process structure group for the first three rounds, then the mixed process structure groups saw the same screens as the low process structure groups.

Regardless of the treatment condition, after participants clicked on the link provided at the bottom of the page, they are taken to the data entry screen.

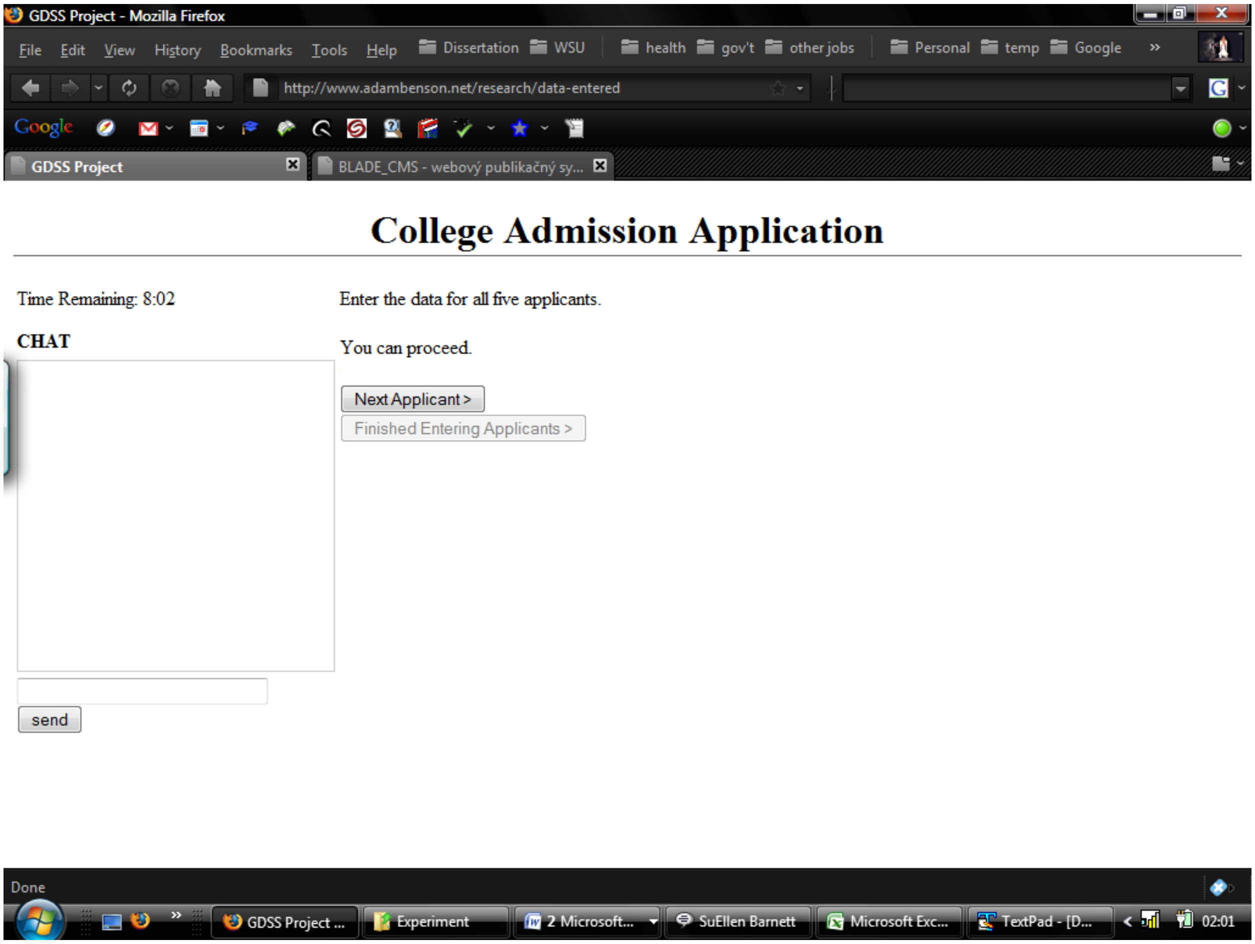
2.8. Data entry screen



In the screen, participants entered the data they found on the booklets they were given (see Appendix A).

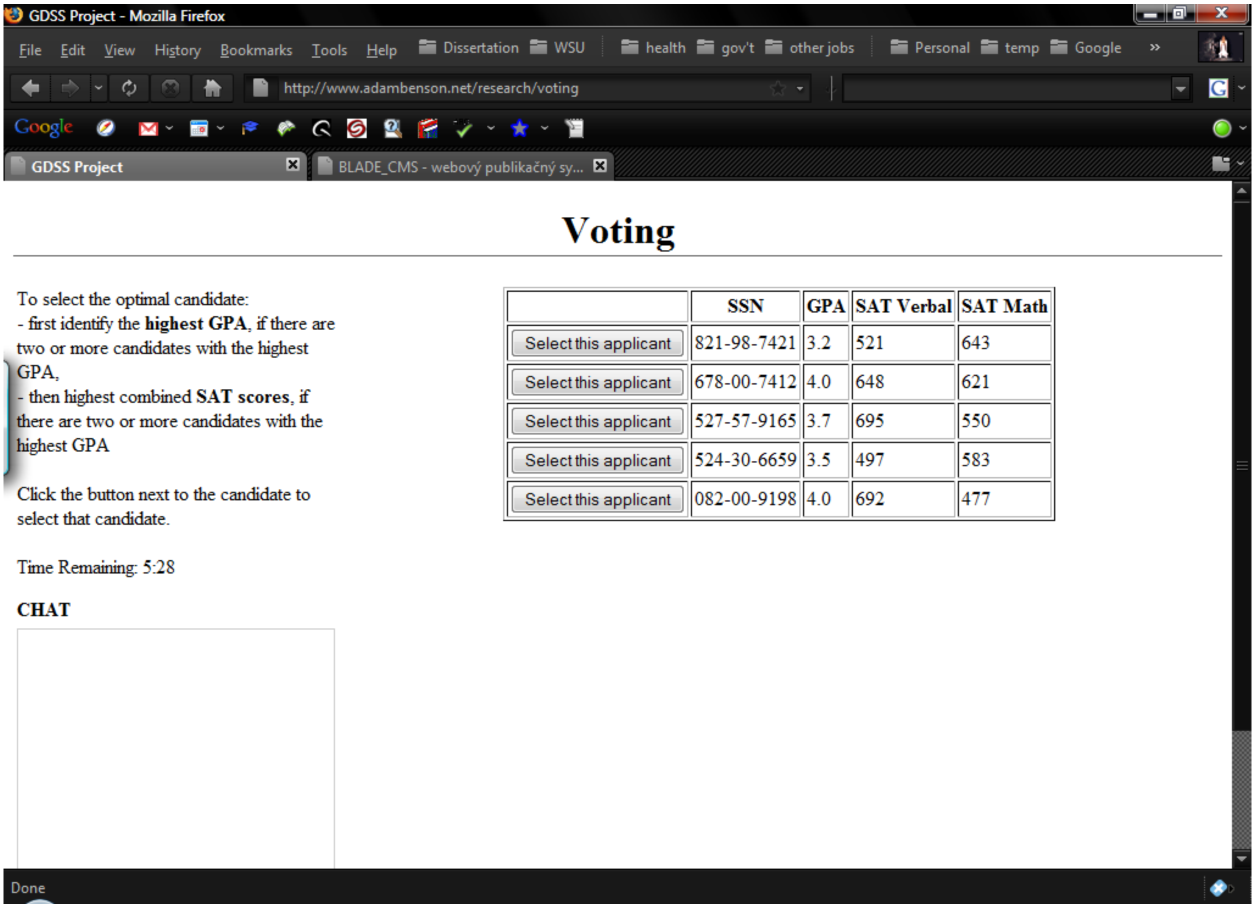
For participants in the high process structure condition, each person had to enter all the information for each applicant. Participants in the low process structure condition were free to divide the labor if they chose to do so. Regardless of the case, data entry for an applicant had to be completed on one form. One person had to enter the SSN, GPA, and SAT scores – that component of data entry could not be divided up so that one person could just enter SSNs for example. When the information for an applicant was complete, the participant would click the submit button to continue on to the progress screen.

2.9. Progress screen



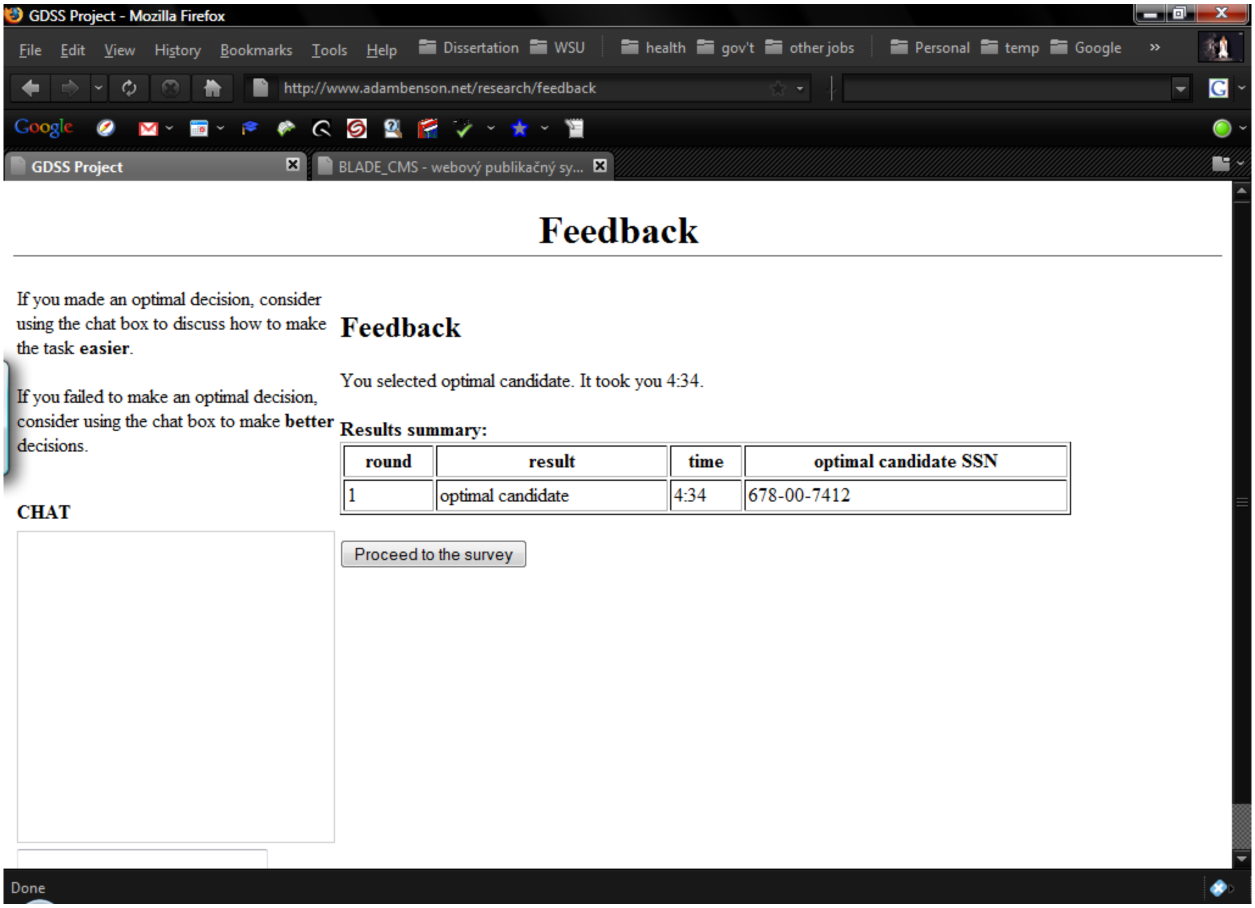
This screen provides participants with the feedback telling them if they may continue to enter data for candidates, or if they can/should move on to decision-making on the voting screen.

2.10. Voting screen



Once the data for all five candidates is entered for a given round, all the participants within a group click a button to the left of the data to indicate which candidate is thought to be the optimal choice for admission. After making a selection, the system informs the participants if a unanimous decision was made. If there is no unanimous decision made, the participants come back to this screen. If a unanimous decision is made, or the round runs out of time, the participants are taken to a feedback screen.

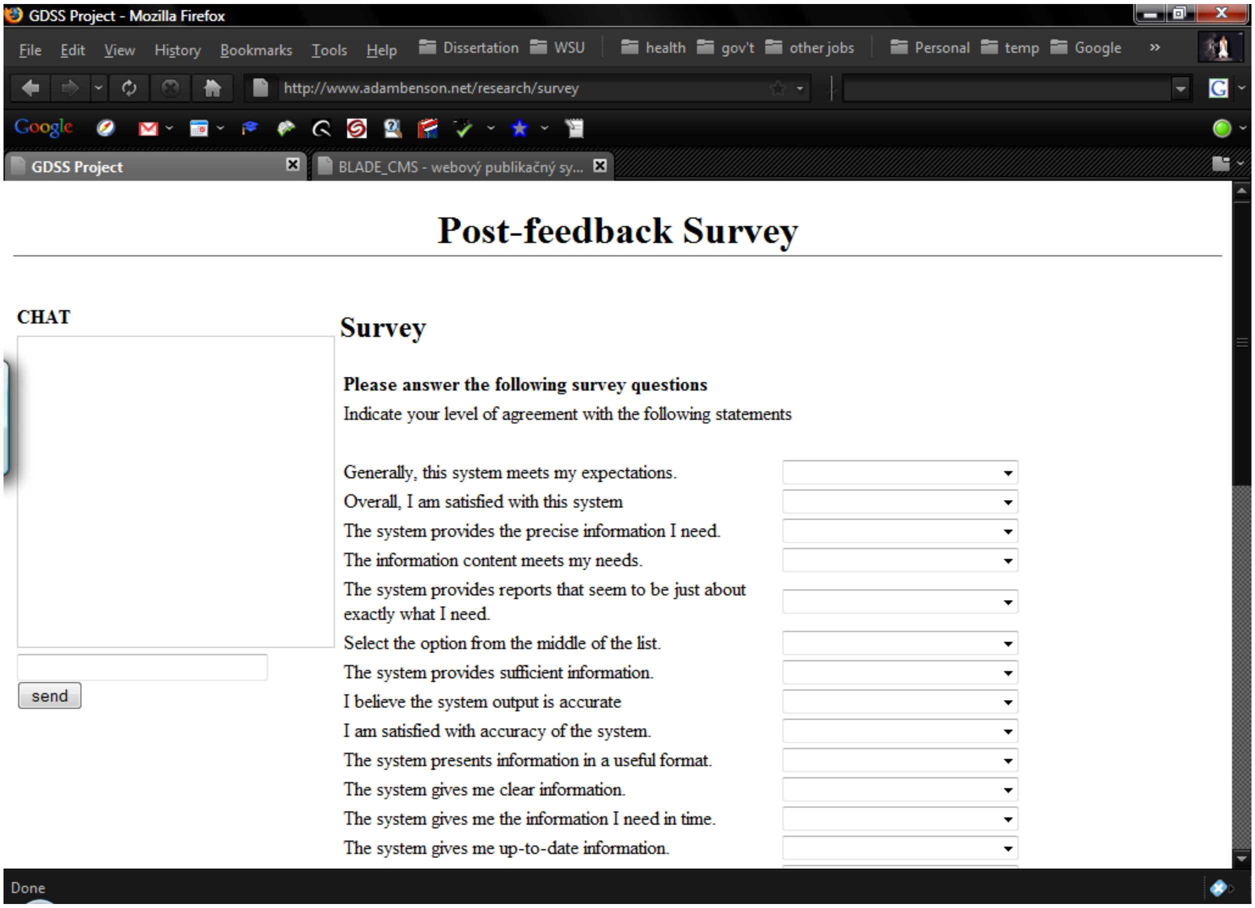
2.11. Feedback screen



This screen tells the participants what the relative rank of their decision was e.g. optimal candidate, second most optimal candidate, etc. The time taken to reach the decision is posted, along with the SSN of the optimal candidate, should the participants when to refer to the booklet. The instructions on the top left recommend using the chat box to discuss ways to make a better decision or make the job easier.

With each successive round of data entry and decision-making, the result summary displays a cumulative report to inform participants how well they are doing in the execution of their task. After participants are given this information, they may click the button to go to the post feedback survey.

2.12. Post feedback survey screen



This screen includes all the survey items related to system, outcome, and process satisfaction. Items related to control variables such as groups satisfaction were included in this survey (see Appendix C). When the participants had completed this form, they were taken back to the data entry form where they were able to start with the next round of data entry and decision-making. This pattern continued until the participants had completed eight rounds, time had run out in the session, or the group had decided to quit the study.

At the end of the study, participants were told that they there was no deception used in this study – that it was merely study to see how well people could follow directions and work together in an online environment.

Appendix B - Individual difference survey items

1. Age –general identifier
    1.1. What is your age? (01-99)

2. Gender – general identifier
    2.1. What is your gender? (male/female)

3. Big Five (sort form) – control variable for group
    3.1. Here are a number of personality traits that may or may not apply to you. Please indicate the extent to which you agree or disagree with that statement. You should rate the extent to which the pair of traits applies to you, even if one characteristic applies more strongly than the other does. (responses: 1 = disagree strongly, 2, 3, 4 = neither agree nor disagree, 5, 6, 7 = agree strongly)

        I see myself as:
        3.1.1. Dependable, self-disciplined.
        3.1.2. Anxious, easily upset.
        3.1.3. Open to new experiences, complex.
        3.1.4. Reserved, quiet.
        3.1.5. Sympathetic, warm.
        3.1.6. Disorganized, careless.
        3.1.7. Calm, emotionally stable.
        3.1.8. Conventional, uncreative.

4. Cultural identify – control variable for group and system construct
    4.1. How do you primarily identify yourself culturally? (American, other)

5. Language skill – control variable for group and system construct
    5.1. What language do you primarily use for
        5.1.1. speaking? (English, other)
        5.1.2. reading? (English, other)
        5.1.3. writing? (English, other)

6. Computer self-efficacy – control variable for system construct
    6.1. Indicate your level of agreement with regard to using unfamiliar software (responses: 1 = disagree strongly, 2, 3, 4 = neither agree nor disagree, 5, 6, 7 = agree strongly)

        I could complete the job using the software package:
        6.1.1. if there was no one around to tell me what to do as I go.
        6.1.2. if I had never used a package like it before.
        6.1.3. if I had only the software manuals for reference.
        6.1.4. if I had seen someone else using it before trying it myself.
        6.1.5. if I could call someone for help if I got stuck.
        6.1.6. if someone else had helped me get started.
        6.1.7. if l had a lot of time to complete the job for which the software was provided.
        6.1.8. if I had just the built-in help facility for assistance.
        6.1.9. if someone showed me how to do it first.
        6.1.10. if I had used similar packages before this one to do the same job.

7. Computer Anxiety – control variable for system construct (responses: 1 = disagree strongly, 2, 3, 4 = neither agree nor disagree, 5, 6, 7 = agree strongly)

    7.1. Indicate your level of agreement with regard to using computers:
        7.1.1. Working with computers makes me feel nervous.
        7.1.2. I hesitate to use a computer for fear of making mistakes that I cannot correct.
        7.1.3. I get a sinking feeling when I think of trying to use a computer.
        7.1.4. I feel apprehensive about using computers.
        7.1.5. Computers scare me.

Appendix C - Post-decision feedback survey for satisfaction

The survey items are listed by relation to their latent construct. All responses for these items were given in the format of: 1 = disagree strongly, 2, 3, 4 = neither agree nor disagree, 5, 6, 7 = agree strongly

1. Indicate your level of agreement with the following statements:

    1.1. System satisfaction – *sub construct of CT experience satisfaction*
        1.1.1. Generally, this system meets my expectations.
        1.1.2. Overall, I am satisfied with this system

    1.2. Content – *sub construct of system satisfaction*
        1.2.1. The system provides the precise information I need.
        1.2.2. The information content meets my needs.
        1.2.3. The system provides reports that seem to be just about exactly what I need.
        1.2.4. The system provides sufficient information.

    1.3. Accuracy – *sub construct of system satisfaction*
        1.3.1. I believe the system output is accurate.
        1.3.2. I am satisfied with accuracy of the system.

    1.4. Format – *sub construct of system satisfaction*
        1.4.1. The system presents information in a useful format.
        1.4.2. The system gives me clear information.

    1.5. Timeliness – *sub construct of system satisfaction*
        1.5.1. The system gives me the information I need in time.
        1.5.2. The system gives me up-to-date information.

    1.6. Ease of use – *sub construct of system satisfaction*
        1.6.1. I find the system user friendly.
        1.6.2. I find the system easy to use.

2. Decision outcome satisfaction – *sub construct of CT experience satisfaction*
    2.1. I am satisfied with our group's decision to vote for the candidate.
    2.2. I thought our group's choice of candidate was a wise one.
    2.3. I think that we did the right thing when we decided to vote for the candidate we selected.

3. Process satisfaction – *sub construct of CT experience satisfaction*
    3.1. I am satisfied that the group carefully considered whether each alternative idea would make for a better quality decision.
    3.2. I am satisfied that the group carefully checked the validity of members' opinions and assumptions.
    3.3. I am satisfied that the behavior of the group was goal directed.
    3.4. I am satisfied with the process used in evaluating the candidates.

4. Group satisfaction – *sub construct of CT experience satisfaction* (a control variable)
    4.1. I feel that I am really a part of this work group.
    4.2. If I could, I would move to a different group.
    4.3. I am content to be part of this group.

    4.4. I am happy to be part of this group.

5. Task commitment – *sub construct of CT experience satisfaction* (a control variable)
    5.1. I am committed to working with the system and my group to reach an optimal decision in time.
    5.2. It is important that the group performs well in this task.

6. CT experience satisfaction – *Omni construct of CT experience satisfaction*
    6.1. Given my experience in performing this task, I think the reward is worth the effort.
    6.2. Overall, I am satisfaction with the entire experience.
    6.3. I am satisfied with the overall experience.

7. Lazy subject check– "weeder" questions designed to identify respondents who were not answering the questions they were asked
    7.1. Select the option from the middle of the list.
    7.2. Select the second value from the top of the list.
    7.3. Select the second value from the bottom of the list.