1-1-2005

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Recommended Citation
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The Influence of Effort, Accuracy, and Negative Emotions on Product Choice-Strategies: Evaluations of Recommendation Agents on Desktops versus Handheld Devices

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ABSTRACT

Intelligent product recommendation agents (RA) are used widely in e-commerce to reduce consumers’ effort and to increase the accuracy of their decisions. This study investigates how to design RAs, for desktop and handheld devices, to alleviate the negative emotions associated with the normative decision-strategy which generates accurate decisions but only with extensive effort on the part of users. Decision-strategies and preference-elicitation methods (i.e., question and answer sessions for RAs to identify the needs of individual consumers) that are employed by RAs generate different levels of effort, accuracy, and the negative emotions, while the additional cognitive effort necessitated when using limited handheld devices moderates such relationship. Provision of the RA that mitigates the negative emotions will instigate the decision-maker to choose the normative decision-strategy for emotion-laden tasks. This study extends RA literature into the area of emotions related to decision-making and into the context of mobile computing.

Keywords
Intelligent product recommendation agent, consumer decision-making, mobile computing, negative emotions

INTRODUCTION

Recommendation agents (RAs) advise consumers about what products to buy, based on the needs expressed by the consumers. A number of RAs have been used successfully in many web storefronts. The role of different RAs has been examined primarily in terms of the cognitive aspects of decision-making, specifically how RAs can reduce effort and increase the accuracy of decisions (Hauble and Trifts 2000). This study expands from the perspective of effort and accuracy, and investigates the role of RAs in reducing the negative emotions that arise when conflicts among product attributes force consumers to trade off some attributes to acquire others (Luce, Payne, and Bettman 2001). These negative emotions merit attention, inasmuch as consumer tendencies to minimize distressing emotional states often result in selections of less desirable decision-strategies.

Few studies have investigated RAs used on mobile handheld devices, although portability of handheld devices enhances consumers’ purchase decisions by providing instant access to product information and advice at the point of purchase. Portability involves disadvantages, however, such as limited display space and awkward input devices, which thereby increase users’ cognitive effort significantly. We know very little about how the increased effort caused by device constraints influence consumers’ purchase decisions (Lee and Benbasat 2004).

In this context, this study investigates: (1) how different levels of effort, accuracy, and the negative emotions effected by RAs influence decision-makers’ intentions to adopt RAs, and (2) how the increase in effort attendant to using handheld devices alters the RA- adoption intentions.

THEORY AND HYPOTHESES

Decision-Strategies

Consumers can apply 12 decision-strategies to multi-alternative/multi-attribute preferential choice problems where they choose one out of a number of alternatives described by a common set of attributes (Payne, Bettman, and Johnson 1993). The costs and benefits of decision-making depend on the decision-strategies utilized (Payne et al. 1993). Of these, the Additive-Compensatory strategy (AC) is closest to the normative strategy, while other strategies are based on heuristics. AC is based on the evaluation of one alternative at a time along all relevant attributes. The Elimination-by-Aspects strategy (EBA), in contrast, compares attribute values against some thresholds across alternatives (Todd and Benbasat 1999). The major
difference is that AC allows a high value of one attribute to make up for low ones of others, whereas, EBA eliminates alternatives with attributes whose values do not meet the cutoff levels, regardless of values of other attributes (Payne et al. 1993). Accordingly, the decision quality of AC is superior to that of EBA, though AC requires greater effort.

Negative Emotions

AC also leads to the negative emotions that occur when alternatives exhibit conflicting values for important attributes. The conflict between attributes implies that consumers cannot further a goal (e.g., safety of family members) without making sacrifices on another (e.g., saving money). Consumers attempt to cope with the negative emotions by resisting making decisions, or if not possible, by avoiding the knowledge that emotion-laden tradeoffs must be made (Luce et al. 2001).

Therefore, EBA becomes desirable precisely because it enables a decision-maker to choose an alternative that stays within certain values of attributes, hence avoiding the conflicts that exist across attributes. In contrast, AC that requires consumers to evaluate alternatives across attributes explicitly reveals the conflicts, thereby generating the negative emotions (Luce et al. 2001).

Recommendation Agents

RAs reduce the effort for applying AC to the level of EBA by automating the intensive information-processing required for using AC; hence, users make more accurate decisions with less effort. We describe two common types of RAs presented in previous research: the RA applying the AC strategy (RA-AC) and the RA applying the EBA strategy (RA-EBA). RA-AC asks consumers to indicate, on a 100 constant sum scale, how important they personally consider each of the product-attributes. Based on these subjective attribute-importance weights, and using standardized values for the different levels of each attribute, RA-AC computes an overall utility score for each alternative, and recommends three products that have the highest utility scores. RA-EBA requires consumers to specify the minimum (or maximum) level of each attribute they will personally accept, and then recommends products that satisfy these cutoff levels.

RA-AC yields the most accurate decisions with low effort, because the complex calculations required for AC (e.g., summations and multiplication) are automated, whereas, RA-EBA produces less accurate decisions with low effort. However, use of RA-AC leads to the intense negative emotions, because RA-AC employs a preference-elicitation method (i.e., question and answer sessions for RAs to identify the needs of individual consumers) involving across-attribute comparisons. As consumers are asked to distribute a total of 100 points to an attribute according to its importance compared to others, consumers are forced to trade off importance of the attribute to emphasize another.

We propose an RA employing a particular preference-elicitation method, namely, the needs-specification method (RA-need), to resolve the negative emotions. RA-need asks the consumer to describe his/her needs (e.g., “I want to take photos from far away”) and the importance of each need on a seven-point scale. RA-need, then, converts consumer-specified needs into relative attribute scores (e.g., to take photos from far away a “5X zoom” is chosen) upon which tradeoffs are made by the RA. RA-need still applies the AC strategy, because it evaluates alternatives at a time along all attributes. In addition, the needs-specification method reduces the negative emotions, because (1) it asks consumers to make choices based upon within-attribute differences rather than across-attribute comparisons and (2) it rephrases questions in terms of the consumer’s needs that are specific to the individual and cannot be judged objectively. Notice, however, this method involves two stages of inputting: needs-specification and importance-indication. Consequently, RA-need takes more effort than the other RAs each of which requires only one stage.

Negative Emotions and Use of Handheld Devices

Handheld devices that are less input-output friendly increase the effort required for decision-making (Albers and Kim 2000). This increased cognitive load prevents individuals from feeling the negative emotions by diverting their attention away from the goals that are threatened by the tradeoffs they must make (Drolet and Luce forthcoming). In other words, consumers do not perceive the negative emotions while trading off important attributes, inasmuch as they fail to recognize that their important goals are at stake. Accordingly, we posit that the constraints of handheld devices distract consumers from the emotional aspects of decision situations. Table 1 summarizes the levels of effort, accuracy, and the negative emotions, generated by RAs, on desktop computers and on handheld devices.

1) The results of our Natural GOMS Language analyses (Kieras 1997) support the different levels of effort necessitated when using the three RAs. The detailed results are available upon request.

2) The results of our Natural GOMS Language analyses show that individuals need 30% longer execution time when using the RAs on handheld devices than when using the same RAs on desktop computers.
Influences of Effort, Accuracy, and Negative Emotions on Consumers’ Intentions to Adopt RAs

We compare the three RAs in order to investigate how effort, accuracy, and the negative emotions effected by the RAs influence decision-makers’ intentions to adopt RAs for their future shopping (hereafter, intention to adopt RAs). A pair of RAs is compared, yielding three studies. A triple comparison in one study is avoided, because learning effect and fatigue can hinder satisfactory detection of the effects of the three factors.

It is important to note that the negative emotions influence the consumer’s intentions to adopt RAs only in emotionally compelling decision situations where s/he purchases products with attributes that have high emotional potentials. The consumer feels the negative emotions and attempts to avoid the emotions only when trading off emotion-laden attributes (Drolet and Luce forthcoming). The emotion-laden attributes are related to moral obligations, social norms, and well-being of others they care (Tetlock, Kristel, Elson, and Green 2000). Accordingly, three studies below focus on emotion-laden decision situations.

Study 1 compares RA-EBA and RA-AC on desktops and handheld devices, in terms of the negative emotions and accuracy generated by the two RAs. RA-EBA (vs. RA-AC) generates low (vs. high) emotions, low (vs. high) accuracy, and low (the same) effort. For emotion-laden decision tasks, consumers attempt to avoid the negative emotions while trading off accuracy, and, as a result, choose EBA over AC (Luce et al. 2001).

H1.1 Decision-makers using desktop computers will exhibit higher intentions to adopt RA-EBA than RA-AC.

Decision-makers using handheld devices do not perceive the negative emotions, because the constraints of handheld devices increase cognitive effort, hence distracting their attention away from the tradeoffs being made. When the effort-accuracy goals conflict with each other, decision-makers trade off accuracy in order to reduce effort; they choose AC over EBA only when AC requires effort equivalent to (or lower than) EBA (Todd and Benbasat 1999). Since RA-AC and RA-EBA involves the same level of effort, they will choose RA-AC over RA-EBA.

H1.2 Decision-makers using handheld devices will exhibit higher intentions to adopt RA-AC than RA-EBA.

Study 2 compares RA-EBA and RA-need on both devices, in terms of effort and accuracy related to the two RAs. Neither of the RAs generates the negative emotions, while RA-EBA requires less effort and RA-need yields more accurate decisions. The consumer experiencing the negative emotions embarks upon effortful decision processes, which result in the choice of more complex decision-strategies (Luce et al. 2001). Accordingly, the greater effort associated with RA-need does not impede the decision-maker from choosing it; rather, RA-need appears desirable to the individual who seeks more complete decision-strategies. Therefore, we expect:

H2.1 Decision-makers using desktop computers will exhibit higher intentions to adopt RA-need than RA-EBA.

The opposite tendency is expected in the situations where handheld devices are used, because the consumer who does not feel the negative emotions chooses the strategy that saves effort over the one that yields more accurate decisions (Todd and Benbasat 1999).

H2.2 Decision-makers using handheld devices will exhibit higher intentions to adopt RA-need than RA-EBA.

Study 3 compares RA-AC and RA-need on both devices, in terms of the negative emotions and effort. As both RAs apply AC, they produce highly accurate results, while RA-AC generates the negative emotions and RA-need requires more effort. In emotion-laden decision contexts, decision-makers’ tendencies to avoid the negative emotions and to embark upon effortful processes outweigh their tendencies to reduce effort (Luce et al. 2001).

H3.1 Decision-makers using desktop computers will exhibit higher intentions to adopt RA-need than RA-AC.
The negative emotions do not arise among consumers using handheld devices. Hence the goal of reducing effort overrules the goal of decreasing the negative emotions.

**H3.2 Decision-makers using handheld devices will exhibit higher intentions to adopt RA-AC than RA-need.**

**RESEARCH METHOD**

**Experimental Design**

Each of the three studies employs a 2 x 2 factorial design with a within-subject factor and a between-subject factor. The within-subject factor, RA type, has two levels: RA-EBA vs. RA-AC; RA-EBA vs. RA-need; RA-AC vs. RA-need. The order that two RAs are presented to participants will be counterbalanced. The between-subject factor, computing devices, has two levels: a desktop and a handheld device. The desktop condition is created on a PC; the handheld condition is operationalized as a Personal Digital Assistant (PDA).

**Experimental Task**

Participants will be asked to choose one used car out of 20 while using RAs. Used cars have attributes with emotional potentials since the attributes (e.g., safety features, crash-test results, and reliability of parts) are closely related to the safety of passengers. The result of our pre-test, using Drolet and Luce’s (forthcoming) attribute emotionality measure, shows that the attributes of used cars have emotional potentials (mean (used cars) = 5.8/7.0). This result ensures that used cars are relevant for emotionally-compelling decision situations.

**Dependent Variable and Manipulation Check**

The dependent variable, intention to adopt RAs, is conceptualized with Wang and Benbasat’s (2004) intentions to adopt RAs as decision aids. Manipulation checks will be conducted to ensure (1) whether three RAs actually lead to the expected levels of effort, accuracy, and the negative emotions, and (2) whether participants can perceive the difference in the three factors across RAs. We will measure both actual and perceived levels of effort and accuracy, because individuals frequently cannot assess effort and accuracy correctly (Agarwal and Karahanna 2000; Payne et al. 1993).

We will ask participants to comparatively evaluate the two RAs in an attempt to provide the common reference frame for the RA evaluations (Lim and Benbasat 2000). Without the common reference frame, participants apply different reference frames, which are developed from diverse individual backgrounds and experiences. To prevent different reference points from affecting the evaluations of RAs, we use the first RA to allow participants to form the common frame of reference; then, ask them to evaluate the second RA as compared to the first RA.

**CONCLUSIONS**

This study has important contributions and implications to both theory and practice. First, it extends RA literature into the area of emotions. In particular, the emotions in this study are not ambient moods, affect, but rather they are emotions associated with the nature of decision-tasks (i.e., conflicts between attributes and consumers’ goal-attainment). This study will reveal that the negative emotions arising from the core of decision-tasks can be alleviated using the needs-specification method, which, in turn, leads consumers to the normative decision-strategy.

Second, it investigates consumers’ purchase decisions with handheld devices. Specifically, we focus on the additional effort attendant to less friendly input-output methods used on handheld devices. The anticipated results suggest that it is imperative to design interfaces for handheld devices to be simple, intuitive, and goal-oriented, rather than rich, entertaining, and aesthetically appealing. Whereas, the additional effort may be useful to distract consumers away from the unpleasant emotions associated with particular aspects of purchase decisions (such as the social consequences of a purchase). This is particularly applicable in physical stores, because increasing numbers of stores are installing handheld devices for consumers who want instant access to product information without waiting for sales representatives, and consumers’ purchase decisions frequently change at the point of purchase even for mature, high-involvement products (Quelch and Cannon-Bonventre 1983).

**REFERENCES**


