Understanding Technology Acceptance: Phase III (Part 2) – Communication Studies

Technical Report HFA-TR-0706
Atlanta, GA: Georgia Institute of Technology
School of Psychology – Human Factors and Aging Laboratory
December 2007

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Executive Summary

The general research objectives of Phase III of the Technology Acceptance Project were two-fold: (1) use the quantitative model to predict technology acceptance; and (2) empirically assess communication methods for conveying product information that will increase acceptance by different customer segments. This report presents the results of the second objective; the results of the first objective are presented in Van Ittersum, Rogers, Capar, Park, Caine, O'Brien, Parsons, and Fisk (2007).

Phases I and II identified the variables that influence technology acceptance. In addition to pursuing a large-scale survey to predict technology acceptance in Phase III we also developed focused studies to empirically test the causal relationships between variables in the model (e.g., knowledge, experience, risk). The outcomes of these studies may be used to guide the development of communication strategies to influence technology acceptance in marketing new technologies. The objectives were to empirically assess communication variables relevant to conveying product information that will increase acceptance by different customer segments.

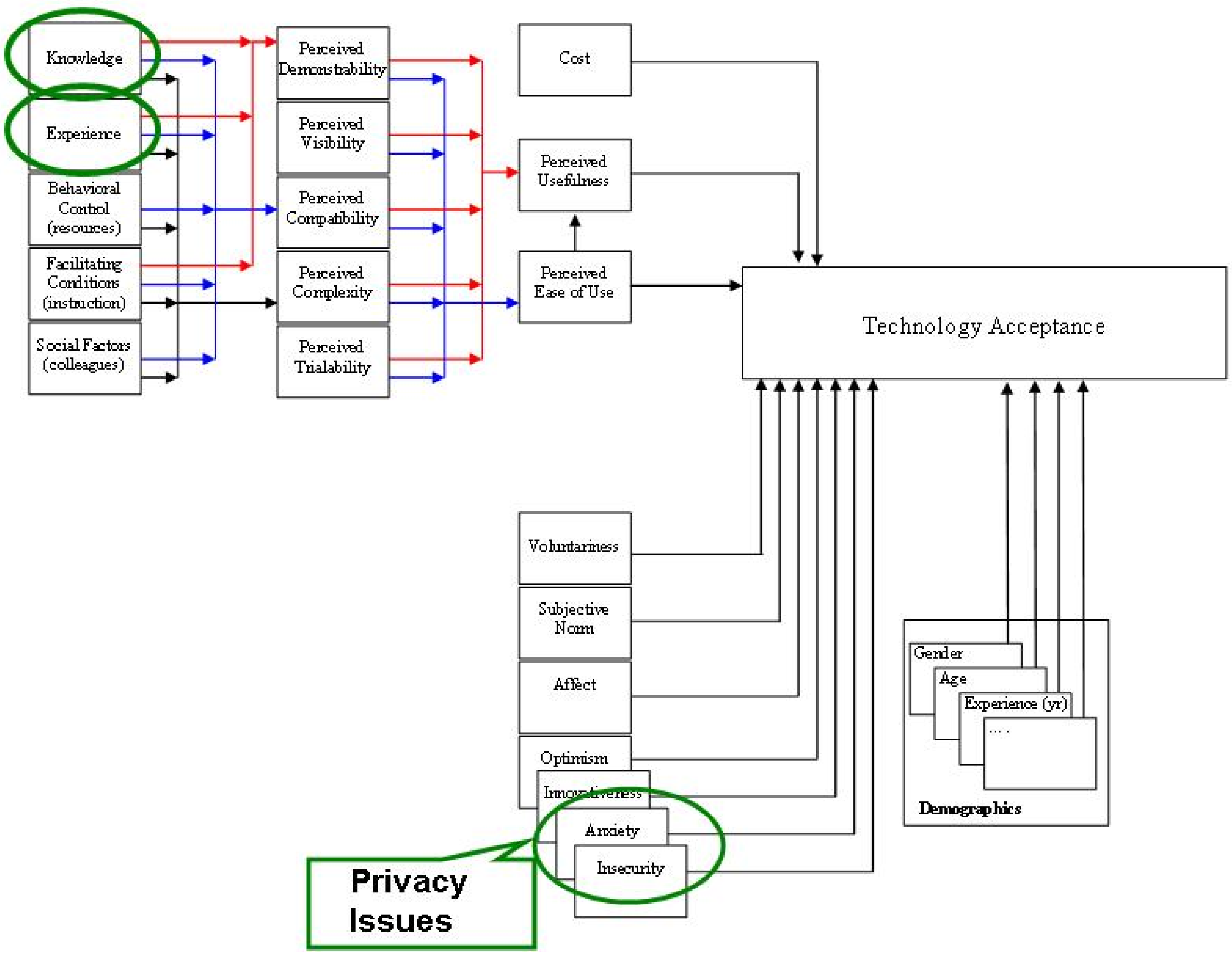
Herein we describe preliminary results for three studies: (1) the role of experience in behavioral acceptance of automation technology; (2) the influence of subtle descriptive features on trust and reliance in an automated system; and (3) understanding privacy conceptualizations in general and in technology contexts. The general findings from Studies 1 and 2 are that small differences in experience and expectations can have significant influences on behavioral acceptance. The initial results of Study 3 suggest a lot of variability in how people think about privacy but common threads such as the need for control have implications for communication with consumers. These projects are all in the final stages of data collection and analysis.

Chapter 1 – Understanding Technology Acceptance: Communication Studies

The general goal of the Technology Acceptance Project is to understand the facets of the variables that influence technology acceptance at the level of individual consumers. In Phase I of the project we developed a qualitative model to represent the main variables and their purported inter-relationships (Van Ittersum, Rogers, Capar, Caine, O'Brien, Parsons, & Fisk, 2006). In Phase II we were able to quantify these relationships and test the model at the general level of intentional, attitudinal, and behavioral acceptance (Van Ittersum, Rogers, Capar, Park, Caine, O'Brien, Parsons, & Fisk, 2007). The goal of this component of Phase III was to test empirically the causal mechanisms that underlie the relationships between these variables and technology acceptance. Moreover, for issues such as privacy, we need to better understand the construct itself - how it can best be defined and measured.

We used the quantitative model developed in Phase II (see Van Ittersum et al., 2007) depicted in Figure 1.1 as the starting point for identifying the relevant variables and relationships to study. The boxes highlighted in green were the focus of the studies presented in this report. Herein we describe preliminary results for three studies: (1) the role of experience on behavioral acceptance of automation technology; (2) the influence of subtle descriptive features on trust and reliance in an automated system; and (3) understanding privacy conceptualizations in general and in technology contexts. These projects are all in the final stages of data collection and analysis thus only the initial patterns of results are presented herein. Final reports will be forthcoming.

Figure 1.1. Investigating Causal Relationships



Chapter 2 – The Influence of Experience on Behavioral Acceptance

Introduction

In-vehicle global positioning systems, flight management systems, and patient life support technologies are all examples of automation that require inputs from humans to perform correctly, provide outputs to their users to help in decision making, and pursue a common goal with their human counterparts. In the case of these three examples the goals are reaching a predetermined destination as quickly and efficiently as possible, flying safely from one airport to another while adhering to established regulations, and keeping the human patient alive and healthy. In all of these cases the automation is more than just a tool; it is a collaborative teammate in pursuit of a shared goal.

Can humans view automation as a teammate? Research shows humans are able to view and interact with computers (automation) in a social way (Nass, Steuer, & Tauber, 1994; Nass, Fogg, & Moon, 1996; Nass, Moon, & Green, 1997; Nass, Moon, & Carney, 1999**;** and Nass & Moon, 2000). Humans may also attribute politeness, stereotypes, emotion, and feelings of shared pursuit or teamwork with automation. Identifying humans and automation as teams yields new variables that might help explain the performance of the human/automation dynamic**.**

One variable that has been shown to affect human team performance is the shared mental model (Salas, Prince, Baker & Shrestha, 1995; Stout, Cannon-Bowers, Salas, & Milanovich, 1999; Volpe, Cannon-Bowers, & Salas, 1996;) which may be defined as "organized knowledge structures that allow individuals to interact with their environment." (Mathieu, Heffner, Goodwin, Salas & Cannon-Bowers, 2000 p.274). The shared mental model allows team members to communicate more efficiently and to anticipate the information requirements of their teammates (Cannon-Bowers & Salas, 1998). The shared mental model may include the environment, as well as the skills, abilities, requirements, and needs of other teammates (Mathieu et al.). It allows group members to handle unforeseen circumstances and problems effectively. Mental models are also considered to be a large part of the acquisition and extension of situational awareness (Endsley, 1995).

A mental model develops as a result of system experience. In the present study the goal was to investigate how different levels of experience influence technology acceptance. Thus the user's mental model served as a proxy for the variable of experience in Figure 1.1 and measures of trust and reliance on the automated aid were indexes of behavioral acceptance.

Quality of mental model was investigated within the context of different automation reliability levels: 70% and 100%. Critical measures were response time and subjective ratings of trust, confidence, and team identity. Additionally, navigation ability was measured by comparing selected routes to optimal routes.

Method

Participants

Twelve undergraduate students ranging in age from 18 to 30 participated in the study (7 females and 5 Males). They received two extra-credit hours or $20 for their participation. Due to the nature of the stimuli, red/green colorblindness was a disqualifier and both near and far visual acuities were tested with a criterion level of 20/40.

Materials

A map similar to the one used by Jastrzembski, Roring, and Charness (2006) constructed of streets, buildings, and landmarks was used as the task environment. The city consisted of a four by four block structure graphically depicted (see Figure 2.1). Each city block was unique by a combination of shapes, colors, and orientation. All stimuli and tasks were presented on a 15 inch, color monitor. The source code was created using JAVA. Participants used an optical mouse and a standard QWERTY keyboard for input devices. A nine question subjective survey using a 5 point Likert Scale administered after completion of all experimental tasks measured participant trust, confidence, and team identification with their automated aid.

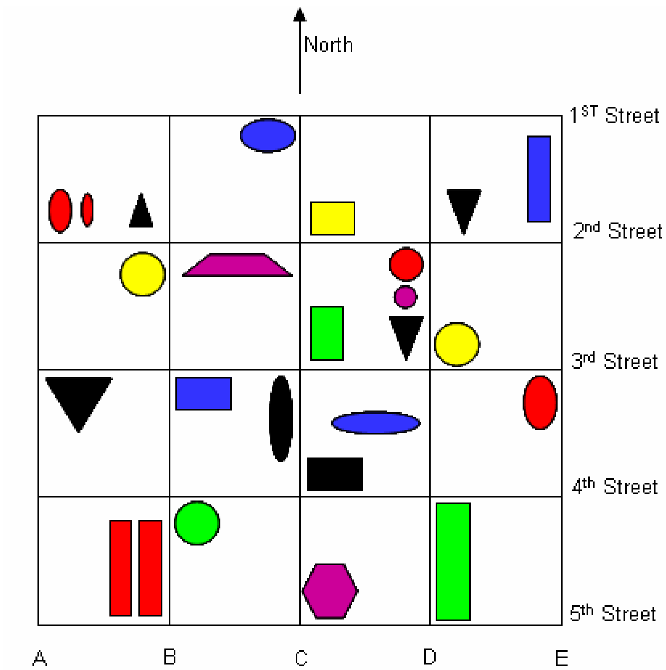


Figure 2.1. Simulated city task environment.

Design

The experiment was a 3 (acquisition level: high, low, and no) x 2 (accuracy of automation support: 70% vs. 100%) mixed design. The between group manipulation of mental model was created by exposure to the map and performance on a set of map related directional and relational questions along with a map reconstruction task (Gilbert & Rogers, 1999). Participants first studied the task environment (Figure 2.1) for 60 seconds, and then completed a distractor task consisting of 30 seconds of subtraction exercises. Immediately following the distractor task, participants reconstructed the city map by dragging and dropping a random assortment of all 16 blocks onto an empty grid replicating the city. Following this, the participants answered 16 relational questions about the task environment. These true/false questions presented the participant with two adjacent city blocks and a statement about their relationship. For example, block X is East of block Y; True or False? Next the participants answered 16 directional questions. Again, two city blocks were presented along with the following statement: how would you travel from block X to block Y? Participants chose one of four cardinal directions and one of three block quantities. For example they might select travel east for two blocks. Participants received immediate feedback after every question/exercise in the acquisition phase.

The map study session followed by the three forms of testing made up one acquisition iteration. The number of acquisition iterations operationally defined the three participant groups. A high acquisition group completed five iterations before moving on to the navigational trials. A low acquisition group completed one iteration before moving on and the no acquisition group received no study time or test before conducting the navigation trials.

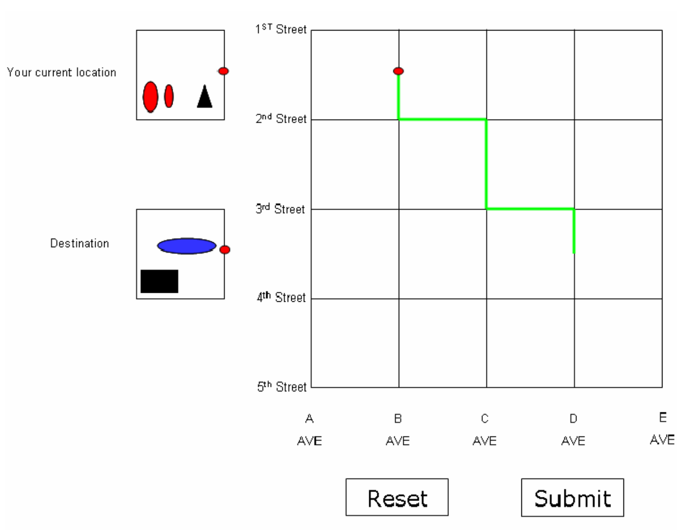


Figure 2.2. Navigation trial.

The navigation trials consisted of two blocks of 20 trials. During one block, the automation performed at 70% accuracy then at 100% in the following block. The order of blocked trials was counterbalanced across participants.

A navigational trial consisted of two city blocks presented to the participant; one the origin, the other the destination (see Figure 2.2). Red, circle icons presented on the two city blocks precisely indicated the locations of origin and destination within the city. A blank city grid consisting of streets and avenues was also presented to the participant with a red dot corresponding to the red dot on the origin block. The automated navigational aid was presented in the form of a route recommendation. This recommendation appeared as a green line extending from the origin (indicated by the red icon on the blank map) to the destination. Participants had to choose whether to trust the automation and maneuver their icon over the recommended route or create a route of their own and discard the recommendation of the aid. Participants were told during instructions that the automation was "accurate, but not perfect". Once participants completed moving their icon to the preferred destination, they selected the submit button and were given feedback on their route selection.

After each block of 20 trials participants were presented with the following statement; "Please indicate, using a number, the reliability of the automated navigation system over the last block of trials." It was expected that participants in the high acquisition group would accurately assess the accuracy of the automation, whereas participants in the low acquisition group would have difficulty determining when the automation performed correctly and when it erred.

Following completion of all navigation trials participants were required to complete another iteration of the acquisition tasks. Participant performance on this iteration would show any improvement or degradation in mental models due to learning or decay during the navigation trials. Following the completion of all computer tasks, participants completed a nine question subjective survey. The 5 point Likert Scale survey, anchored at 1 (Strongly Disagree), 3 (Neither Agree nor Disagree), and 5 (Strongly Agree), attempted to assess participant attitudes of self-confidence, trust in the automation, and team identification with the navigational aid.

Results

Data collection for this study continues. Statistical analysis of the data collected lacks the required power to find significance due to the small number of participants tested thus far. However, some trends can be seen in the data and will be commented on.

Participant errors while interacting with navigational system fell into one of three categories. First, misuse errors occurred when the automation provided the user with an inaccurate route, but the user chose to travel the recommended route. Secondly, disuse errors occurred when the automation provided the optimal route from origin to destination, but the user disregarded the recommendation and chose their own, inaccurate route. Finally, an "other" error occurred when the automation erred, the user identified the error, but still chose a route different from the optimal route.

One trend identified was the tendency of the low acquisition group to make a large number of misuse and disuse errors during the 70% block trials. As expected the high acquisition group made very few of these errors during the navigational trials. The no acquisition group made a large number of misuse errors, but made almost no disuse errors (see Figures 2.3 & 2.4).

After the 70% block trials, participants entered a subjective rating of reliability for their automated teammate. The high and low acquisition groups seem to be relatively close on their ratings; both overestimated the accuracy of the automation. Conversely, the no acquisition group estimated the reliability of the automation relatively accurately (see Figure 2.5).

For the 100% block trials all acquisition groups performed well, generally navigating from origin to destination with no errors. All groups were very accurate in their assessment of the automation's accuracy during these trials.

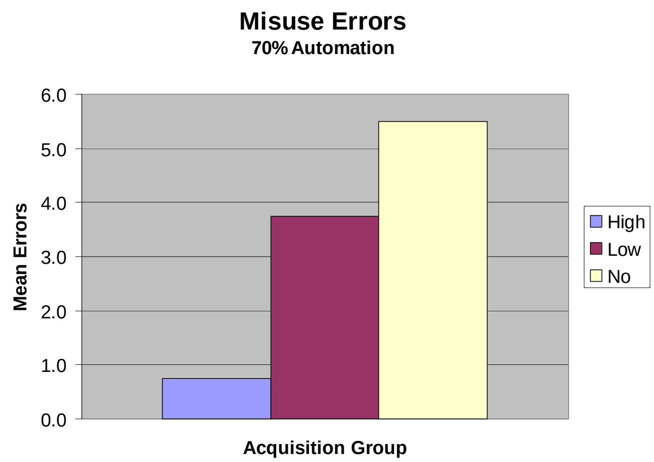


Figure 2.3. Mean number of misuse errors per group during 70% block trials. Preliminary data representing four participants in each group.

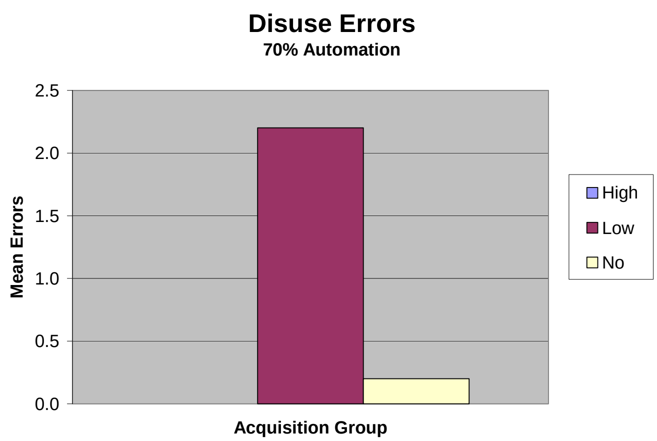


Figure 2.4. Mean number of disuse errors per group during 70% block trials. Preliminary data representing four participants in each group.

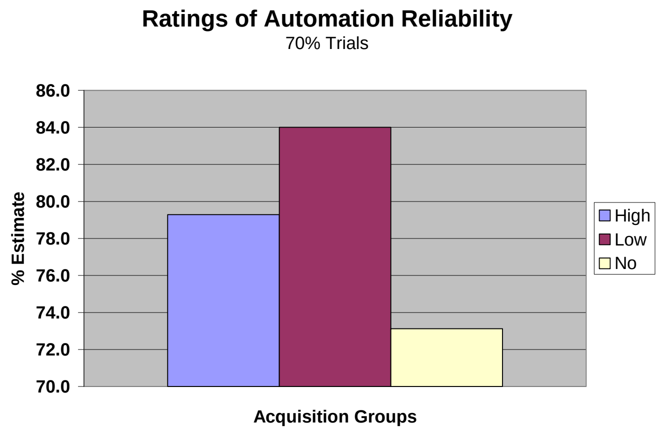


Figure 2.5. Mean percentage estimate by acquisition group of automation performance during 70% block trials (four participants in each group).

With respect to the subjective data, ratings of self-confidence correspond with acquisition group. That is, self-confidence in navigation ability is lower for groups with less or no exposure to the map during acquisition iterations.

The purpose of a collaborative system is to assist the human user in the achievement of their goals. In the case of the automated navigation system used in this study, its purpose was to assist participants navigating from origins to destinations. The best measure of how successful the human and the aid were is the number of optimal routes selected (see Figure 2.6). Members of the high acquisition group selected optimal routes nearly every time. Their mental models of the city map, acquired through five iterations of map study and testing, seemed to assist them in identifying correct automation recommendations and automation errors. Members of the low acquisition group had difficulty navigating the city during the 70% block trials. Their mental models of the city, acquired through one iteration of map study and test, seemed insufficient in identifying automation errors, resulting in several misuse errors. All groups performed at or near ceiling in the 100% block trials.

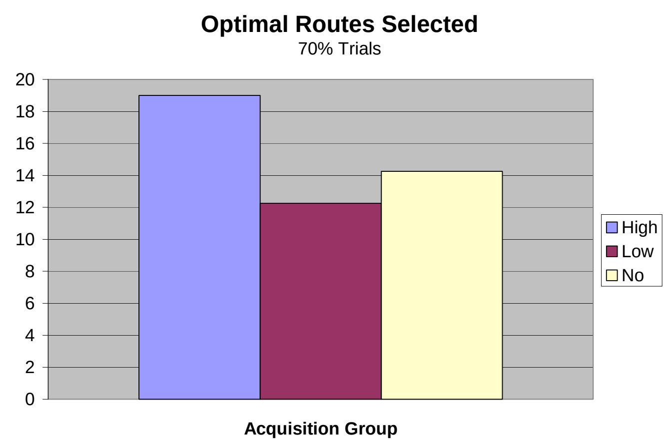


Figure 2.6. Mean number of optimal routes selected during 20, 70% block trials.

Discussion

This study's strength is its ability to directly manipulate user prior experience to the task environment (and thus presumably mental model quality). Once complete, this study will provide valuable insight into the influence of mental models in effecting user trust and reliance (i.e., behavioral acceptance) in automated systems.

As the preliminary results seem to suggest, identifying automation errors is the key to better performance. An accurate and robust mental model is a resource that may be drawn upon to confirm or deny the accuracy of the automation's recommendation. Within the context of this study, that same mental model is then used to create an accurate user generated solution.

When users fail to perceive automation errors they tend to make automation misuse errors: errors resulting from an over reliance on the automation or using it when it would be better not to (Parasuraman & Riley, 1997). Accurate mental models would help identify automation errors and prevent misuse errors. This idea may seem intuitive, but what happens when the user holds an inaccurate mental model (mental picture of the city map)? What about no mental model? The preliminary results suggest that having no mental model may force users into misuse errors whenever the automation errs. Correspondingly, an inaccurate mental model may make users susceptible to this error as well.

Another common automation error is automation disuse. This error results from the underutilization of automation, or users choosing not to utilize the automation when it would be beneficial to do so (Parasuraman & Riley). In this study, users in the high acquisition group (and presumably possessing accurate mental models) and users in the no acquisition group made little to no disuse errors. On the other hand, low acquisition group members (presumably possessing vague and inaccurate mental models) tended to commit these types of errors more frequently. Disuse errors are a result of distrust (Parasuraman & Riley), and it is possible that misuse errors degraded trust in the low acquisition group to the point where participants were susceptible to disuse errors.

This study could potentially provide support for producers of automated systems investing more time and effort into educating users on the way automated systems generate outputs. In other words, educating customers on how and why the automation interacts with the environment and produces warnings, advisories and recommendations. Additionally, if users are more informed about the conditions that cause automated systems to err, then they may be better equipped to handle and overcome those errors; saving valuable time and cost. Finally, this study could provide support for the idea that having no mental model is better than having an inaccurate mental model when dealing with automated systems and their task environments.

Chapter 3 – Experience and Expectation Influences on Behavioral Acceptance

Introduction

One of the hallmarks of our research approach is that we are testing causal relationships in the context of different systems in an effort to achieve task representativeness and thus increase generalizability. Therefore we developed another simulated task space – one that imposed dynamic processing requirements with varying levels of difficulty. We used this simulator to investigate the variables of experience, expectation, and user age on behavioral acceptance of an automated technology. Experience was assessed by tracking behavioral acceptance across extended use of the automated system. Expectation was manipulated by providing different background information about the system itself. User age was assessed by testing younger and older adults.

Method

Participants

Sixty older (65-75 years) and sixty younger adults (18-28 years) were recruited from the Atlanta area and the Georgia Tech undergraduate community respectively.

Design

Expectancy (low, high, or standard) was manipulated between subjects whereas age was used as a grouping variable. The experimental time was divided into three blocks approximately 20 minutes in length.

Materials

Simulated scenario. A dual-task Automated Warehouse Management System (AWMS) was used for the experiment. Participants played the role of a warehouse manager where they were responsible for receiving packages into inventory and dispatching fully loaded trucks. Both tasks occurred simultaneously so participants had to balance their attention appropriately. Participants were aided on the truck-dispatching task by an automated system that notified them when the system estimated a truck was fully loaded. Each block consisted of dispatching 40 trucks, so each participant encountered 120 trucks during the three experimental blocks. For the three blocks, the automation was 90 percent reliable.

Expectancy descriptions. Participants were provided with a description of the automation that framed the system in terms of a well tested, high performing system developed by a well-established company (high expectancy condition) or framed as a prototype system without testing developed by a relatively new company (low expectancy condition). See Figure 3.1 for details. In addition, a standard expectancy condition was used to replicate instructions commonly provided in research involving human-automation interaction. More specifically, participants were told that the system is highly reliable but may make errors. Participants in the standard condition were also provided with a description of both misses and false alarms.

Figure 3.1. Expectation manipulation

Category of Manipulation	**High Expectation Manipulation**	**Low Expectation Manipulation**
Company History	Company is **well established** Company has been around for many years	Company is **not well established** Company is new to the market
Technology	System utilizes advanced technology System uses **advanced** algorithms and sensing technologies	System utilizes advanced technology System uses **new** algorithms and sensing technologies
Level of System Testing	System has been **well tested** and 'bugs' have been worked out of the system	System is a **prototype** going through its **first system test**

Compared to standard instructions:
"System is very reliable but may make some errors."

Expectancy questionnaire. User expectancies were measured using an expectancy questionnaire after hearing the expectancy description and before interacting with the automated system.

Procedure

Participants completed an informed consent form outlining the study as well as their rights as participants. Upon providing informed consent, participants completed a demographics questionnaire.

The experimenter then read the description of the AWMS while participants followed along with the written text. After the verbal description, participants were given the expectations questionnaire to complete. Instructions for the tasks were provided to participants and they were allowed to practice both tasks separately and then both tasks together before beginning the experimental blocks. Participants had to reach a pre-set criterion on each practice to move on to the experimental session. After successfully completing the practice, participants began the first experimental block. Each block was separated by a mandatory one-minute break but participants were told to take as much time as they needed between blocks. Participants were debriefed following the last experimental block.

Results

User expectancies

A 3 (expectancy: low, high, or standard) x 2 (age: young or old) between subjects ANOVA was conducted with expected system performance was the dependent measure.

Overall, there was a significant main effect of expectancy ($F(2, 113) = 23.52$, $p < .05$).

Tukey multiple comparisons revealed that participants in the high expectancy condition reported higher expected system performance compared to participants in the low expectancy condition ($t(113) = 23.26$, $p < .05$). In addition, participants in the standard condition reported higher expected system performance compared to those in the low expectancy group ($t(113) = 16.73$, $p < .05$). There was no difference in expected system performance between the high and standard expectancy conditions ($t(113) = 6.54$, $p > .05$). There was no significant main effect for age ($F(1, 113) = 2.64$, $p > .05$) and there was no significant interaction.

Reliance

A 3 (block) x 3 (expectancy) x 2 (age) split plot ANOVA was conducted. The percentage of time participants relied on the automation was used as the dependent measure.

Significant main effects were found for age ($F(1, 113) = 43.11$, $p < .05$), expectancy ($F(2, 113) = 5.14$, $p < .05$), and block ($F(1.44, 163.21) = 10.58$, $p < .05$). Overall, older adults (M = 66.30, SD = 35.29) relied significantly more on the automation compared to younger adults (M = 35.83, SD = 34.85). Tukey multiple comparison tests were used to determine the source of the expectancy main effect. The source of the main effect was due to significant differences in reliance behavior between the high expectancy group and the standard expectancy group ($t(113) = 23.95$, $p < .05$). There were no significant differences between the low and high expectancy groups ($t(113) = 9.83$, $p < .05$) or between the low and standard expectancy groups ($t(113) = 14.12$, $p < .05$).

Paired sample t-tests, corrected using a Bonferroni correction, revealed that there were significant differences in reliance between block 1 and block 2 ($t(118) = 3.80$, $p < .0167$) where participants relied more during block 2 compared to during block 1. In addition, participants relied on the automation significantly more during block 3 compared to during block 1 ($t(118) =$

3.34, p < .0167). There was no significant difference between reliance behavior during block 2 and block 3 ($t(118) = .37$, $p > .0167$). There were no significant interactions (Figure 3.2).

Compliance

A 3 (block) x 3 (expectancy) x 2 (age) split plot ANOVA was conducted. The percentage of time participants complied with the automation was used as the dependent measure.

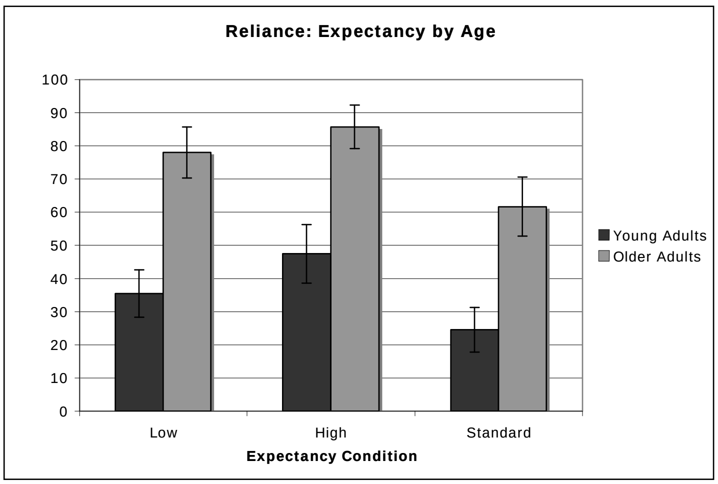


Figure 3.2: Reliance behavior by expectancy condition (low, high, and standard) and age.

A significant main effect was found only for age ($F(1, 113) = 8.27$, $p < .05$). There were no significant main effects of expectancy ($F(2, 113) = 2.19$, $p > .05$), or block ($F(2, 112) = 2.76$, $p > .05$). Overall, older adults (M = 72.05, SD = 36.72) complied significantly more with the automation compared with younger adults (M = 55.15, SD = 30.96). There were no significant interactions for compliance behavior (Figure 3.3).

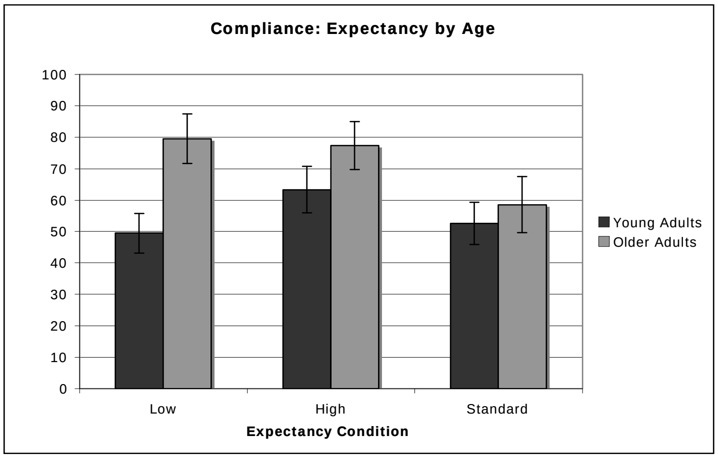


Figure 3.3: Compliance behavior by expectancy condition (low, high, and standard) and age.

Discussion

Little research has investigated the role of user expectancies on reliance and compliance behavior. In addition, most research in the domain of human-automation interaction use procedures that inform participants of the nature of potential automation errors (misses or false alarms). This study sought to investigate the role of user expectancies on reliance and compliance while interacting with a completely unfamiliar system.

The results presented indicate that the initial expectancy manipulation successfully resulted in higher overall expected system performance by participants in the high expectancy condition and lower expected system performance by participants in the low expectancy condition. Dzindolet, Pierce, Beck, Dawe, and Anderson (2001) reported a bias toward automation or a “perfect automation schema” where people place higher initial trust in automation compared to a human. This perfect automation schema may explain the higher expected system performance by participants in the standard condition. It is plausible that in the absence of more specific knowledge of the system, as was the case with the standard condition, participants rely on their naïve perfect automation schema when they estimate expected system performance.

Participants in the high expectancy condition relied on the automation more compared to both the low and standard conditions, however, only the difference between the high and standard condition was statistically significant for reliance behavior. This finding is interesting because participants in the standard expectancy condition initially reported higher expected system performance on the expectancy questionnaire, comparably to the high expectancy condition, but relied well below the level reported prior to system interaction. These findings in this study do not support a cognitive anchoring hypothesis wherein participants rely on and comply with automation to the same extent that they report planning on relying on and complying with the automation.

It is plausible that participants in the standard expectancy condition with limited knowledge of automation errors (misses and false alarms) were primed to expect errors. Although the low expectancy condition were primed to expect low system performance, participants in the standard condition were provided with explicit knowledge of the type of system errors and were likely better able to identify an error when it occurred. Once the system provided evidence of a system error, participants then expected, and acted to counteract, subsequent system errors despite reporting a high level of expected system performance initially. In contrast, participants in the low expectancy condition, without explicit knowledge of the type of system errors, were less capable of identifying an error when it occurred and thus had less low expectancy confirming evidence. Meanwhile, participants in the high expectancy condition, who had no knowledge of system errors, and who expected a high level of system performance, may have processed sufficient high expectancy confirming evidence leading them to rely on the system more.

This same pattern of results was not found for compliance behavior. There were no differences in compliance behavior between the three expectancy conditions. This may be due to salience of errors that occur during alarm state of automation. In a sense, the automated alert may act as a cue informing all participants, regardless of expectancy condition, to be aware of system errors.

Overall, older adults relied on and complied with the automation more than younger adults. However, their pattern of reliance and compliance behavior was the same across expectancy conditions. The observed main effect of age is most likely due to increased workload for older adults. The experimental task was difficult, requiring participants to shift attention between two separate tasks which may have been why older adults had more difficulty performing the task compared to younger adults. Since the automation was intended to help with one of the tasks, it is not surprising then that older adults took more advantage of the benefits of the automation. The similar pattern of behavior between younger and older adults indicates that older adults are likely extracting and processing information similarly to younger adults.

Chapter 4 –Understanding the Construct of Privacy

Introduction

The variables of anxiety and insecurity have been reported in the literature as predictors of technology acceptance (see Figure 1.1 and Van Ittersum et al., 2006). A related construct is privacy which may influence feelings of anxiety and insecurity. Privacy as it relates to computer-based technology has been a concern since at least the 1960s (Davies, 1997). However, much of the work on the topic of privacy *and* technology has been non-empirical and atheoretical. The primary issues of concern have revolved around the design of privacy-enhancing technologies (Burkert, 1997), public policy issues (Bennett, 1992), legal issues (Gellman, 1997), privacy in the workplace (Boyle & Greenberg, 2003), and privacy in public space (Flaherty, 1989). We could find no detailed, systematic investigations of what is considered private in the context of home technology. Folklore exists regarding when privacy concerns are high but that level of knowledge should not be a foundation for design decisions. We must better understand the nature of the privacy concerns to determine where and how intervention efforts should be placed. Currently, decisions about privacy are based on anecdotal information; self-perception of designers; and a non-systematic approach to the collection of privacy concerns and needs. To wit: “we as designers do not understand the real totality of privacy in a way that lets us see how our design choices will affect it” (Boyle & Greenberg, p. 2). Yet the idea that privacy would affect technology acceptance is certainly intuitive and has some empirical support (e.g., Melenhorst, Fisk, Mynatt, & Rogers, 2004).

To begin to determine how to design technologies that users perceive as privacy protective, we must understand what privacy is, and what users’ conceptual model of privacy is. However, though the question of privacy has begun to receive much scholarly attention, two major barriers cited by many privacy researchers are the lack of a good definition of privacy (Harris Interactive, 2003; Westin, 1967; 1981) and the difficulties that arise because, “privacy means different things to different people.” (Jensen, Potts, & Jensen, 2005).

In addition to the confusing theoretical history of privacy, recent privacy studies have also not addressed privacy as a construct, preferring instead to focus on narrower topics such as online self-disclosure in a particular domain (such as ecommerce, Ackerman, Cranor, & Reagle, 1999; social networking sites; or information sharing preferences, Ludford, Priedhorsky, Reily, & Terveen, 2007). While these studies do address privacy in their own domain, what they leave out is a broader understanding of how perceptions of privacy in one context may affect another. In addition, few attempts have been made to study gender, age, and cross-cultural differences in privacy perceptions and beliefs.

The aim of the present study is to collect folk privacy definitions to begin a dialogue about the motivations and justifications for privacy behaviors (disclosure, sharing, etc.). We also wish to start to tease out privacy concerns and beliefs across several contexts, and begin to make conclusions about differences in privacy perceptions across genders, generations, and cultures. As we are still collecting data, we present early results from younger adult males and females, and begin to discern distinctions between these two groups.

Method

Participants

Participants were 26 students recruited using an online psychology subject pool and by recruitment emails directed at psychology students. Five focus group sessions were conducted with 6-8 participants in each session. To promote disclosure (Karat, Karat, & Brodie, 2008), encourage discussion, and enable analysis of differences across sessions groups were kept homogenous with respect to gender. Thus, of the 26 total participants, 13 were male and 13 were female. Participants ranged in age between 18 and 26. Participants were compensated with course credit or with $10 an hour for 3 hours of their time.

Materials

Forms and Questionnaires. Participants were asked to rank 8 privacy beliefs on a Likert scale to assess their base privacy attitudes and allow for categorization into one of three Westin classifications of privacy concern (Harris Interactive, 2003; Jensen et al., 2005). These privacy attitudes included overall privacy beliefs (e.g. "Existing laws and organizational practices provide a reasonable level of protection for consumer privacy today") and online privacy beliefs (e.g. "I am concerned about online identity theft") based on Jensen et al.'s adaptation of Westin's segmentations. Participants also completed a questionnaire to determine technology usage (history, breadth of technology use, and time spent using such technologies), as well as a demographic and health questionnaires.

Focus Group Script. The focus group script was designed to elicit two pieces of information: 1) participants' individual folk definition of privacy and what it means to them, and 2) their opinions about privacy in 6 semi-structured scenarios. The scenarios were chosen to provide participants with a wide range of topics for discussion, also broadly representing the information-based and boundary-based privacy theories of Westin (1967; 1981) and Altman (1975). The script is presented in Appendix A.

Procedure

All participants were required to provide their privacy attitudes at least 24 hours prior to the focus group session so as not to bias the content of the discussion. The rest of the questionnaires were given to participants upon arrival to the session and were completed in spare time at the beginning of the discussion, at breaks, and, if needed, when the discussion was concluded.

Privacy definitions. The first task given to participants was to write down their individual definition of privacy, or their idea of what privacy means to them. After working individually, participants brainstormed about privacy definitions they shared, explored ideas only some group members had mentioned in their definitions and debated about ideas about privacy that weren't shared by all group members. Participants were encouraged to share personal stories with the group as they discussed privacy definitions and were asked to discuss the last time privacy had come to their mind prior to the present study.

Privacy scenarios. The rest of the focus group discussion was focused on the discussion of 6 semi-structured scenarios. Scenarios were chosen to represent a wide range of potential privacy concerns, yet be relatable to a wide range of participants. Scenarios touched on aspects of both Altman's (1975) and Westin's (1967; 1981) theories of privacy, namely *anonymity* ("Atlanta is trying to crack down on traffic violations by installing a traffic camera on every stoplight"), *solitude* ("You are using a cell phone with a tracking device, and you find out that anyone in the world can determine your exact location"), *personal autonomy* ("You have a lifetime of photos you are thinking of storing on a website"), and *reserve* ("You are having a conversation with your friends at home"). General privacy concerns commonly observed in discussions on privacy, such as concerns of *identity theft* ("You are using your credit card in a restaurant and the waiter takes the card into the other room for 5 minutes") and *health disclosure* ("You have symptoms of an illness that you are discussing with a nurse"), were also introduced.

Each scenario was also followed up by multiple probes, each aimed at digging deeper into the reasons for privacy beliefs and behaviors. For example, the scenario that discusses a lifetime of photos being stored follows up using a probe to get at differences that may exist when photos are stored using a different medium (e.g. a scrapbook, or an online photo album), having a smaller set, choosing who sees the set of photos, and having a set with sensitive pictures. These probes were also chosen keeping in mind the four design dimensions affecting awareness and acceptance of monitoring within cooperative workplaces offered by Bellotti and Sellen (1993), namely capture (the nature of the information), construction (how the information is stored), accessibility (who has access to the information), and purpose (why people want the data) and the design criteria proposed by Jensen, Tullio, Potts & Mynatt (2005) such as notice/awareness, choice/consent, integrity/security, and enforcement/redress.

Results

Privacy Definitions

A bottom-up coding scheme was applied to the individually written privacy definitions. The fundamental ideas that participants mentioned most often were that privacy involves *other people* (59%) and *information* of one form or another (52%). Supporting those fundamental beliefs, younger adults brought up ideas of *control* (i.e., controlling a piece of information, 26%), *decisions* (about what to do with the information, 30%), *disclosure* (whether to share the information, 41%), and *non-disclosure* (whether to keep the information to yourself, 37%). Issues about consent and confidentiality were also raised in discussion about whether or not to disclose something and when to disclose. Younger adults also talked about the *right* to privacy (22%), and the mutual *respect* (15%) that one should be given in regards to *personal* information (11%). Typical privacy definitions are shown below:

> P5 - female: “I believe that privacy is keeping information that [one] finds to be personal to yourself. I think it is important that information I find personal can only be divulged by me, in good conscious state, to people that I trust to keep it 'secret'.”

> P17 - male: “Information and experiences from my life that only I, and those people that I deem appropriate, should have access to… specifically, thoughts, emotions, and actions that aren't necessarily anyone else's business but my own.”

Gender differences. Although overall participants from both genders discussed privacy in terms of control, there were some differences in motivating factors across genders. Females were more likely to talk about privacy involving others (71%) than males (46%). In addition, females brought up topics that none of the males in the study mentioned, such as respect (29%), seclusion (21%), and the ‘personal’ nature of privacy (21%), as well as mentioning safety (14%) and having to protect one’s privacy (14%).

On the other hand, males tended to raise issues of personal needs in privacy, mentioning privacy as having freedom (8%), being anonymous (8%), comfort (8%), or not being seen or heard (8%). Females did not bring up any of these topics, which are also at the root of Westin’s privacy theory (1967; 1981). Males also mentioned issues of convenience, such as being bothered by granting access to certain information.

Age differences. Although currently in data collection phase with older adults (aged 65-75), we have already begun to notice some differences in privacy definitions of older adults based on a qualitative analysis of the first focus group. The biggest difference is that older adults tended to define privacy in terms of space as opposed to information. For example, having your own space and invasions in your home were some topics discussed. In addition, when older adults did define privacy as information, they tended to have a different idea of what this information was. In their privacy definitions, older adults mention private information as something that is given to them: a legal document, health information, their social security number, or a secret that a friend confides in them. Younger adults tended to define privacy of identity, or of personal information about them. Younger adults tended to focus their definitions on what Westin calls reserve, or the desire to limit disclosures to others and requiring others to recognize and respect that desire (1967; 1981).

Discussion

Beginning to understand what people really mean when they talk about privacy is important because it will help inform designers in creating technologies that are perceived as private. As younger adult participants stressed privacy of their personal information, keeping a user's identity secret on a website is a choice that should be given to this audience. Perhaps habits and actions are not as important to keep secure for older adults, who thought more about spaces they occupy and 'official' documents.

The data we have collected and analyzed so far represent only one step at trying to understand the notion of what is private. We are currently in the process of collecting data from the older adults and from both younger and older adults in India. Our next steps will be to complete data collection with these groups, and begin to evaluate privacy definitions of all three groups, as well as comparing genders. We must also start to delve into the privacy attitudes for each of the scenarios that we have developed.

Chapter 6 – Conclusions and Future Research

The general findings from Studies 1 and 2 are that small differences in experience and expectations can have significant influences on behavioral acceptance. For example, in Study 1 user experience influenced reliance on the automation in several ways. First, participants with more experience made more misuse errors. However, minimal experience led to more *disuse* errors than either no or high experience suggesting that a little experience can perhaps lead to overconfidence. Although the absolute number of errors was small such disuse errors are practically important depending upon the consequence of the error. We plan to extend this research to include older adults as well as different levels of user experience.

Study 2 illustrated that relatively subtle differences in product descriptions also influence behavioral acceptance. The initial findings suggest the effects differ for young and older adults. Moreover, system experience reduced the effect of the previous knowledge. In addition, the pattern of overall higher reliance for older adults may be indicative of a workload effect. We intend to investigate these findings in more depth by providing participants with more experience and assessing trust, reliance, and self-confidence across time.

The initial results of Study 3 suggest a lot of variability in how people think about privacy but common threads such as the need for control have implications for communication with consumers. These findings illustrate the importance of understanding what people really mean when they talk about privacy, individual and group differences in privacy definitions, and the role of technology in privacy definitions and behaviors. When participants were asked to write their individual definitions of privacy, control was a very common theme. These results may provide guidance about descriptions of technology (e.g., telematics) that should be provided to potential consumers and what those systems do. We are currently collecting U.S. data with younger and older individuals as well as younger and older adults in India. Our goals are to understand how people think about privacy and whether privacy concerns differ across contexts, ages, and cultures.

In Phase 4 we plan to extend our research on the causal relationships between variables based on what we have learned in the present studies as well as those reported in Van Ittersum et al. (2007; see Figure 6.1). First we will complete the extensions described above for the studies reported herein. We will be extending this research to investigate relationships between behavioral control (workload, experience) and reliance. We are also in the process of developing a conceptual model to relate experience and behavioral acceptance and testing boundaries of the model.

In the Van Ittersum et al. (2007) survey we observed that *attitudinal acceptance* of Swath Control Technology for Planters was largely driven by the *perceived usefulness* of the technology. Moreover, the most important factor influencing farmers' perception of the *perceived usefulness* of the Swath Control Technology for Planters was *perceived compatibility, ease of use,* and *result demonstrability*. We intend to investigate these relationships by understanding system characteristics that signify intuitive design. Feelings of intuitive use communicate to customers (through the variable of perceived ease of use) and in turn influence technology acceptance. Our initial efforts have focused on identifying the psychological variables related to intuitive design and use (see Figure 6.2). We are currently designing several studies that will provide insight into user experiences and design characteristics that lead to feelings of intuitive use – these studies will provide guidance for both marketing and design.

Figure 6.1. Technology Acceptance Phase IV

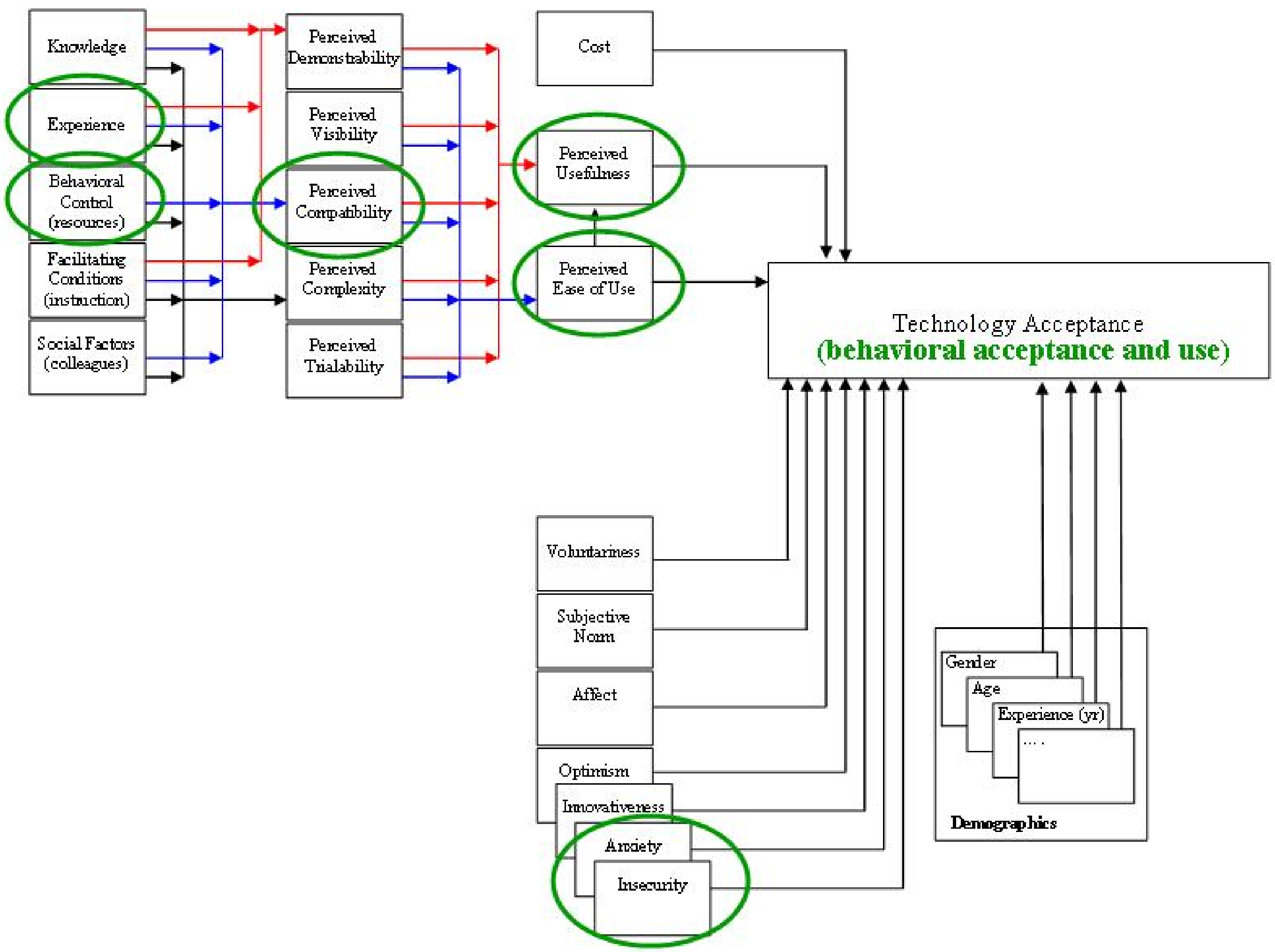
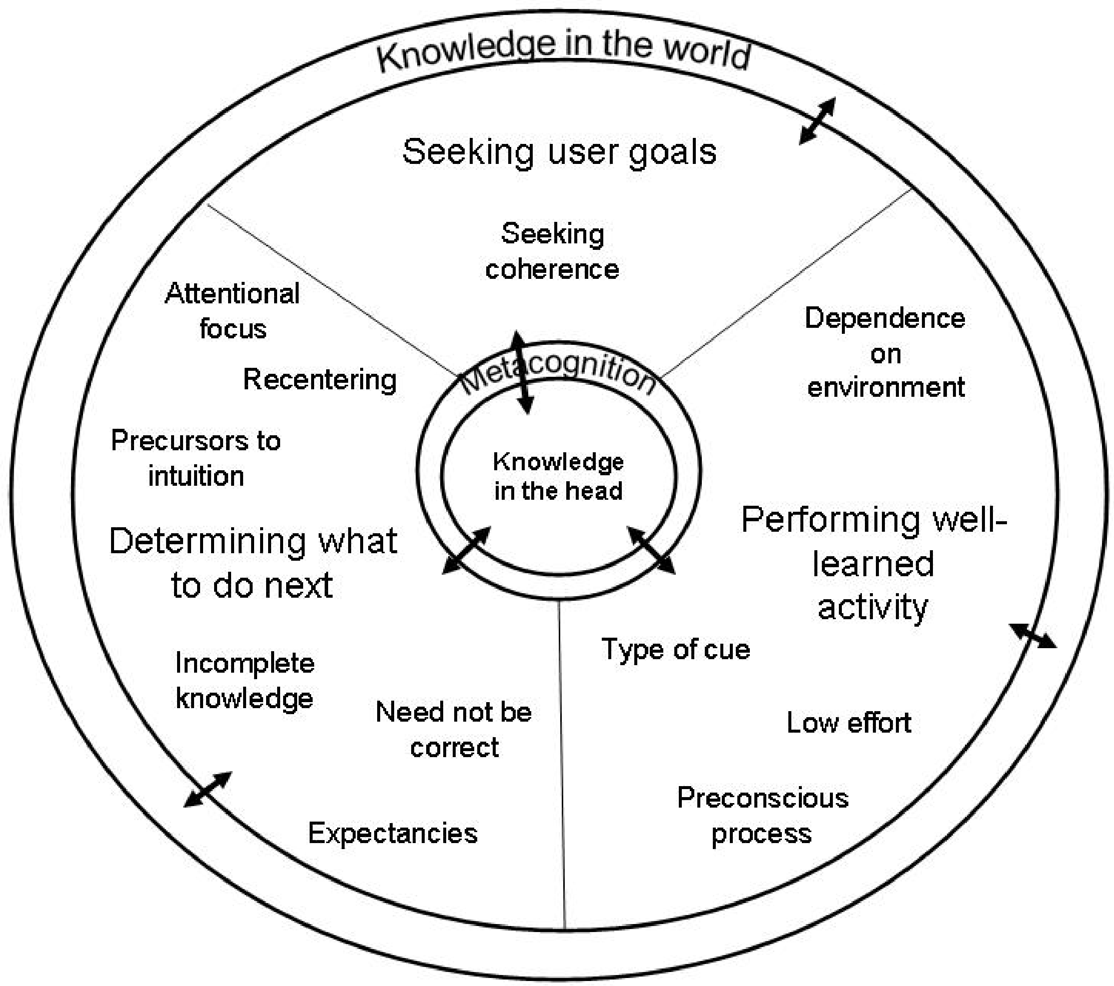


Figure 6.2. Organizational Framework for Intuitive Design



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Appendix A: Script for Privacy Focus Group Study

Privacy Focus Group Script

{INFORMED CONSENT}

I have given you two copies of the consent form, one copy is for us and the other is for your own records. Note that before you sign the consent forms, please make sure that you feel comfortable with participating today. If you decide for any reason that you are not able to participate today, let me know at any time. If you do not have any questions and you still wish to continue, you may sign the consent forms.

{INTRODUCTION}

Welcome, and thank you for your participation today. I would like to make a few introductions before we get started with the discussion. My name is Michelle and I will be leading the discussion today. Helping me today is Kelly – she will be writing things on the whiteboard and joining in the discussion as well.

Today we will discuss your ideas and concerns about privacy. We will be recording the session today. Because we care very much about what each of you has to say, please speak up. We don't want to miss anything that you have to say.

{DISCUSSION}

Now, we will move on to the focus group discussion. How many of you have participated in one of these before? We will be treating it just like a discussion. Before we begin, you should understand that there are no right or wrong answers, only different experiences and opinions. Feel free to express your opinions, perhaps in disagreement with another group member, as these types of discussions enable us to learn a lot about the different kinds of opinions that people have. In doing so, however, please remain respectful of the other members of the group.

A very important component to this type of study is confidentiality. There are two parts to this confidentiality that I wish to point out. First, as you read in the consent form, your name and your voice will not be tied to any of the data collected in this study. We will keep any information that ties you to the data on a password-protected computer in our lab. Secondly, we ask that anything we say in this room remain confidential amongst you guys. We hope that if you choose to talk about this study that you will not use each others names, and protect the identity of those in this room.

The session will last about two and a half hours. We would ask that you please turn off or silence your cell phones for this session. If there is something that Kelly or I can do to make you more comfortable, like get you a different chair or get you something to drink, please let us know. Also, before we begin, if you need to use the restroom, please do so now.

Ok, I'm going to turn on the tape recorder and begin recording now.

Discussion Questions

1) Please introduce yourself to the group by stating your first name and where you grew up/hometown.

2) We are here today to talk about privacy, so the first thing I would like to do is to have everyone take that blank piece of paper you see in front of you and write down your individual definition of privacy, or what it means to you. Feel free to brainstorm, but please work individually. When you are finished please fold the paper and put it in the envelope in front of you, and place the envelope under your chair or behind you. Thank you!

3) Ok, so what were some of the ways people defined privacy. Kelly will keep track of all the different things we have to say by writing them on the easel.
    a. Would anyone like to share their definition with the group?
    b. What are some key words you associate with privacy? What immediately pops into your head?

4) Now I'd like you all to think of the last time you thought about privacy before today.
    a. When was the last time that privacy came to your consciousness?
    b. What were you thinking or talking about it?
    c. Would anyone like to share their story with the group?

5) Group discussion (using examples that the group thought of)
    i. So what is privacy in these situations that we have just discussed?
    ii. What is private about [insert example]?

Scenarios

In the last section of this focus group, we are going to discuss privacy in a few different situations or contexts. We know that people think about privacy in many different ways: some people may have concerns in certain situations, and some people may not. So for each one of the scenarios we discuss, please express your concerns if you have some, and tell us a little bit about why that is a concern for you. If you feel that you do not have any concerns about the scenario, please tell us why not. If you feel that you have concerns other than privacy, please mention them briefly.

Since we are really interested in what concerns you may have and what types of things you may do in these situations, please try to put yourself in the role of the scenario as best as you can.

[For example, if the scenario is "You are walking in the supermarket," and you do not have any privacy concerns, it is quite alright to say "I am not concerned about privacy in the supermarket," instead of "Someone might be concerned with having the checkout person see what you are buying."]

Does anyone have any questions before we begin?

1) **You have a lifetime of photos you are thinking of storing on a website.**
    a. Standard Probes
        i. Do you have any privacy issues or concerns with this situation?
        ii. What about this situation makes it concerning?
        iii. Why

    b. Additions to this scenario
        i. What if you used a scrapbook?
        ii. What about an online photo album (like Flickr, Picasa, Snapfish, etc)?
        iii. What about if they were just photos from a recent trip?
        iv. What if there were sensitive photos included in your set?
        v. What if you could pick exactly who saw the photos?

2) **You are using your credit card to buy dinner in your favorite restaurant. When the waiter picks up the bill with your card in it, he takes the card in the other room for 5 minutes.**
    a. Standard Probes
        i. Do you have any privacy issues or concerns with this situation?
        ii. What about this situation makes it concerning?
        iii. Why

    b. Additions to this scenario
        i. What if the restaurant is one that you've never been to before?
        ii. What about using your credit card to order takeout online?
            1. At home
            2. In a crowded place (library, work)
            3. On a network that is not yours
        iii. Sometimes when you fly you have to swipe your credit card at the airport kiosk to pull up the flight information.
        iv. Are there any other times when using your credit card that you think about privacy?

3) **Health Information: You have the symptoms of a an illness that have lasted for over a week. You call your doctor's office and describe your symptoms to a nurse.**
    a. Standard Probes
        i. Do you have any privacy issues or concerns with this situation?
        ii. What about this situation makes it concerning?
        iii. Why

    b. Additions to this scenario
        i. What about if you are in a crowded room?
        ii. What if your symptoms were more serious? Embarrassing? (AIDS, Mental Health, STDs)
        iii. What about finding information about a health issue that you have online?

4) **Location: You are using a cell phone with a locating device (such as GPS). You find out that there is a way for anyone in the world to find out your exact location.**
   a. Standard Probes
      i. Do you have any privacy issues or concerns with this situation?
      ii. What about this situation makes it concerning?
      iii. Why

   b. Additions to this scenario
      i. What if your location was approximate?
      ii. Would it matter if only certain people could determine your location? [for example, only those in your family's cell phone plan]
      iii. Grocery Store
      iv. Out to dinner
      v. Home

5) **Traffic Light: Atlanta is trying to crack down on traffic violations by installing traffic cameras on every stop light. These cameras monitor traffic and then take a snapshot of anything out of the ordinary, such as someone running a red light. (Red-light camera)**
   a. Standard Probes
      i. Do you have any privacy issues or concerns with this situation?
      ii. What about this situation makes it concerning?
      iii. Why

   b. Additions to this scenario
      i. What if there were video cameras recording at all times?
      ii. What if this info was available to anyone on a certain TV channel?
      iii. What if Atlanta was going to crack down on traffic violations by placing more cops at intersections around town?

6) **Conversation: You are having a conversation with friends at home.**
   a. Standard Probes
      i. Do you have any privacy issues or concerns with this situation?
      ii. What about this situation makes it concerning?
      iii. Why

   b. Additions to this scenario
      i. What about in another location, such as a crowded park? Small coffee shop? Taxi/subway?
      ii. What about on the phone?
      iii. What about if you are discussing politics or religion?
      iv. What about if this conversation is taking place over instant messenger? Over a video conference? Or an internet forum?

Extras

7) Having guests over? (kind of like conversation one)
8) Overhearing someone's cell phone conversation (kind of like having conversation one)
9) Being emotional/sick in front of strangers
10) Imagine you are creating a website about you

Standard follow-ups for all questions:

If off track – say, "That's good, but the focus of this question is [repeat part of question]."

If need additional probe – say, "Any [others, more, one else, thing else]?"

If need explanation – say, "What do you mean?"

If use the term 'privacy' or 'private' – say, "Can you use another word instead of 'private' or 'privacy' in that statement?

Repeat Privacy Definitions

We have talked a lot about different privacy concerns today, so now we would like to revisit an exercise we did at the beginning of the focus group. I'd like you to each take the additional piece of paper in front of you and write out your definition of privacy. Once you are done, please fold the piece of paper and place it in the same envelope as before.

Final questions

So, let's just think back over this hour and a half that we've been together, and try to summarize it a bit.

1) Please sum up your thoughts about privacy into a few sentences. What is your personal take-away from this session?
2) Next, please think about what everyone in the session discussed. If you were going to tell someone who was not here today what the important parts of the discussion were, what would you say?
3) Have your views about privacy changed over the years? Are there circumstances that have changed your views?

OK, we are finished with the discussion. Does anyone have any questions? I am turning the tape recorder off now.

Please complete this technology acceptance questionnaire. After you complete this questionnaire you are free to go. Thank you for your participation in this focus