December 2003

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Abstract

Human-computer interaction (HCI) has changed dramatically as advances in computing technology have made computer-generated voice and animation commonplace in computing applications. These types of human-computer interactions have been incorporated into business applications ranging from computer-based training to Internet shopping agents. Research on how the design of these interactions may influence user perceptions and outcomes, however, is still in the early stages. This paper describes a research study designed to investigate how the multiplicity of social cues and the personality exhibited in these interactions influences user involvement and decision-making outcomes. Prior research on consumer decision-making and similarity-attraction theory was used to develop a theoretical model and hypotheses, and design an experimental application. The experiment has been conducted and results will be presented at the conference.

Keywords: Software agents, intelligent agents, decision-making, decision performance, involvement, similarity-attraction, personality traits, social cues

Introduction

Computing technology has enabled human-computer interaction to advance from simple text-based instructions to richer agent-based interactions incorporating animation and computer-generated voice. Interface developers have quickly integrated this new technology into a variety of applications, as evidenced by the presence of animated interface agents in office automation software (such as the Microsoft paperclip) as well as the increasing use of Internet shopping agents in online environments. In typical fashion, the design and development of these advanced interfaces has outpaced our understanding of the behavioral impact of these enhancements.

Researchers in the HCI and communications areas have begun investigating the behavioral impact of these interface enhancements from different perspectives. HCI researchers have found that users respond in a social manner to interfaces that exhibit social cues through test, voice, and animation. The managerial implications of this behavior have not been addressed, however, in this research stream. Similar research has begun in the communications literature but with an expected focus on the communication process and related constructs.

The purpose of this research is to investigate the managerial implications of using advanced interface techniques in business computing applications, and specifically to investigate the effects of computer-based agents on user information processing and decision-making performance. Existing research on decision-making with computer-based decision aids provides a comparative basis for understanding the impact of these newer interface technologies and a good starting point for integrating the results into existing MIS research. Research on consumer decision-making and similarity-attraction provides the theoretical foundation for

the study. An experiment was designed to assess the impact of multiple levels of advanced interactivity in the interface on decision-making outcomes.

The paper is organized in the following sections. First, the theoretical foundations for the project are reviewed and the hypotheses and research model are presented. The research design and surveys are described in the methodology section. Lastly, the current status of the project and the conference presentation are discussed.

Theoretical Foundations and Research Model

An integrated view of HCI research and the consumer decision-making literature was used to develop a theoretical model that explains how interaction levels and perceived computer-based personality influence decision-making outcomes. Prior research on consumer information processing and decision-making suggests that increased decision-maker involvement in a task will result in greater attention, effort, and comprehension by the decision-maker. Existing research on the social aspects of human-computer interaction suggests that greater levels of involvement may be obtained by providing more information cues in the computing application and by matching the personality exhibited with these cues to the decision-maker. A review of these two bodies of research is provided below.

HCI: Similarity-Attraction and Computers as Social Actors

A series of experimental studies conducted by Nass and colleagues (see Nass and Moon 2000 for a review) has provided evidence that humans respond to social cues in human-computer interaction in a manner similar to how humans respond to other humans. This application of social rules to computers has been labeled the Computers as Social Actors (CSA) paradigm. The basic premise of the paradigm is that individuals respond to social cues from computers with social behaviors, and this conditioned response occurs despite the individual knowing that the computer is in no way human. Demonstrated social responses include gender stereotyping, politeness, and reciprocal self-disclosure. The results are particularly applicable to MIS research, as even experienced computer users appear to consistently respond to these computer-based social cues. Similarity-attraction theory (Byrne & Griffitt 1969) has been applied within this paradigm to assess whether users recognize and prefer to interact with computer-based personalities that are similar to their own personality (Nass & Moon 2000, Burgoon et. al. 1999). This theory may also offer an explanation for why users are more responsive or attentive to an application with increasing levels of social cues.

Similarity-attraction is a mature theory stating that individuals will be more attracted to individuals that exhibit similar characteristics. This theory has been extended to interactions with friends and colleagues in business settings. In the early stages of an interaction or relationship, personality traits are easy markers for assessing similarity and reducing the uncertainty of a new interaction. We are more comfortable with people that exhibit traits that are familiar (e.g., like our own). In human-computer interactions, we would expect users to be more comfortable with computer-based interactions that are similar to their everyday interactions with other humans. A new computer-based application with more levels of social interaction (e.g., text, voice, and animation) will seem increasingly similar to human-human interaction and may be preferred by users. When these computer-based interactions exhibit personality traits similar to the user's traits, the attraction may be increased.

Support for the influence of interaction levels on decision-making performance can also be found in studies involving media richness theory. Media richness theory (a.k.a. information richness theory) proposes that task performance is enhanced when the task needs are aligned with the medium's ability to convey information appropriate to the task (Daft & Lengel 1986). Media, it is argued, vary in their ability to support communication and changes in understanding (Daft & Lengel 1986, Daft, Lengel and Trevino 1987). Richer media typically are thought to convey information in natural languages (as opposed to numeric information), through a greater multiplicity of cues (visual information, tone of voice, etc.), employing greater personalization of the message, and finally through providing opportunities for faster feedback.

Despite the surface appeal of media richness theory, a number of studies have reported mixed results when examining the tie between media choice and performance (Daft, Lengel and Trevino 1987, Dennis and Kinney 1998, Markus 1994, Ngwenyama and Lee 1997). Nonetheless, as a starting point, media richness theory is useful as a framework for examining agent technologies, since one way these technologies can vary is through the multiplicity of social cues they provide (i.e. through text, voice, and animations). In our decision-making context, the CSA paradigm and similarity-attraction theory would suggest that a decision-making application with more social cues will provide greater opportunity for a user to assess similarity, and thus potentially be

more (or less) attractive to the user. This attraction or appeal would increase the user's involvement with the application and the supported decision-making task. The impact of increased involvement on decision-making is discussed in the next section.

Consumer Decision-Making and Computer-Based Decision Aids

Research on consumer decision-making has been appropriately integrated into most of the behavioral computer-based decision-aid research in management information systems (MIS). For example, Todd and Benbasat's DSS decision performance model (1999) was developed from a series of experiments that utilized Payne, Bettman, and Johnson's work on the cost-benefit framework for decision choice (1993). While such MIS research has provided important insights into how decision aids can be used to influence decision strategy and performance, this research was conducted prior to the advent of advanced HCI techniques and does not explicitly address the increased interaction levels and social responses to computers that are present today.

The consumer decision-making literature similarly provides a theoretical foundation for the next advancement in MIS research on decision aids. Consumer research defines involvement as the consumer's motivation to process information related to a decision task, with perceived personal relevance being a key aspect of involvement (Celci & Olson 1988). For example, in a study of consumer processing of product information and choice, the consumer's involvement with the product was found to increase the effort that the consumer devoted to the task and the consumer's overall comprehension of the product (Celci & Olson 1988). The two general sources of an individual's involvement in a decision-making task are believed to be 1) intrinsic characteristics, and 2) situational characteristics (Celci & Olson 1988). For example, an individual planning to buy a car in the next six months (an intrinsic characteristic) may find automobile shopping more personally relevant. Situational characteristics in a decision-making task might include salient features such as a discounted price or a striking image.

Increased effort and comprehension could also be expected when a decision-maker is more involved with a computer-based decision-aid that supports a decision-making task. If the level of social cues or interaction in a decision aid (situational characteristics) can enhance the involvement of the user, then an increase in the user's decision-making performance and understanding of the decision aid should result. In our context of computer-based decision aids, involvement is viewed as the user's motivation to process information and utilize the decision aid.

Research Model and Hypotheses

The research model shown in Figure 1 was developed from a review and integration of the HCI and decision-making literature discussed above. Hypotheses I and II address the relationship between interaction levels, personality, and involvement, and are supported by the CSA paradigm and Similarity-Attraction Theory. Hypotheses III and IV address the relationship between involvement and decision performance and understanding of the decision aid, and are supported by the consumer decision-making literature.

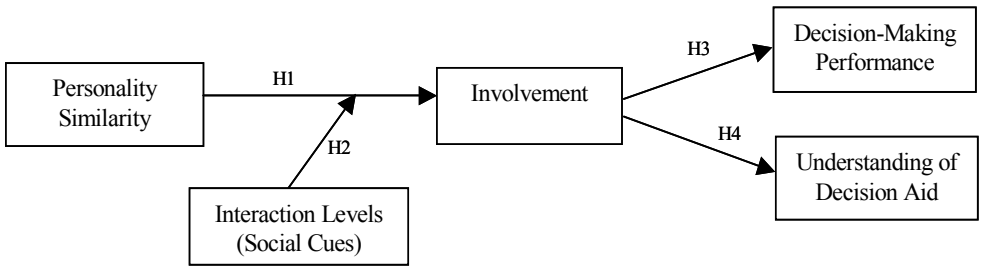

Figure 1. A Model of the Impact of Personality Similarity on Computer-Based Decision-Making

H1. The similarity of personality traits between the decision-maker and the decision aid increases decision-maker involvement with the decision aid.

H2. Increased interaction levels (social cues) will enhance (moderate) the effect of personality similarity on decision-maker involvement with the decision aid.

H3. Decision-making performance increases as decision-maker involvement with the decision aid increases.

H4. Understanding of the computer-based decision aid increases as decision-maker involvement with the decision aid increases.

Research Methodology

A 4x2 research design will be used, varying the interaction levels (text-only (T), text-voice (T-V), text-voice-cartoon animation (T-V-CA), text-voice-human animation (T-V-HA)) and the personality of the decision aid (dominant, submission). Subjects will be randomly assigned to one of the eight treatment conditions. A pre-experiment survey will be administered to ascertain the subjects' perceptions of their own personality traits (dominant or submission). A post-experiment survey will be administered to assess user perceptions of involvement, understanding of the decision aid, and to provide manipulation checks on the perceived personality of the decision aid and the level of interaction provided.

Task

The subjects will perform an apartment selection task similar to that employed by Todd & Benbasat (1999) and Payne et. al. (1993) in prior decision-making studies. This task was chosen as it is a salient choice problem for most college students, and it has been successfully employed in other decision-making experiments using college age subjects.

As in other computer-based decision-making experiments, ten apartment alternatives with eight attributes were provided. The eight attributes were rent, size, distance to campus, laundry facilities, noise, Internet access, age of facility and parking. Care was taken to select attributes that would be similarly valued by all subjects. For example, all subjects would prefer reserved parking to off-site parking. Other attributes, such as the number of bedrooms, were not used as such attributes might elicit different preferences from different subjects.

The decision aid enables the subjects to first specify their preference for each attribute by allocating 100 points among the eight apartment attributes. The decision aid then provides a spreadsheet-based interface with several functions to facilitate the subject's selection of an apartment. These functions include hiding and showing apartment alternatives (rows) and features (columns), changing the order of the apartments (rows) and features (columns), and sorting by one or two of the apartment features. The subjects were asked to specify their favorite apartment after they finished reviewing the ten alternatives.

Treatment Conditions

The interaction levels (T, T-V, T-V-CA, T-V-HA) were developed using the Microsoft Agent Technology. The computer-based decision tool first provides the user with a tutorial on how to use the tool and then guides the user through the actual use of the tool. In the T treatment, the decision aid delivers the tutorial and instructions for use through text displayed in text balloons. In the T-V treatment, the text balloons along with a computer-generated voice that reads the text in the balloons is provided. In the T-V-CA treatment, an animated cartoon agent (a bird) speaks the same text using the same computer-generated voice and the text balloons. In the T-V-HA treatment, an animated human-looking agent speaks the same text using the same computer-generated voice and the text balloons. At each level, the human-computer interaction is increasingly similar to human-human interaction.

The dominant-submissive dimension from the five-factor personality model (Trapnell & Wiggins 1990) was used to assess the impact of personality similarity. This dimension represents the degree to which an individual is assertive and willing to exercise control over others, and was selected because it can be easily manifested in all interaction levels and accurately assessed in a short interaction period. This personality trait was represented in the treatments by varying the word choice, voice characteristics, and actions/animations of the decision tool in keeping with similar experiments on personality traits (Nass & Moon 2000, Burgoon et. al. 1999). In the T treatment, the information content was kept the same, but the dominant script was modified to include more assertive, commanding statements. In the T-V treatment, the dominant script included the same assertive statements and the frequency, range, and speed of the computer-generated voice was increased to be in keeping with the typical vocal traits of a more dominant personality. In the T-V-CA and T-V-HA treatments, the dominant script included the same assertive statements and vocal cues, and the agent animations were allowed greater movements and gestures in keeping with a more dominant personality.

Measures

The measurement of the subject's personality on the dominant-submissive dimension of extraversion and the manipulation check on the dominant-submissive nature of the computer-interaction was obtained using a 16-item adjective scale (Trapnell & Wiggins 1990). Involvement was measured with existing scales from the marketing and communications literature. Decision-making performance was measured by several common decision-making outcomes. First, the subjects' final selections were compared to their *normative choice* using a weighted-additive calculation. The effort of the subjects was evaluated by counting the *number* and *type* of decision aid features used and the *length of use*. The subjects' *satisfaction* with the decision aid and *confidence* in their decision choice was also measured. *Understanding* of the decision-aid tool, the degree to which the user has learned to use the features of the tool, was assessed through recall questions on the functionality provided by the tool.

Data Analysis

Analysis of the full model shown in Figure 1 will be performed using AMOS 4.0 for structural equation modeling with multiple groups and maximum likelihood estimation. Supplemental analysis of specific parts and relationships in the model, including manipulation checks, will be performed using ANOVA and regression.

Results and Limitations

A pilot study was initially conducted and the full experiment has been completed with 412 subjects participating. The conference presentation will include a complete data analysis and discussion of the results. Limitations of the study include the use of student subjects and the cross-sectional nature of the study, and will be discussed in detail at the conference.

References

Available upon request.