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# An E-retailer's Dilemma: The Dual Influence of Information Presentation Format on Antecedents of Consumer Website Usage

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## ABSTRACT

This study addresses the question of which information presentation format e-retailers should choose to encourage consumers to use their websites. The study proposes a model built on three conceptual foundations: the technology acceptance model (TAM), the theory of cognitive fit, and the trade-off effort-accuracy model. The model posits that consumers' perceived cognitive effort mediates the relationship between cognitive fit and consumer perceived the perceived usefulness of the website interface for selecting the best product alternative. An online experiment was conducted with 599 e-shoppers. The results suggest that e-retailers encounter a dilemma when selecting the information presentation format for their website interface. Indeed, while cognitive fit is positively related to perceived ease of use of the website, it is negatively related to perceived effort. In turn, perceived effort is positively related to perceived usefulness conceptualized as perceived decision accuracy.

## Keywords

Online shopping; website use; cognitive fit; technology acceptance; consumer decision; trade-off effort-accuracy

## INTRODUCTION

E-retailers face the critical challenge of creating a shopping experience that will lead customers to prefer visiting their website rather than those of their online competitors or the "brick and mortar" competitors. Previous research suggests that product information presentation format can facilitate consumer decision making during online shopping (e.g. 2000; Hong, Thong and Tam, 2004; Widing and Talarzyk, 1993). As such, an appropriate information presentation format could contribute to consumer usage of a website. Yet, the question remains of which format e-retailers should choose to encourage the consumers to use their websites.

Addressing this question, this study proposes a model of the antecedents of retailing website usage that builds upon three foundations. First, because consumer website usage is voluntary, the model builds upon the technology acceptance model (TAM), which is recognized for the predictive power of perceived usefulness and perceived ease of use (Davis et al. 1989). Second, because the key question pertains to the relationship between interface design and perceived ease of use and perceived usefulness, and because product selection is a decision making task, the model is anchored in the cognitive fit theory, which posits that the effectiveness of an information presentation format depends on its congruence with the decision task (Vessey, 1991). Third, because in an online shopping context, decision accuracy depends subjective criteria unique to a given consumer rather than on objective criteria (Kamis, Koufaris and Stern, 2008), this context calls for identification of the mechanism by which cognitive fit translates into perceived usefulness. To do this, the study builds upon the trade-off effort-accuracy model (Payne, Bettman and Johnson, 1993).

The proposed model, which was tested in an online experiment with 599 consumers, suggests that that consumers' perceived cognitive effort mediates the relationship between cognitive fit and consumer perceived usefulness of the decision aid. The model hypothesizes that the presence of a cognitive fit between a product selection task and the information presentation format is positively related to perceived ease of use of the website and negatively related to perceived effort in making the

decision; in turn, perceived effort is positively related to perceived usefulness. This implies that e-retailers face a dilemma when selecting an information presentation format for their websites: either promoting an effortless decision process at the expense of a confident selection or offering a decision making context that leads consumers to feel confident with their choice, while perceiving the website relatively less easy to use.

## **THEORETICAL BACKGROUND**

### **Technology Acceptance Model**

The technology adoption model (TAM), which is the most often used model to predict voluntary technological adoption, is applicable to a broad range of technologies and user populations while remaining parsimonious and being theoretically justified (Davis, Bagozzi and Warshaw, 1989). TAM is an application of the theory of reasoned action (Ajzen and Fishbein, 1980) where beliefs about an information system's perceived ease of use and perceived usefulness influence the attitude towards the system, which leads to intentions and results in behavior. A number of studies, however, have ignored intention to use and studied the direct effect of perceived ease of use and perceived usefulness on usage (e.g. Gefen and Straub, 1997; Teo, Lim and Lai, 1999).

Perceived ease of use (PEOU) refers to the degree to which a person believes that using a particular system will be free of effort, and PU (PU) refers to the degree to which a person believes that using a system will increase their job performance (Davis, 1989). Developed under the assumption of voluntary behaviors, TAM has been used in multiple contexts to explain technology usage, including Web usage (Lederer, Maupin, Sena and Zhuang, 2000), messaging technologies (Adams, Nelson and Todd, 1992) and automated delivery systems (Haynes and Thies, 1991).

Several online shopping studies have used TAM as a conceptual foundation, and some have aimed to expand TAM's explanatory power. For instance, Pavlou (2003) used TAM in conjunction with trust and perceived risk to explain intention to transact online and, ultimately, actual online transaction; Gefen, Karahanna and Straub (2003) used it along with trust to explain consumer intended decision to return to an e-vendor; (Kamis, et al., 2008) proposed a model where TAM and cognitive fit of the information presentation format, task complexity, perceived enjoyment and perceived control were hypothesized to explain intention to purchase goods online and intention to return to an online store.

### **Cognitive Fit Theory**

Cognitive fit theory is based on the assumption that humans, being limited information processors perform better in solving problems when the complexity of the task environment is reduced (Vessey, 1991). Originally formulated to address inconsistent results from studying the impact of graphical versus tabular information presentation formats on decision making performance, the theory posits that the type of decision making task has to be taken into account in examining this relationship. The theory is based on the assumption that different information presentation formats will emphasize different types of information (Vessey and Galletta, 1991).

The theory posits that decision makers build a mental representation of the problem they have to solve. This mental representation consists in the particular decision task and the information available to make the decision. A cognitive fit exists if the information presentation format emphasizes the problem solving elements that match those required in the processes used to solve the problem (Vessey, 1991). Conversely, there is a non-fit when there is a mismatch between the presentation format and the task. In that case, similar processes cannot be used both to act on the problem representation and to solve the problem. Consequently the decision maker will have to transform the data to make them suitable for making the decision (Vessey and Galletta, 1991). This additional effort in analytical processing required to translate the information leads to significant cognitive strain and will result in a worse objective performance than if there was fit (Vessey, 1991).

The theory has been applied in various contexts, including geographical information systems (Dennis and Carte, 1998; Smelcer and Carmel, 1997) and workplace technological tools (Dishaw and Strong, 1999; Goodhue, 1995; Goodhue and Thompson, 1995; Zigurs and Buckland, 1998). Cognitive fit theory has been used as a conceptual foundation in studies on online shopping. For instance, Hong, Thong and Tam (2004) found that when consumers are presented with product information in a format that fits their shopping task, consumers can search the website more efficiently and better recall the product information. In another study, Jiang and Benbasat (2007) studied the impact of the fit between task complexity and information presentation format on consumers' product understanding, measured in terms of consumer actual product knowledge and their perception of website diagnosticity. Recently, Kamis et al. (2008) examined the effect of cognitive fit on the perceived usefulness of a product customization interface.

### Trade-off Effort-accuracy Model

Outlined by Payne, Bettman and Johnson (1993), the trade-off effort-accuracy model suggests that a decision maker is a “limited-capacity information processor to the demands of complex task environments” and “that the two primary considerations underlying contingent decision behaviours are the desire to achieve a good decision and the desire to minimize the cognitive effort needed to reach this decision” (Payne, et al., 1993, p.9). In other words, the combined objective of decision makers is to maximize the decision accuracy and minimize the effort within the limits of their cognitive capacities. It also means that one can get better accuracy by applying more effort to the decision making task (Song, Jones and Gudigantala, 2005). This conceptualization implies that cognitive effort, identified by Pereira (2000) as the psychological cost of obtaining and processing the relevant information in order to make a decision, is positively related to perceived quality of the decision.

The theory has been used in various contexts to explain information processing activities and outcomes, such as shopping decision systems (Chu and Spires, 2000; Häubl and Trifts, 2000; Todd and Benbasat, 1999) and complex task decision systems (Lilien, Rangaswamy, Van Bruggen and Starke, 2004; Williams, Dennis, Stam and Aronson, 2007). Few studies, however, have examined the role of the trade-off between effort and accuracy in an online shopping context. One study, by Kuo, Chu, Hsu and Hsieh (2004) addressed the question of whether consumers indeed trade-off between effort and accuracy in websearching and examined the influence of self-efficacy on this trade-off.

### RESEARCH MODEL

The research model builds on TAM, the cognitive fit theory and the trade-off effort-accuracy model to generate hypotheses on the relationships between cognitive fit and the antecedents of website usage in an e-shopping context (see Figure 1). More precisely, the model suggests that cognitive fit and perceived cognitive effort are antecedents of PEOU and PU. In theorizing on the impact of system design characteristics, i.e. information presentation format, the model responds to a call for studies that contribute to understanding how to influence PEOU and PU through system design (Benbasat and Barki, 2007).

Cognitive fit theory was proposed in a context where there exist objective measures of decision quality. In an online shopping context, however, no such objective measure exists. Indeed, subjective measures of decision quality have to be used (Kamis, et al., 2008). The model proposed here uses PU of an e-shopping website as the subjective measure of decision quality. The conceptualization is akin to perceived decision making performance or perceived accuracy of the decision described by Davis (1989). More precisely, in an e-shopping context, an information presentation format will be perceived as useful when the consumer is satisfied with his/her decision and feels that they made the best decision they could. As in TAM, PEOU refers to the degree to which the consumer feels that using the website for product selection was free of effort. Perceived cognitive effort refers to “the concentration and thought expended to select an alternative” (Cooper-Martin 1996), and depends on the number of elementary information processes, such as reading, memorizing, comparing, multiplying or adding, that are performed to complete a task. Since the cost-benefit research suggests that decision-making effort is positively related to decision making accuracy, this study hypothesizes that perceived cognitive effort mediates the relationship between cognitive fit and perceived accuracy.

Inherent to the definition of cognitive fit is the notion that when fit is present, the decision process requires less effort than if there is non-fit. It could therefore be expected that a website displaying information in a format emphasizing problem solving elements that match the processes the consumer uses to select a product will require less cognitive effort and also will appear easier to use. The relationship between cognitive fit and PEOU was tested by Mathieson and Keil (1998) who observed that the fit between an information system interface and a database query task is related to PEOU of the system. Also, although their design did not explicitly test non fit, Klopping et al.(2004) found that the fit between general Internet product information and an online shopping task was related to PEOU. Finally, Dishaw et al. (1999) in the context of software projects, observed a significant relationship between task-technology fit and PEOU.

*H1: PEOU of a retailing website is higher when the information presentation format fits the decision task than when it does not fit the task.*

The relationship between fit and cognitive effort was tested in product a selection context by Coupey (1994) who found that information presentation formats organized in a sub-optimal manner required significantly more mental rearranging operations than better organized ones. This relation was also hypothesized, yet unsupported in an e-commerce context by Hong et al. (2004).

*H2: Decision making among a set of product alternatives requires less cognitive effort if the retailing website presents the information in a format that fits the nature of the task than when the format does not fit the nature of the task.*

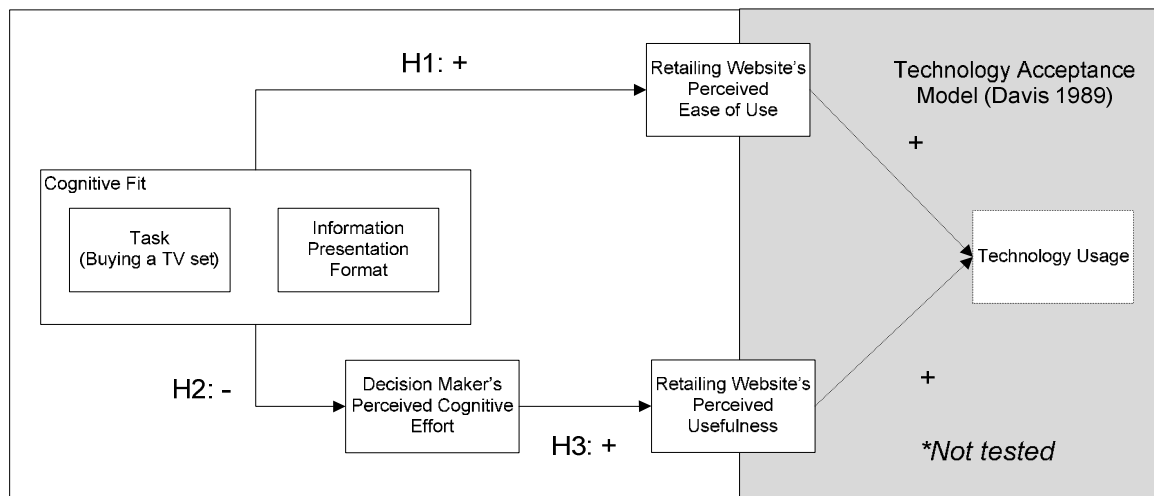


Figure 1. The Research Model

The trade-off effort-accuracy hypothesis of positive relationship between effort and accuracy (Payne et al. (1993) has been validated extensively in cost-benefice research (e.g. Swink, 1995). While the arbitrage made by the decision maker between those two remains a matter of discussion (Chu and Spire, 2000; Todd and Benbasat, 1999), it is nevertheless plausible to believe that according to this stream of research a decision problem in which more cognitive effort is voluntarily and actively invested will result in a more accurate or confident solution. Hence, the following hypothesis:

*H3: The degree of cognitive effort invested in decision making among a set of product alternatives offered on a website is positively related to the degree of confidence in having selected the best available alternative.*

## RESEARCH METHODOLOGY

An online shopping interface was created to test the model. As familiar settings increase ecological validity, respondents accessed the simulated e-commerce interface from their own computers to recreate an actual online shopping experience. The information presentation format was manipulated using two widely used e-commerce presentation formats: a comparison matrix and individual web pages. The model was tested using four levels of task difficulty.

### Sample and Experimental Procedure

An online experiment was conducted with 599 users acquainted with online shopping, who were recruited with a snowball sampling procedure. Respondents qualified for entry in a money prize draw. Chi-square tests showed no significant differences between experimental groups in terms of participants' gender, age group, income, Internet use, and type of Internet connection.

A  $2 \times 4$  experimental design was adopted. The two between-subjects factors were *cognitive fit* and *task complexity*. Each subject was randomly assigned to one of eight conditions. For each condition, a Latin square design was used to balance the order of the alternatives presented. After completing a training task – selecting a computer mouse – subjects had to select a television set among several alternatives. The decision of using television sets was based on the fact that most potential subjects were familiar with the product and could evaluate the quality of the product based on its characteristics before the actual usage (Alba, Lynch, Weitz, Janiszewski, Lutz, Sawyer and Wood, 1997; Ordonez, 1998). Once the television set was selected, participants completed an online questionnaire that measured PEOU, PU/decision accuracy and perceived cognitive effort.

### Measurement

Cognitive fit was manipulated using two widely used types of display for e-commerce retailing: a matrix and a single page display. Cognitive fit was associated with matrix display and non-fit was associated with single page display. The matrix presents all the information on the same page of alternatives (rows)  $\times$  attributes (columns) (Häubl and Trifts, 2000). In the single page display, all the alternatives are listed by an identification number on one central index page connected by hyperlinks to separate pages, each dedicated to a single alternative. To view a different alternative, the subjects clicked on a

“Return to list” button to return to the index page. For both information presentation formats, the alternatives’ presentation order was selected using a balanced Latin square design, thus controlling for order effect. The main difference between the presentation formats is that a single page display requires that decision-makers rely more on their short term memory (Coupey, 1994). Alternatively, a comparison matrix facilitates the comparison of alternatives (Bettman and Kakkar, 1977).

When selecting among several alternatives, decision makers must trim the data down to what they are capable of processing, hence the increase in complexity associated with the quantity of data to process (Payne (1976). As Table 1 shows, there were four levels of task complexity. Each level had four attributes: price, country of design, presence or absence of surround sound, and type of warranty. All the alternatives were identical in terms of screen size. Brand names were not presented to diminish selection bias associated with prior experience and brand image (Widing and Talarzyk, 1993).

<b>Selection Process</b>	<b>Very Low Complexity</b>	<b>Low Complexity</b>	<b>High Complexity</b>	<b>Very High Complexity</b>
Number of alternatives	2	2	4	8
Differentiating attributes*	4	4	4	4
• Price	2 values ( <i>\$100 difference</i> )	2 values ( <i>\$31 difference</i> )	4 values	8 values
• Country of design	2 values	2 values	4 values	8 values
• Surround sound	Yes or No	Yes or No	Yes or No	Yes or No
• Warranty	Full or limited	Full or limited	Full or limited	Full or limited
Number of elements of information to evaluate	8	8	16	32

**Table 1. Task Complexity Manipulations**

PEOU was measured by adapting Davis’s (1989) measure to the e-shopping context. The measure of perceived cognitive effort was adapted from Cooper-Martin (1996). The technology PU/decision accuracy was measured by decision makers confidence in selecting the best available alternative using an adapted form of a satisfaction questionnaire by Oliver and Swan (1992). A two steps exploratory factor analysis was performed using principal component analysis and varimax rotation. First, a rotation was performed on each individual scale to confirm their uni-dimensionality. The items with the best behavior and highest load on the factors were retained; overall each scale demonstrated satisfactory reliability ( $\alpha = 0.833$  for PEOU;  $\alpha = 0.852$  for perceived effort measure;  $\alpha = 0.864$  for PU/decision accuracy). A rotation was performed on all scales at once to confirm that each scale’s set of items loaded on a different dimension than the other scales’ sets. The results were deemed satisfactory.

**RESULTS**

The impact of cognitive fit on PEOU (H1) and on decision maker perceived cognitive effort (H2) was tested using ANOVA (see Table 2 for details). Results revealed that subjects exposed to a shopping decision task where the information was presented using a comparison matrix (i.e. cognitive fit) perceived the retailing website easier to use than subjects using single page format (non-fit) when the task complexity was Low ( $F_{1,168} = 9.30, p \leq .003$ ), High ( $F_{1,126} = 12.86, p \leq .001$ ) and Very High ( $F_{1,132} = 57.34, p \leq .001$ ). Nevertheless, the null hypothesis ( $H_0: \mu \text{ Fit} = \mu \text{ Non-Fit}$ ) could not be rejected for the Very Low complexity condition ( $F_{1,165} = 2.68, p \leq .103$ ). Those results provide support for H1. The results also showed that subjects using a comparison matrix (i.e. cognitive fit) perceived that product selection less cognitive effort than subjects using single page format (non-fit) when the task complexity was Low ( $F_{1,168} = 9.38, p \leq .003$ ), High ( $F_{1,126} = 18.49, p \leq .001$ ) and Very High ( $F_{1,132} = 23.49, p \leq .001$ ). Again, the null hypothesis could not be rejected for the Very Low complexity condition ( $F_{1,165} = 0.35, p \leq .557$ ). Overall, those results provide also support for H2.

Complexity	Fit Mean (S.D.) n	Non-Fit Mean (S.D.) n	F (df)	p-value	Direction
<i>Perceived Ease of Use</i>					
Very Low	28.81 (3.93) 85	27.51 (6.12) 82	2.68 (1)	≤ .103	H <sub>0</sub> :F = NF
Low	29.53 (3.70) 86	27.52 (4.83) 84	9.30 (1)	≤ .003	F > NF
High	29.75 (4.36) 65	26.48 (5.89) 63	12.86 (1)	≤ .001	F > NF
Very High	30.11 (3.81) 65	23.32 (6.21) 69	57.34 (1)	≤ .001	F > NF
<i>Perceived Cognitive Effort</i>					
Very Low	16.82 (6.59) 85	17.41 (6.40) 82	0.35 (1)	≤ .557	H <sub>0</sub> :F = NF
Low	15.10 (5.19) 86	17.90 (6.66) 84	9.38 (1)	≤ .003	F < NF
High	14.82 (6.27) 65	19.79 (6.82) 63	18.49 (1)	≤ .001	F < NF
Very High	16.31 (6.56) 65	22.32 (7.71) 69	23.49 (1)	≤ .001	F < NF

**Table 2. ANOVA for Perceived Ease of Use and Perceived Cognitive Effort as a function of Cognitive Fit**

The role of perceived cognitive effort in explaining PU was tested with regression analysis. The results presented in Table 3 support the hypothesis at all levels of complexity: Very Low ( $\beta = .216, t_{165} = 3.58, p \leq .001$ ), Low ( $\beta = .173, t_{168} = 2.52, p \leq .013$ ), High ( $\beta = .178, t_{126} = 2.65, p \leq .009$ ), Very High ( $\beta = .239, t_{132} = 4.13, p \leq .001$ ).

<b>Dependant Variable: <i>Perceived Usefulness/Decision Accuracy</i></b>				
Complexity (n)	$\beta$ (S.E.)	t (df)	p-value	R <sup>2</sup>
<i>Decision Maker Perceived Cognitive Effort</i>				
Very Low (167)	.216 (.06)	3.58 (165)	≤ .001	.072
Low (170)	.173 (.07)	2.52 (168)	≤ .013	.036
High (128)	.178 (.07)	2.65 (126)	≤ .009	.053
Very High (134)	.239 (.06)	4.13 (134)	≤ .001	.115

**Table 3. Regression Analyses for the Effect of Perceived Cognitive Effort on Perceived Accuracy/Usefulness**

**DISCUSSION AND CONCLUSION**

The objective of this study was to provide guidance for e-retailers in choosing between product information presentation formats. Contrary to the conventional wisdom saying that facilitating the decision process is the main objective of a shopping interface, this study suggests that promoting easier decisions-making is not always the most effective approach for e-retailers since consumers do not get as much mentally invested into the decision tasks. This study provides initial evidence that e-retailers are faced with a dilemma when designing their website interface. On the one hand, the information can be presented to shoppers in a manner that will essentially facilitate the selection of one alternative over the others but will not put emphasis on building shoppers beliefs about having selected the best available alternative. On the other hand, the information can be presented in a way that will not be as easy to process, but because more effort is invested will result in a more confident decision. The dilemma here is that when selecting an information presentation format, e-retailers have to decide between easier and more confident decision processes to attract consumers to their websites.

Overall, the hypothesized relations of this study are supported and although the model explained variance remains modest, it appears to be increasing with the complexity of the task. One could however argue that the relationship between cognitive fit and PU and perceived cognitive effort were unsupported for very low level of task complexity. A probable explanation for these inconsistent results might be that the problem was then too simple for differences in perceptions to be reported by the subjects.

By offering an initial attempt to explain the relationship between fit and technology PU when applied to subjective choice evaluation context, this study answers a concern about inadequate theoretical explanations raised in earlier research (e.g. Dishaw and Strong, 1999). This study findings suggesting a negative correlation between cognitive fit and the decision system usefulness could also be used to explain earlier inconclusive results (e.g. Häubl and Trifts, 2000) even though this finding might contradicts earlier observations. One example being Bharati and Chaudhury (2004) who include ease of use as a component of information system quality which concept was found positively related to decision satisfaction. Clearly, further research on the subject is required.

Like any experimental research, this study has limitations that limit the generalisability of its results. First, the artificial decision context created for this experiment might not have triggered the level of motivation that consumers would feel when purchasing on their own. Also, the results of this research are based on the comparison of two information presentation formats. The value of the findings would be improved if other types of presentation formats were tested.

While the study provides insights on the impact of the information presentation format on consumers' perceptions of a retailing website, further research is required to obtain a deeper understanding of these effects. Particularly, an examination of potential moderators would be valuable. Further studies could examine the role of involvement caused by the challenge associated with the decision problem. In the product involvement field, higher involvement has been related to greater comprehension processes (i.e. cognitive effort) (Celsi and Olson, 1988).

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