J. of the Acad. Mark. Sci. (2010) 38:471–489
DOI 10.1007/s11747-009-0182-9

ORIGINAL EMPIRICAL RESEARCH

The effects of attribute concreteness and prominence on selective processing, choice, and search experience

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Received: 26 April 2008 / Accepted: 29 October 2009 / Published online: 9 December 2009

Abstract The "concreteness" principle and the "prominence" hypothesis are used as a theoretical basis for hypothesizing the effects of two important information display factors, attribute concreteness and attribute prominence, on consumer selective information processing. The results of two studies indicate that attribute concreteness together with attribute correlation leads to the selective processing of *attributes*, while attribute prominence and attribute correlation results in the selective processing of *alternatives*. Moreover, selective processing mediates the impact of these display factors on choice, while reducing the amount of information search. Further, the amount of information search and experienced cognitive effort mediate the effects of selective processing on consumer affect during the search process. The research is important from a theoretical standpoint, because it fills an important knowledge gap in the literature on how information environment influences affect selective processing and choice. It is important from a marketing strategy perspective because it examines how a merchant can influence consumer choice by merely changing the manner in which attribute information is displayed or alternatives are initially organized (i.e., pre-sorted).

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Keywords Selective information processing · Information search · Affect · Perceptual processing · Online consumer behavior · Attribute correlation · Alternative organization

Imagine that you are navigating through an online travel website as you attempt to book a resort vacation. The information on a particular resort (e.g., nightly rate, room amenities, resort attractions) can be displayed as numeric information (e.g., $429 per night) or as a verbal description (e.g., luxurious down comforters with cotton-rich linens). Some resort attributes may be shown with vivid pictures (e.g., a photo of a dive pool with an artificial reef), while others are mentioned in a more muted form (e.g., a small font listing of the $49 per day resort fee). How would these information display factors influence the attributes and alternatives you select for processing? And could your selections have an effect on the resort you choose for your vacation? The research reported here seeks to answer these questions.

The selection of an information processing strategy is contingent on the characteristics of the information environment (Bettman et al. 1991; Payne et al. 1993). Information environment characteristics include perceptual influences such as visually salient information that involuntarily captures consumer attention and task complexity factors such as problem size and attribute correlation (Bettman et al. 1998).

Two important information display influences are attribute concreteness and attribute prominence. Attribute *concreteness* refers to whether attribute information is presented in an easy to process form (e.g., a single word such as "excellent" or a rating such as "$$$$") or in a form that requires further processing (e.g., a verbal description such as "world class fusion cuisine from Chef Nobu"). Attribute *prominence* refers to whether an attribute receives more attention because

it is visually salient (e.g., "★★★★"). Attribute concreteness contributes to task complexity, while attribute prominence is a perceptual influence.

The marketer's ability to design the shopping environment can be used to influence consumer information processing and choice (Alba et al. 1997; Häubl and Trifts 2000; Diehl et al. 2003). For example, a retailer can decide how to present attribute information (relates to attribute concreteness) and which attributes to use in order to highlight particular alternatives (relates to attribute prominence) or how to initially organize (i.e., pre-sort) alternatives (also relates to attribute prominence). Based on the manner in which information is displayed, a consumer then has to decide what attribute information and alternatives to select for further processing (Ariely 2000). Information display influences, such as attribute concreteness and prominence, may be particularly important in e-commerce, because task complexity factors such as problem size (e.g., the number of attributes and alternatives) can be controlled by consumers through the use of shopbots and recommendation agents (Häubl and Murray 2006; West et al. 1999). It is much more difficult for consumers to avoid the potential influence of easy to process or visually salient information because of the involuntary nature of these effects in online settings.

While the theoretical importance of attribute concreteness and attribute prominence has been noted in the decision-making literature through the "concreteness" principle (e.g., Slovic 1972) and the "prominence" hypothesis (e.g., Tversky et al. 1988), there has been relatively little research on how these factors may interact with task complexity factors to influence information processing. For example, could the presentation of an attribute in concrete form or in a prominent manner alter the importance that a consumer might otherwise have assigned to that attribute? And if so, could such a change also affect what alternative is chosen?

We conduct two studies to examine how attribute concreteness and prominence affect the selective processing of attributes and alternatives, and how such selective processing, in turn, influences choice and the subjective search experience of the consumer. The research is important from a theoretical standpoint because it fills an important knowledge gap in the literature on how information environment influences affect selective processing and choice. It is important from a marketing strategy perspective because it examines how a merchant can influence consumer choice by merely changing the manner in which attribute information is displayed or alternatives are initially organized (i.e., pre-sorted). The research is also important from a public policy perspective because it can be used to develop counter-strategies that would enable consumers to be less susceptible to information display influences.

Conceptual framework

Information processing strategies may be classified using four characteristics, namely, the amount of information processed, the pattern of processing (attribute-based versus alternative-based), the type of processing (compensatory versus non-compensatory) and the selectivity in processing (Bettman et al. 1998). Due to limited cognitive capacity, consumers often select certain attributes and alternatives for processing, while disregarding others. Thus, *selective* processing refers to consumers spending unequal amounts of time or effort acquiring information on different attributes or alternatives (Bettman et al. 1991). In contrast, when the same amount of information is examined for each attribute and alternative, consumers are engaged in *consistent* processing.

Consumers process information selectively as the task becomes more complex or when they encounter perceptually salient information (Janiszewski 1998; Lurie 2004). They do so by focusing on attributes that are easier to process or are visually prominent. The greater the selectivity in information processing, the more likely that choice will be affected by information environment influences (Bettman et al. 1998). In other words, selective processing is *not* desirable unless consumers focus on better quality alternatives and/or on the most important attributes (Diehl 2005).

Effects of attribute concreteness on selective attribute processing and choice

The "concreteness principle" predicts that consumers tend to use information only in the form in which it is displayed (Slovic 1972). Attribute information can be conveyed at different levels of concreteness (Johnson et al. 1988). For example, numerical information is considered to be more concrete, because it can be used for direct comparisons between alternatives (Huber 1980). Verbal and linguistic information is considered to be more abstract (Stone and Schkade 1991). Previous research has also found that concrete attributes are easier to process (Jarvenpaa 1989; Johnson and Fornell 1987), are better and more quickly understood (Kieras 1978; Paivio 1971), are easier to encode (Viswanathan and Childers 2001), are easier to use in comparisons (Bettman and Sujan 1987), and have a greater impact on choice (Nisbett and Ross 1980; Horsky et al. 2004). In contrast, abstract attributes are difficult to process and require more cognitive effort. Hence, selective processing of abstract attributes tends to save more effort than selective processing of concrete attributes. Meanwhile, the accuracy-effort framework proposes that consumers choose decision strategies that help them to make an accurate choice and minimize their effort (e.g., Bettman et al. 1998). Accordingly, consumers are more likely to selectively process abstract (vs.

concrete) attributes when doing so reduces cognitive effort without sacrificing decision accuracy.

Attribute correlation, which refers to the inter-correlations among the attribute values of choice alternatives, determines the extent to which the selective processing of attributes influences decision accuracy. Previous research has found that many decision heuristics (e.g., eliminating alternatives based on an attribute) become less accurate when attributes are negatively correlated (Bettman et al. 1993). Consequently, consumers are less likely to selectively process attributes when they know that attributes are negatively correlated (Bettman et al. 1993). In other words, consumers are more likely to selectively process attributes when they know that attributes are positively correlated. Combining the above arguments regarding the effects of attribute concreteness and attribute correlation on the selecting processing of attributes, we propose that consumers are more likely to selectively process attributes when there are more abstract (vs. concrete) attributes and they know that attributes are positively correlated. However, as consumers are generally less likely to selectively process attributes when they know that attributes are negatively correlated, we propose that consumers are less likely to selectively process attributes regardless of attribute concreteness when they know that attributes are negatively correlated.

While consumers may perceive that selective attribute processing does not unduly affect decision accuracy under positive attribute correlation conditions, selective attribute processing may still result in inferior choices due to the difficulties in integrating abstract and concrete attribute information to form an overall impression of an alternative. When consumers consistently process concrete attribute information, it is easier for them to integrate such information to form an overall impression, because concrete information is easier to use in comparisons (Bettman and Sujan 1987) and has greater impact on choice (Nisbett and Ross 1980; Horsky et al. 2004). For example, after examining several concrete attribute values that denote the best attribute category (e.g., "excellent"), consumers are likely to infer that the alternative is exceptional. However, when consumers selectively process abstract attributes, they have to integrate information on the abstract attributes they have examined with information on concrete attributes. Due to the different format of abstract and concrete information, and the premise of the "concreteness principle" that consumers use information only in the format that it is presented, they may find it difficult to integrate abstract information with concrete information, leading to an ambiguous impression of an alternative. Moreover, consumers tend to have less information on an alternative when they selectively process attributes. Hence, having less information on an alternative may also contribute to a vague impression of an alternative. Given that selective attribute processing influences consumers' overall impression of each alternative, we argue that selective attribute processing influences consumer choice. On the contrary, when attributes are negatively correlated, consumers tend to consistently process attributes regardless of attribute concreteness, resulting in no difference in alternative evaluation and choice.

H1. *Consumers are more likely to selectively process attributes when they know that attributes are positively correlated and there are more abstract (vs. concrete) attributes. However, consumers are less likely to selectively process attributes regardless of attribute concreteness when they know that attributes are negatively correlated.*

H2. *Selective processing of attributes mediates the effect of attribute concreteness on choice when consumers know that attributes are positively correlated, but not when consumers know that attributes are negatively correlated.*

Effects of attribute prominence on selective alternative processing and choice

The "prominence hypothesis" predicts that prominent attributes are more important in consumer choice (Tversky et al. 1988). The prominence of an attribute can often be altered by marketers (Hutchinson and Alba 1991). Previous research has shown that visually salient information displays can increase the prominence of an attribute by making it more attention-getting (Janiszewski 1998), and easier for consumers to locate (Jarvenpaa 1990). Prominent attributes are more accessible (Janiszewski 1998) and are given more importance (Shavitt and Fazio 1991).

The literature shows that using an attribute to sort alternatives can increase the prominence of that attribute (e.g., Areni et al. 1999; Häubl and Murray 2003; Russo 1977). Sorted alternatives require less effort to process (Häubl and Trifts 2000) and reduce information search (Schkade and Kleinmuntz 1994). Hence, as the prominence of the sorting attribute (i.e., the attribute by which alternatives are organized) increases, consumers are likely to use that attribute to evaluate and screen alternatives. Moreover, consumers are more likely to selectively process alternatives with better values on the sorting attribute, provided such a strategy does not sacrifice decision accuracy. However, as discussed earlier, when consumers know that attributes are negatively correlated, they are less likely to selectively process information as doing so tends to reduce decision accuracy. Negative attribute correlation also reduces the differences among alternatives in terms of overall attractiveness (Huber and Klein 1991), which makes the screening process more difficult. Thus, relying on one

attribute to evaluate and screen alternatives may result in the elimination of alternatives which are otherwise equally attractive. Further, when attributes are negatively correlated, the effect of sorting on purchase likelihood is less pronounced than when they are positively correlated (Areni et al. 1999). Therefore, when attribute prominence is induced by sorting, consumers are more likely to selectively process alternatives when they know that attributes are positively (vs. negatively) correlated. However, when alternatives are not sorted (i.e., are in random order), selective alternative processing is low regardless of attribute correlation because selective processing is no longer a viable effort reduction strategy.

H3. *Consumers are more likely to selectively process alternatives when an attribute's prominence is increased by sorting and they know that attributes are positively correlated. However, consumers are less likely to selectively process alternatives regardless of attribute correlation when alternatives are listed in random order.*

Attribute prominence can also be increased by a visually salient display. An attribute can be made more prominent by changing its size, color, and visual contrast with the background. Consumers often involuntarily pay more attention to visually prominent information. Hence, they are more likely to choose products with a prominent attribute (Bettman et al. 1998; Janiszewski 1998). Since involuntary attention to a prominent attribute can occur prior to cognitive deliberation, consumers are likely to search more on the visually salient attribute and use it to screen alternatives even when attributes are negatively correlated. Hence, they are more likely to selectively process alternatives with better values on the visually salient attribute. However, such an effect happens only when the prominence of the visually salient attribute is not attenuated by other factors. As mentioned earlier, sorting alternatives also makes the sorting attribute prominent, thus diminishing the prominence of the visually salient attribute and its effect on selective alternative processing.

H4. *When alternatives are listed in random order, attribute prominence created by visually salient displays influences selective alternative processing. However, when alternatives are sorted, such an effect is attenuated.*

When attributes are positively correlated, using the prominent attribute (either created by sorting or visually salient displays) to eliminate less desirable alternatives does not affect decision accuracy. Thus, the quality of consumer choices will not be affected by selective alternative processing. In contrast, when attributes are negatively correlated, selective processing of alternatives tends to result in examining more alternatives with better values on the prominent attribute. Given that consumer choice is affected by where consumers search for information and what information is processed (Moorman et al. 2004), consumers are more likely to choose alternatives with better values on the prominent attribute.

H5. *Selective processing of alternatives mediates the effect of attribute prominence on choice when consumers know that attributes are negatively correlated, but not when consumers know that attributes are positively correlated.*

Effects on subjective search experience

Consumers choose information processing strategies that can help balance effort reduction and accuracy improvement goals (e.g., Bettman et al. 1991). Whether it is a result of attribute concreteness or attribute prominence, selective information processing reduces the amount of information search, which then reduces the cognitive effort required for the task (Häubl and Trifts 2000; Lynch and Ariely 2000). After the effort reduction goal has been attained by either form of selective processing, consumers may then focus on improving accuracy by consistently processing the remaining information. Specifically, consumers who selectively process attributes may process alternatives more consistently, while consumers who selectively process alternatives may process attributes more consistently. Thus, consumers will use selective attribute processing and selective alternative processing in a compensatory manner to trade-off effort reduction with accuracy improvement. The compensatory argument is supported by a recent finding that consumers spend similar amounts of time gathering information for search and experience goods (Huang et al. 2009).

H6. *Selective attribute processing and selective alternative processing are negatively correlated, and both reduce the amount of information search.*

The preceding hypotheses attempt to predict the effect of attribute concreteness and attribute prominence on search strategies, based on the trade-off between effort reduction and accuracy improvement goals. However, the subjective search experience, as manifest by the cognitive effort experienced during the task and the affective feelings generated by the task, is also an important consideration to consumers. Besides choosing selective processing strategies to balance effort reduction and accuracy improvement goals, consumers may also choose search strategies to actively manage their subjective search experience. Selective information processing reduces the amount of information search and lowers the cognitive effort required for the task. Hence, the amount of information search mediates

the effect of selective processing on experienced cognitive effort. But, expending cognitive effort also increases negative affect (Garbarino and Edell 1997). Hence, experienced cognitive effort mediates the effect of the amount of information search on affect.

H7. *The amount of information search mediates the effect of selective processing on experienced cognitive effort.*

H8. *Experienced cognitive effort mediates the effect of the amount of information search on affect.*

When viewed collectively, the hypotheses constitute a conceptual framework (see Fig. 1) that can be used to understand how information display factors affect the selective information processing strategies used by consumers, and how these strategies, in turn, influence consumer choice and subjective search experience.

Study 1

Method

Participants and design A total of 307 undergraduate students participated in study 1. They were randomly assigned to the experimental conditions in a 2 (attribute concreteness: concrete vs. abstract) × 2 (attribute correlation: positive vs. negative) × 3 (attribute prominence: alternatives sorted by a concrete attribute vs. alternatives sorted by an abstract attribute vs. a random ordering of alternatives) between-subjects design.

Procedure Participants were informed that the purpose of the study was to research how consumers search for information online. They were presented a scenario where they were asked to imagine that they had just moved to a new city due to a job change, and they were having close friends visit for the weekend who they wanted to take out for dinner. Hence, they needed to search for information on local restaurants where they could have a great time. Participants were told that local restaurant information was available on "Cyber-Dining," an experimental website (similar to www.citysearch.com) created for this research. On the homepage of Cyber-Dining, there was a list of 30 hypothetical local restaurants serving American cuisine. Each restaurant was described using four attributes: distance, atmosphere, food, and service. When participants clicked on the name of a restaurant, a web page with hyperlinks to the four attributes appeared. They could then click on each hyperlink to examine detailed information for that attribute. Each attribute had three attribute levels. Participants were instructed to browse the website at their own pace. After they had completed the information search task, they were asked to indicate three restaurants that they were most likely to visit (in order of preference) and fill out a questionnaire regarding their search activities. While participants were searching for restaurant information on Cyber-Dining, their search behavior was recorded by the web server and stored in a log file. The clickstream data included the alternatives and attributes examined and the sequence by which different alternatives and attributes were examined.

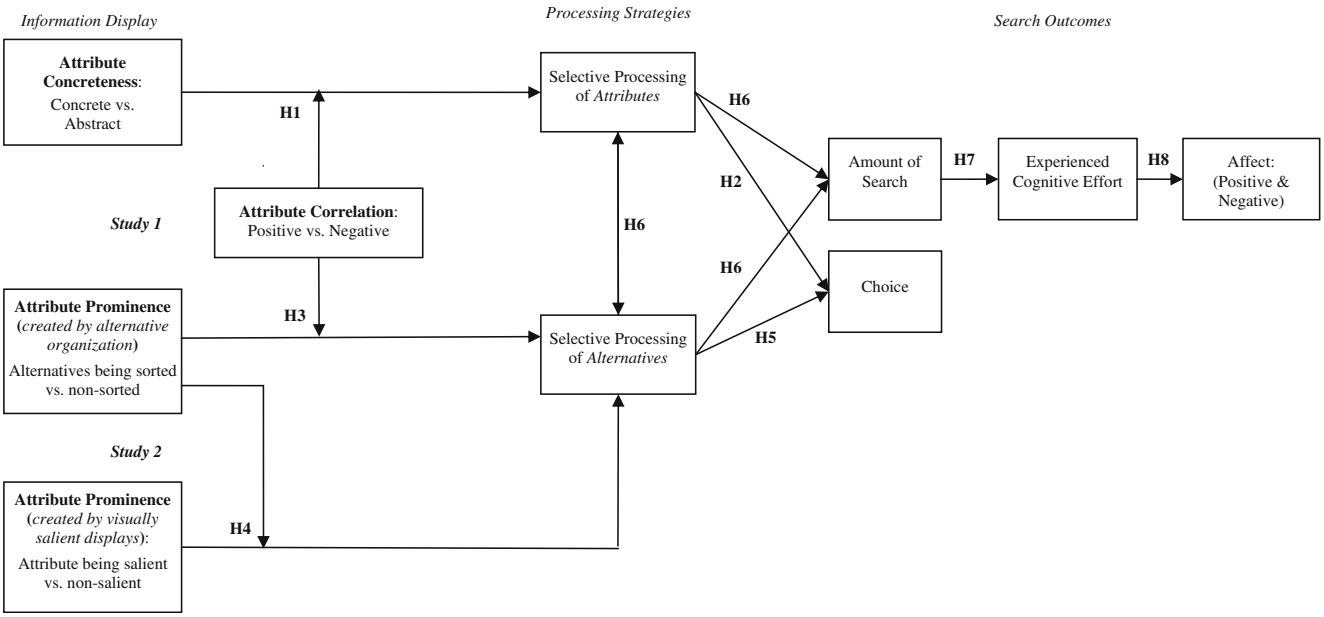


Figure 1 A conceptual model for linking information display influences with processing strategies and search outcomes.

Experimental variables

Attribute concreteness (concrete vs. abstract) The concrete versus abstract conditions were created by changing the manner in which attribute information was displayed. In the more concrete attributes conditions, three concrete attributes (distance, food and service) and one abstract attribute (atmosphere) were used to describe each restaurant. Distance was presented in driving time in minutes from home to the restaurant. The attribute values for distance were: about 5 min, about 30 min, and about 60 min. Food and service were presented using one word adjectives: excellent, average, and poor. Atmosphere was described using a verbal narrative that detailed the décor and the dining experience at the restaurant. In the more abstract attributes conditions, three abstract attributes (atmosphere, food and service) and one concrete attribute (distance) were used to describe each restaurant. Atmosphere, food, and service were presented using narrative descriptions, while distance was presented in terms of driving time in minutes.

The narrative descriptions of restaurant attributes were adapted from descriptions of actual restaurants listed on popular dining websites (e.g., www.citysearch.com). These websites usually have consumers rate restaurants on atmosphere, food and service, using a scale from 5-stars to 1-star. We chose restaurants for which there was a high consensus among consumers who had rated the restaurant as being excellent (5-stars), average (3-stars), or poor (1-star) and adapted these descriptions for the experimental website. We used a very positive tone and adjectives that are synonyms of excellent to represent "excellent," a neutral tone and words that are synonyms of average to represent "average," and a very negative tone and adjectives that are synonyms of poor to represent "poor."

A post-test using 33 undergraduate students was conducted to confirm that the verbal narratives used in the abstract attribute conditions were equivalent to the one-word adjectives used to describe the same attributes in the concrete attribute conditions (e.g., "excellent," "average" and "poor"). Participants performed a card sorting task where they were asked to sort the verbal narratives used to describe food and service in the main study into three groups based on quality. Distance and atmosphere were not included in the post-test as the same narratives for these attributes were used across all experimental conditions. Upon completion of the sorting task, participants were asked to provide brief one- or two-word labels to the three groups. Results of non-parametric χ^2 tests showed that significantly more participants assigned each verbal narrative to the correct category (42 out of the 44[1] food narratives were significant at the .05 level and 2 were at the .1 level; all of the 46 service narratives were significant at the .05 level). Participants used words such as "highest quality," "excellent" and "outstanding" to label the group containing narratives equivalent to "excellent"; words such as "acceptable," "average" and "okay" to label the group with narratives equivalent to "average"; and words such as "very bad," "poor" and "extremely low quality" to label the group with narratives equivalent to "poor". Therefore, for each alternative, the attribute levels of food and service were the same across different attribute concreteness conditions, even though the attribute was presented differently.

Attribute correlation (positive vs. negative) Attribute correlation was manipulated by varying the correlation among attribute values to make attributes either positively or negatively correlated. As mentioned earlier, there were three attribute levels for each attribute. Distance ranged from about 5 min driving time (excellent), about 30 min driving time (average), to about 60 min driving time (poor). Atmosphere, food, and service ranged from excellent, average, to poor. In the positive attribute correlation conditions, each restaurant's four attribute values were at the same level (i.e., all the attribute values were either excellent, average, or poor). However, in the negative attribute correlation conditions, each restaurant's distance and atmosphere were negatively correlated as were food and service. Participants were informed of the attribute correlation in the scenarios presented to them. For example, in the positive attribute correlation conditions, participants were told that "Most nice restaurants are very close to your home and they have a good atmosphere, tasty food, and good service," while in the negative attribute correlation conditions, they were told that "Most restaurants with good atmosphere are very far away from your home. Some restaurants have tasty food but not so good service; while others have good service but not so tasty food."

Attribute prominence (prominent distance vs. prominent atmosphere vs. no prominence) As mentioned earlier, the prominence of an attribute can be increased by using it to sort alternatives. Hence, attribute prominence was manipulated by creating three sorting conditions. In the prominent distance conditions, all the restaurants were ordered by distance and were grouped into three subsets, about 5 min driving time, about 30 min driving time, and about 60 min driving time. In the prominent atmosphere conditions, all the restaurants were ordered by atmosphere and grouped into three subsets, excellent atmosphere, average atmosphere, and poor atmosphere. In no prominence conditions, all the alternatives were listed in alphabetical order. Given that all the restaurants were hypothetical, an alphabetical ordering is equivalent to a random ordering of alternatives

[1] The 44 food and 46 service narratives used in the post-test included the narratives used in the positive and negative attribute correlation conditions.

(Diehl 2005). There were about ten restaurants in each subset.

Dependent measures

Amount of information search The amount of information search was measured by the total number of unique attributes examined during the search task (i.e., an attribute examined for a second time was not counted). There were 120 unique attributes (30 restaurants; each described by four attributes). We focused our analysis at the attribute level in order to reveal selective processing at that level. Thus, this measure was slightly different from those used in other studies where the number (or proportion) of alternatives examined was used to measure the amount of information search (e.g., Häubl and Trifts 2000; Swaminathan 2003). Although the amount of time that participants spent on the information search task was recorded, it was not suitable for use as a dependent measure because abstract attributes require much more time to process than concrete attributes.

Selective processing A consumer who selectively processes attributes may examine some attributes more often than other attributes and/or on average process fewer attributes per alternative. Thus, selective processing of *attributes* can be depicted by (1) the standard deviation of the number of alternatives examined for each attribute (SD_ATT[2]) and (2) the average number of attributes examined for each alternative (AV_ATT[3]). A consumer who selectively examines alternatives may examine more alternatives in some alternative subsets than other subsets and/or examine fewer subsets. Hence, selective processing of *alternatives* can be portrayed by (1) the standard deviation of the number of alternatives examined in each subset (SD_SET[4]) and (2) the number of subsets examined (NO_SET). In order to investigate how the experimental variables affect both the central tendency and the variances toward processing certain attributes and alternatives, we used both AV_ATT and SD_ATT to measure selective attribute processing and NO_SET and SD_SET to measure selective alternative processing. The correlation between AV_ATT and SD_ATT was −.42 ($p<.001$), while the correlation between NO_SET and SD_SET was −.88 ($p<.001$). Hence, the two indicators of selective attribute processing (SD_ATT and AV_ATT) were significantly correlated as were the two indicators of selective processing of alternatives (SD_SET and NO_SET).

Experienced cognitive effort Experienced cognitive effort was measured using three 7-point semantic differential items adapted from Pereira (2000). Participants were asked whether the search task was very easy/very difficult, very simple/very complex, and didn't require a lot of effort/required a lot of effort. Cronbach's α was 0.94.

Affect Affect (positive and negative) was measured using responses to items adapted from Garbarino and Edell (1997) and Richins (1997). Participants were asked to rate their feelings during the information search process on the following items: pleasure, happy, and enjoyed (positive affect) and frustrated, annoyed, irritated (negative affect). Cronbach's α was 0.87 and 0.94 for positive and negative affect respectively.

Choice Participants' first choice was recorded. For a particular alternative, the attribute value of atmosphere was the same across different conditions while the values of other attributes varied due to the attribute correlation manipulation. Thus, participants' first choice (denoted by C) was coded according to the alternative's attribute value on atmosphere (1 = excellent, 2 = average, and 3 = poor). The lower the value of C, the better the choice on atmosphere.

Control variables

Perceived attribute importance, accuracy goal during the search task, subjective knowledge of restaurants, online search experience, and gender were considered as possible control variables because they could influence how participants searched for information and chose alternatives. First, consumers' perceived attribute importance may determine how much a specific attribute is processed and how they make a choice. Thus, we measured attribute importance by asking participants to assign a percentage weight to each attribute so that the total equaled 100%. Second, the accuracy-effort framework proposes that the choice of an information processing strategy is influenced by a desire to increase decision accuracy and reduce effort (e.g., Bettman et al. 1991). Thus, the extent to which consumers seek to make an accurate decision also influences the use of different processing strategies. We used a 4-item 7-point Likert scale (e.g., "I tried to examine as many restaurants as possible so that I could make the best choices") to measure accuracy goal (Cronbach's α=.87). Third, we measured subjective knowledge of restaurants by using the statement "Compared with your friends, how knowledgeable are you about restaurants?" Fourth, online shopping experience was measured by using the statement

[2] SD_ATT=Standard deviation (number of attribute 1 examined, number of attribute 2 examined, ……., number of attribute 4 examined).

[3] AV_ATT = Total number of unique attributes examined / Total number of unique alternatives examined/.

[4] SD_SET = Standard deviation (number of unique alternatives examined in subset 1, number of unique alternatives examined in subset 2, number of unique alternatives examined in subset 3).

"How much experience do you have using online shopping websites?" A correlation analysis showed that there was no significant correlation between subjective knowledge of restaurants, online shopping experience and the dependent measures. Hence, only perceived attribute importance, accuracy goal, and gender were included in the hypothesis tests as control variables.

Results

A total of 261 participants finished the information search task and completed the questionnaire regarding their search activities.[5] The clickstream data in the web server log file indicated that, on average, participants examined 17.32 restaurants. However, in the questionnaire, participants reported having examined fewer restaurants ($M_{Subjective}$= 10.50, t_{260}=15.50, p<.001) than what was recorded in the web server log file.

Experimental checks

Attribute concreteness We asked participants to report their subjective estimation of the amount of time they had spent on the information search task. Results showed that those in the more concrete attributes conditions perceived that they had spent significantly less time on the search task than those in the more abstract attributes conditions ($M_{Concrete}$= 9.01, $M_{Abstract}$=10.69, F(1, 257)=4.02, p<.05). The difference was consistent with the literature that concrete attributes are easier to process and quicker to understand (e.g., Jarvenpaa 1989), and thus require less time to process. Hence, the attribute concreteness manipulation was regarded to be successful.

Attribute correlation Participants in the negative attribute correlation conditions reported that they had to make more tradeoffs among restaurant attributes than those in the positive attribute correlation conditions did ($M_{Negative}$= 5.35, $M_{Positive}$=2.94, F(1, 259)=153.56, p<.001). The difference was consistent with the literature that the more negatively attributes are correlated, the more consumers have to give up something on one attribute in order to get more of another attribute (e.g., Bettman et al. 1993, 1998). Therefore, the manipulation of attribute correlation was also considered to be successful.

[5] The study required participants to search the experimental website and then complete an online questionnaire. Eight participants finished the study but did not complete the questionnaire. Thirty eight participants examined fewer than three alternatives yet chose three restaurants, because they could view restaurant names on the homepage of the experiment website. Thus, the validity of their search data was questionable. These participants were dropped from the analyses.

Effects on selective attribute processing and choice

Hypothesis 1 posits that attribute correlation moderates the effect of attribute concreteness on selective processing of attributes. ANCOVA results (see Table 1) showed that selective attribute processing was greater when there were more abstract (vs. concrete) attributes and when participants knew that attributes were positively (vs. negatively) correlated. Further analyses confirmed that when participants knew that attributes were positively correlated, selective attribute processing was greater under more abstract (vs. concrete) attributes conditions ($SD\_ATT_{Concrete}$=4.38 vs. $SD\_ATT_{Abstract}$=6.09, F(1, 130)=7.72, p<.01; $AV\_ATT_{Concrete}$=2.43 vs. $AV\_ATT_{Abstract}$=2.04, F(1, 130)= 6.58, p<.05). However, when attributes were negatively correlated, attribute concreteness did not significantly influence selective attribute processing ($SD\_ATT_{Concrete}$= 5.43 vs. $SD\_ATT_{Abstract}$=5.38, F (1, 127)=.01, N.S.; $AV\_ATT_{Concrete}$=2.47 vs. $AV\_ATT_{Abstract}$=2.46, F (1, 127)=.00, N.S.). Further, under the more abstract attributes conditions, selective attribute processing was greater when participants knew that attributes were positively (vs. negatively) correlated ($SD\_ATT_{Positive}$=6.09 vs. $SD\_ATT_{Negative}$=5.38, F(1, 130)=13.65, p<.001; $AV\_ATT_{Positive}$=2.04 vs. $AV\_ATT_{Negative}$ = 2.46, F (1, 131)=13.14, p<.001) (see Fig. 2). These results showed that consumers are more likely to selectively process attributes only when there are more abstract attributes and they know that attributes are positively correlated. Thus, hypothesis 1 was supported.

Hypothesis 2 predicts that selective processing only mediates the effect of attribute concreteness on choice under the positive attribute correlation conditions. First, under positive attribute correlation conditions, the findings from hypothesis 1 showed that selective attribute processing was greater when there were more abstract (vs. concrete) attributes. Second, regression analysis showed that participants chose restaurants with poorer atmosphere when they more selectively processed attributes (β_{SD_ATT}=.21, p<.05; β_{AV_ATT}=−.21, p<.05). Third, ANCOVA showed that participants chose restaurants with poorer atmosphere when there were more abstract (vs. concrete) attributes ($Atmosphere_{Abstract}$=1.27 vs. $Atmosphere_{Concrete}$=1.17, F(1, 125)= 4.08, p<.05). Finally, when selective attribute processing was entered as a covariate in the previous ANCOVA, the effect of attribute concreteness on choice was no longer significant (F_{SD_ATT} (1, 124)=2.53, N.S; F_{AV_ATT} (1, 124)= 2.43, N.S). However, under the negative attribute correlation conditions, attribute concreteness did not significantly influence consumer choice (F(1, 121)=.14, N.S.). Hence, the selective processing of alternatives mediated the effect of attribute concreteness on choice only when participants knew that attributes were positively correlated, which supports hypothesis 2.

Table 1 Study 1: effects on selective processing of attributes (H1)

		SD_ATT	AV_ATT
Attribute concreteness	*Concrete:*	4.90	2.45
	Abstract:	5.70	2.25
		F(1, 245)=2.84	F(1, 245)=8.84*
Attribute correlation	*Positive:*	5.25	2.23
	Negative:	5.36	2.47
		F(1, 245)=.03	F(1, 245)=4.99*
Attribute prominence (*Created by alternative organization*)	*Random:*	6.43	2.54
	Concrete:	5.45	2.11
	Abstract:	4.15	2.41
		F(2, 245)=10.01**	F(2, 245)=3.91*
Attribute concreteness×Attribute correlation		F(1, 245)=5.61*	F(1, 245)=3.92*
Attribute concreteness×Attribute prominence		F(2, 245)=2.47	F(2, 245)=1.04
Attribute correlation×Attribute prominence		F(2, 245)=5.19**	F(2, 245)=4.29*
Attribute prominence×Attribute correlation×Attribute concreteness		F(2, 245)=.05	F(2, 245)=3.50*
Control variables:			
Gender		F(1, 245)=.79	F(1, 245)=.12
Accuracy goal		F(1, 245)=4.20*	F(1, 245)=13.85***
Attribute importance		F(1, 245)=.70	F(1, 245)=.76

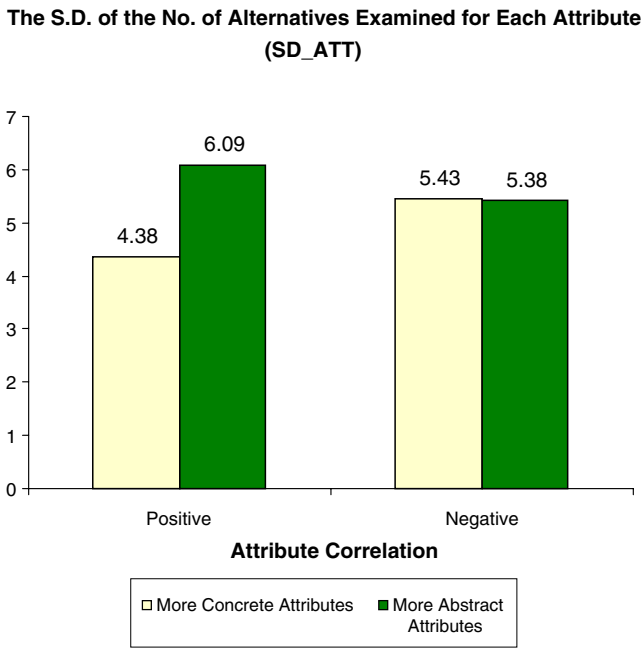
SD_ATT the standard deviation of the number of alternatives examined for each attribute, *AV_ATT* the average number of attributes examined for each alternative

*$p<.05$, **$p<.01$, ***$p<.001$

Effects on selective alternative processing and choice

Hypothesis 3 posits that attribute prominence created by sorting interacts with attribute correlation to affect selective alternative processing. ANCOVA results showed a significant interaction effect of sorting with attribute correlation on both the standard deviation of the number of alternatives examined in each subset (SD_SET) ($F(2, 245)=4.48$, $p<.05$) and on the number of subsets examined (NO_SET) ($F(2, 245)=3.44$, $p<.05$). Post hoc analysis revealed that there was no significant difference between the sorted by distance conditions and the sorted by atmosphere conditions, so these conditions were combined to create a single sorted condition. Results (see Table 2) showed significant main effects of sorting and attribute correlation (i.e., participants more selectively processed alternatives in different subsets when alternatives were sorted and when participants knew that attributes were positively correlated). The significant interaction effect between sorting and attribute correlation confirmed our prediction that when an attribute was made prominent by using it to organize (i.e., pre-sort) alternatives, selective alternative processing was greater when participants knew that attributes were positively (vs. negatively) correlated ($SD\_SET_{Positive}=.34$, $SD\_SET_{Negative}=.22$, $F(1, 177)=24.46$, $p<.001$; $NO\_SET_{Positive}=2.17$, $NO\_SET_{Negative}=2.59$, $F(1, 177)=15.51$, $p<.001$). However, when alternatives were unsorted (i.e., attributes were of equal prominence), attribute correlation did not significantly influence selective alternative processing ($SD\_SET_{Positive}=.08$, $SD\_SET_{Negative}=.06$, $F(1, 80)=2.13$, N.S.; $NO\_SET_{Positive}=2.98$, $NO\_SET_{Negative}=3.00$, $F(1, 80)=.91$, N.S.). Further, when participants knew that attributes were positively correlated, selective alternative processing was greater when alternatives were sorted (vs. random) ($SD\_SET_{Sorted}=.22$, $SD\_SET_{Random}=.06$, $F(1, 127)=43.13$, $p<.001$; $NO\_SET_{Sorted}=2.59$, $NO\_SET_{Random}=3.00$, $F(1, 127)=17.29$, $p<.001$) (see Fig. 3). Thus, consumers are more likely to selectively process alternatives when alternatives are sorted and they know that attributes are positively correlated. Hence, hypothesis 3 was supported.

Hypothesis 5 predicts that the selective processing of alternatives mediates the effect of attribute prominence on choice only under the negative attribute correlation conditions. The procedure used to test hypothesis 2 was also used to test this hypothesis. The overall measures of selective alternative processing (SD_SET and NO_SET) could not reveal how selectively alternatives were processed in different subsets. Hence, we used the percentage



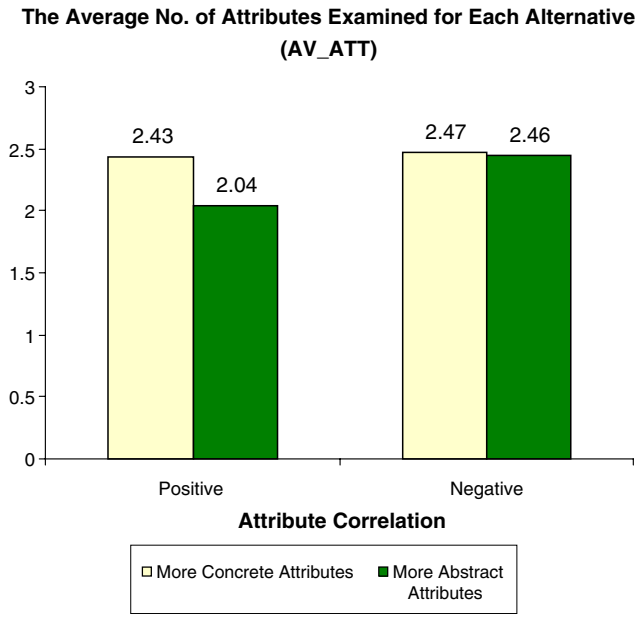


Figure 2 Study 1: effect of attribute concreteness and attribute correlation on selective attribute processing (H1).

of alternatives examined that belonged to subset 1[6] (i.e., the number of alternatives examined in subset 1 divided by the total number of alternatives examined) as a measure of selectivity. When participants knew that attributes were negatively correlated, participants examined a higher percentage of alternatives in subset 1 when alternatives were sorted by atmosphere (44%) than when alternatives were not sorted by atmosphere (25%) ($F(1, 121)=38.41$, $p<.001$). Second, the percentage of alternatives examined that belonged to subset 1 significantly affected their choice ($\beta=-.42$, $p<.001$). Third, participants chose alternatives with better atmosphere when alternatives were sorted by atmosphere ($C=1.40$) than when alternatives were not sorted by atmosphere ($C=1.69$, $F(1, 121)=5.06$, $p<.05$). Finally, when the percentage of alternatives examined that belonged to subset 1 was included in the previous ANCOVA, sorting no longer had a significant impact on choice ($F(1, 120)=.00$, N.S.). However, when participants knew that attributes were positively correlated, attribute prominence created by sorting did not significantly influence choice ($F(1, 125)=.40$, N.S.). Thus, the selective processing of alternatives mediated attribute prominence on choice only when participants knew that attributes were negatively correlated, which supports hypothesis 5.

Effects on subjective search experience

The next set of hypotheses investigates how selective information processing influences search outcomes, such as the amount of information search, experienced cognitive effort, and affect. Hypothesis 6 posits that selective processing of attributes and alternatives are negatively correlated and both reduce the amount of information search. Correlation analysis indicated that the standard deviation of the number of alternatives examined for each attribute (SD_ATT) and the standard deviation of the number of alternatives examined in each subset (SD_SET) were negatively correlated ($r=-.48$, $p<.001$). Further, regression analysis using standardized z scores showed that selective processing of attributes and selective processing of alternatives reduced the amount of information search [($\beta_{SD\_ATT}=-.12$, $p<.05$) and ($\beta_{SD\_SET}=-.60$, $p<.001$) respectively], while the average number of attributes examined for each alternative (AV_ATT) and the number of subsets examined (NO_SET) increased the amount of information search [($\beta_{AV\_ATT}=.47$, $p<.001$) and ($\beta_{NO\_SET}=.39$, $p<.001$) respectively]. Thus, hypothesis 6 was supported.

Hypothesis 7 posits that the amount of information search mediates the effect of selective processing of attributes and alternatives on experienced cognitive effort. According to the procedure recommended by Iacobucci et al. (2007), we tested the mediation effect using structural equation modeling. We used SD_ATT and AV_ATT as indicators of selective processing of attributes (latent variable) and SD_SET and NO_SET as indicators of selective processing of alternatives (latent variable). The initial assessment of the measurement model indicated high multicollinearity between AV_ATT and SD_ATT, as the standard regression weight of AV_ATT on selective processing of attributes exceeded 1. Thus, AV_ATT was not included in the model. The fit indexes of structural

[6] Subset 1 contained restaurants with "excellent" atmosphere across all experimental conditions.

Table 2 Study 1: effects on selective processing of alternatives (H3)

		SD_SET	NO_SET
Attribute prominence (*Created by alternative organization*)	*Random:*	.08	2.99
	Sorted:	.28	2.38
		F(1, 249)=105.47***	F(1, 249)=18.76***
Attribute correlation	*Positive:*	.26	2.43
	Negative:	.18	2.71
		F(1, 249)=11.65**	F(1, 249)=2.42*
Attribute concreteness	*Concrete:*	.23	2.55
	Abstract:	.21	2.58
		F(1, 249)=.56	F(1, 249)=.00
Attribute Prominence×Attribute Correlation		F(1, 249)=8.45**	F(1, 249)=6.88**
Attribute Prominence×Attribute Concreteness		F(1, 249)=.09	F(1, 249)=.05
Attribute Correlation×Attribute Concreteness		F(1, 249)=.01	F(1, 249)=.04
Attribute Prominence×Attribute Correlation×Attribute Concreteness		F(1, 249)=.00	F(1, 249)=.00
Control variables:			
Gender		F(1, 249)=.49	F(1, 249)=.79
Accuracy goal		F(1, 249)=2.39	F(1, 249)=1.08
Attribute importance		F(1, 249)=.01	F(1, 249)=.03

SD_SET the standard deviation of number of alternatives examined in each subset, *NO_SET* the number of subsets examined
*$p<.05$, **$p<.01$, ***$p<.001$

equation modeling demonstrated that the model (see Fig. 4) was of good fit ($\chi^2=8.56$, $df=9$, $p>.1$; GFI=0.99; CFI=1.0; RMSEA=0.0). Results showed that SD_ATT and selective processing of alternatives significantly affected the amount of information search, which then significantly affected experienced cognitive effort. However, the direct effects between selective processing and experienced cognitive effort were not significant. Sobel tests confirmed the mediating effect of amount of information search (SD_ATT: $z=2.23$, $p<.05$; selective processing of alternatives: $z=-2.57$, $p<.05$). Thus, hypothesis 7 was supported.

Hypothesis 8 posits that experienced cognitive effort mediates the effect of the amount of information search on affect. The fit indexes demonstrated that the model (see Fig. 5) was also of good fit ($\chi^2=40.33$, $df=30$, $p>.05$; GFI=0.97; CFI = 0.99; RMSEA=0.04). Results showed that the amount of information search significantly affected experienced cognitive effort, which then significantly influenced both positive and negative affect, while the direct effects between the amount of information search and affect were not significant. Sobel tests confirmed the mediation of experienced cognitive effort (positive affect: $z=-2.53$, $p<.05$; negative affect: $z=2.66$, $p<.01$). Therefore, hypothesis 8 was supported.

Discussion

Study 1 examined how attribute concreteness and attribute prominence (created by pre-sorting alternatives on an attribute), together with attribute correlation, affect consumer selective information processing, choice, and the subjective search experience. Specifically, consumers were more likely to selectively process attributes when attribute concreteness was low and they were aware that attributes were positively correlated. Selectively processing abstract attributes then led to inferior choices in positive attribute correlation conditions. Likewise, consumers were more likely to selectively process alternatives when attribute prominence was high and they were aware that attributes were positively correlated. There was also a moderate tendency to selectively process alternatives when alternatives were sorted and attributes were negatively correlated. Selective alternative processing then led to choices favoring the prominent attribute under the negative attribute correlation conditions. Further, selective processing of attributes and alternatives were negatively correlated and both reduced the amount of information search. Finally, the amount of information search mediated the effects of selective processing on experienced cognitive effort, and experienced cognitive effort, in turn, mediated the effect of the amount of search on affect. Thus, study 1 validated the hypothesized sequential relationships between attribute characteristics, selective processing strategies, choice, and subjective search experience (see Fig. 1).

The findings of study 1 are important as they indicate how information display influences (i.e., varying an attribute's concreteness or prominence) can affect the selection of a processing strategy, which in turn can

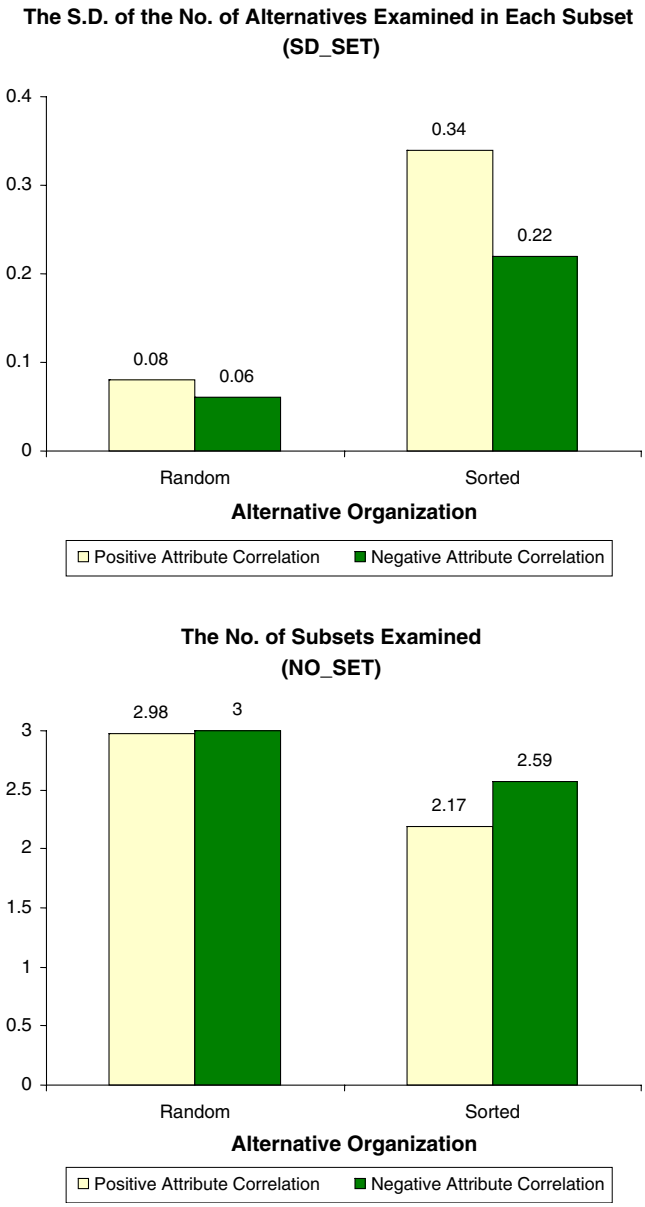


Figure 3 Study 1: effect of alternative organization and attribute correlation on selective alternative processing (H3).

influence the quality of consumer choice. While consumers may choose a processing strategy that they believe will have the least impact on decision accuracy, the process of selecting which attributes and alternatives to examine can in and of itself have an effect on choice over and beyond cognitive influences such as attribute importance and accuracy goal. The findings are also important because they show that consumers actively manage their subjective search experience by choosing different processing strategies under dissimilar conditions.

However, study 1 only examined the effect of attribute prominence that was created by pre-sorting alternatives on a particular attribute, which does not allow a test of hypothesis 4. In study 2, we investigated whether attribute prominence created by a visually salient display influences consumer selective processing and choice, thereby enabling a test of hypothesis 4 and validating hypothesis 5.

Study 2

Method

Participants and design A total of 146 undergraduate students participated in study 2. They were randomly assigned to experimental conditions in a 2 (attribute prominence created by a visually salient display: salient atmosphere vs. salient price)×2 (attribute prominence created by sorting: random vs. sorted by a non-visually-salient attribute) between-subjects design. In order to clearly differentiate the two prominence variables in this study, in the rest of this section, we use "attribute visual salience" to indicate attribute prominence created by visually salient displays and "alternative organization" to indicate attribute prominence created by pre-sorting alternatives.

Procedure Participants were first presented with the same hypothetical scenario as in study 1: they needed to search for restaurant information on the experimental website "Cyber-Dining." There were 30 hypothetical restaurants listed on the homepage of Cyber-Dining. Participants were told that all the restaurants are near their home and offer American cuisine. Each restaurant was presented with two hyperlinks leading to atmosphere and price information respectively. Participants could choose which attribute to examine by clicking the appropriate hyperlink. Both attributes (atmosphere and price) had five levels. Attribute correlation was kept negative so that participants had to make a trade-off between the two attributes. As in study 1, participants were instructed to browse the website at their own pace, choose three restaurants that they were most likely to visit (in order of preference), and fill out a questionnaire regarding their search activities. The click-stream data was recorded by the web server and stored in a log file.

Experimental variables

Attribute visual salience (salient atmosphere vs. salient price) An attribute's visual salience was manipulated using the procedure used by Janiszewski (1998). On the homepage of Cyber-Dining, the visually salient attribute was presented in a much larger area than the non-visually-salient attribute. The hyperlinks to the salient attribute were highlighted in bright green to create contrast with the

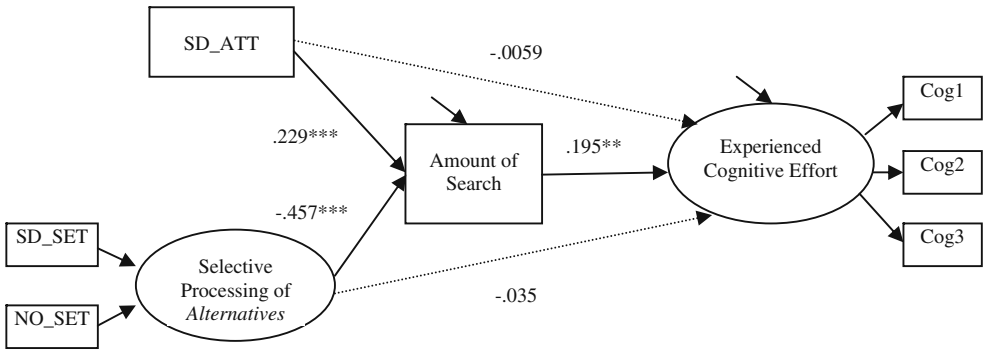


Figure 4 Study 1: the mediating effect of amount of information search between selective processing and experienced cognitive effort (H7).

background color (white), while the hyperlinks to the non-visually-salient attribute were not highlighted. Specifically, when atmosphere was the salient attribute, large size pictures were used to present restaurant atmosphere on the homepage, while price was presented by a hyperlink in a small font size. When price was the salient attribute, price was presented with large numbers in bright green color, while atmosphere was presented by a hyperlink in small font size.

Alternative Organization (random vs. sort by a non-visually-salient attribute) As in study 1, in the random order conditions, all the restaurants were listed in alphabetical order because such an order can be considered as random when hypothetical alternative names are used (Diehl 2005). In the sorted by a non-visually-salient attribute conditions, all restaurants were sorted on the non-visually-salient attribute. Specifically, when atmosphere was displayed saliently, restaurants were sorted into five subsets according to their price, ranging from highest ("$$$$$") to lowest ("$"). When price was displayed saliently, restaurants were sorted into five subsets based on their atmosphere, ranging from best ("★★★★★") to worst ("★"). Restaurant subset 1 referred to restaurants with the best atmosphere but with the highest price (i.e., high-end restaurants), while subset 5 referred to restaurants

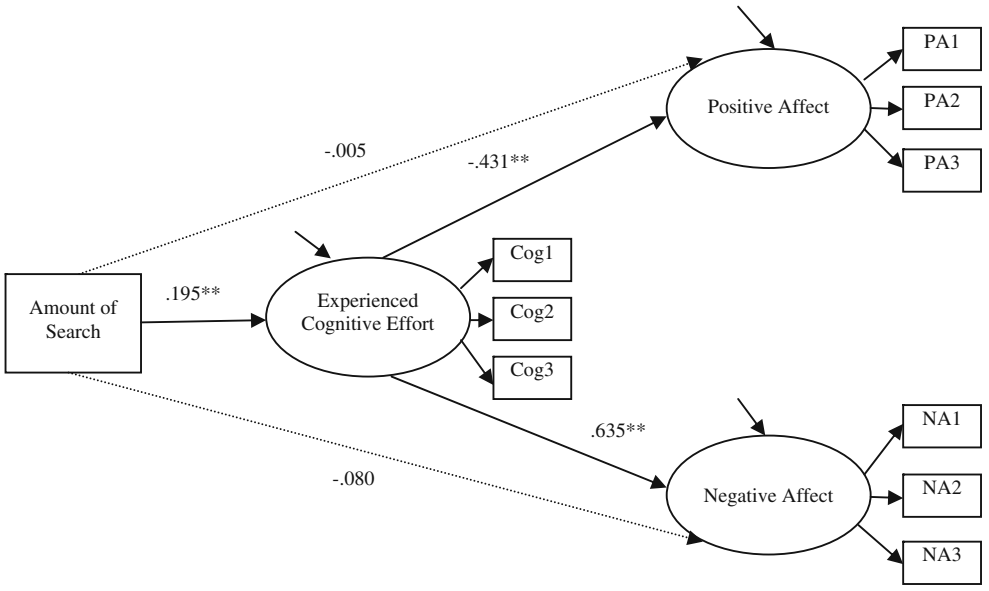


Figure 5 Study 1: the mediating effect of experienced cognitive effort between amount of information search and affect (H8).

with the worst atmosphere but the lowest price (i.e., low-end restaurants).

Dependent measures

Selective processing The objective of study 2 was to examine whether participants examined certain alternatives more often than others in different experimental conditions. Selective processing of *alternatives* was measured by the percentages of the number of alternatives examined in each subset. Given that there were five subsets of alternatives, S_i_P was used to notate the percentage of the number of alternatives examined in each subset (with i ranging from 1 to 5). S_i_P was calculated by dividing the number of unique alternatives examined in subset i by the total number of unique alternatives examined. If the percentage was unequally distributed across the five subsets, participants had selectively processed *alternatives*. The measure was the same as the one used in study 1 to examine the effect of selective alternative processing on choice.

Choice Choices were recorded and then coded into numbers. Given that there were five subsets of restaurants, each choice was given the number that notated its subset. For example, if a participant chose a restaurant from subset 1, choice was coded as 1. Thus, the measure of choice ranged from 1 (best atmosphere but highest price) to 5 (worst atmosphere but lowest price).

Finally, as in study 1, we measured importance weight of attributes, accuracy goal and gender. Preliminary analysis showed that gender did not associate with the dependent measures. Thus, the importance weight and accuracy goal were included in the hypotheses tests as control variables.

Results

A total of 124 participants finished the information search task and completed the questionnaire regarding their search activities.[7] The clickstream data indicated that on average participants examined detailed information for 8.87 restaurants, and examined 3.23 subsets of restaurants. As in study 1, participants reported that they had examined fewer restaurants ($M_{Subjective}$=6.99, t_{123}=4.17, p<.001) than what was recorded in the web server log file. Participants also reported that they had to make trade-offs between atmosphere and price ($M_{Tradeoff}$=5.20>4, t_{123}=11.20, p<.001). There was no significant difference in the extent of the trade-offs reported across the different experimental conditions.

[7] One participant who did not complete the questionnaire and twenty-one participants who did not examine detailed information on the restaurants, but still made choices, were dropped from the study.

Experimental checks

Attribute visual salience As consumers tend to pay more attention to visually salient information, two 7-point items asking participants whether atmosphere/price information on Cyber-Dining's homepage attracted most of their attention were used as a manipulation check for attribute visual salience. Participants paid more attention to atmosphere (vs. price) when atmosphere was displayed saliently ($M_{Atmosphere}$=5.84, M_{Price}=4.25, F(1, 122)=26.83, p<.001), whereas they paid more attention to price (vs. atmosphere) when price was displayed saliently (M_{Price}=4.80, $M_{Atmosphere}$=3.48, F(1, 122)=21.68, p<.001).Therefore, the manipulation of attribute visual salience by varying visual display was considered to be successful.

Effects on selective alternative processing

Hypothesis 4 posits that attribute prominence created by visually salient displays influences selective alternative processing when alternatives are randomly listed, but such an effect is attenuated when alternatives are sorted by the non-visually-salient attribute. MANCOVA was conducted with the percentages of the number of alternatives examined in each subset (i.e., S_1_P, S_2_P, S_3_P, S_4_P, and S_5_P) as the dependent variables and attribute visual salience and alternative organization as the independent variables. The results showed that there was no significant main effect of attribute visual salience (*Wilk's* λ=.96, F(4, 115)=1.26, N.S.) and alternative organization (*Wilk's* λ=.96, F(4, 115)=1.08, N.S.). However, there was a significant attribute visual salience by alternative organization interaction (*Wilk's* λ=.88, F(4, 115)=4.11, p<.01). Given that there were only two levels for each independent variable, the results of Pillai's Trace and Hotelling's Trace were the same as *Wilk's* λ. In the random order conditions, attribute visual salience significantly influenced the percentages of the number of alternatives examined in each subset (*Wilk's* λ=.78, F(4, 65)=4.15, p<.01). Specifically, participants examined relatively more high-end restaurants (subset 1 and 2) when atmosphere was presented saliently ($S_1\_P_{Atmosphere}$=28%, $S_1\_P_{Price}$=15%, F(1, 68)=9.76, p<.01; $S_2\_P_{Atmosphere}$=32%, $S_2\_P_{Price}$=22%, F(1, 68)=3.92, p=.05). In contrast, they examined relatively more lower-end restaurants (subset 3 and 4) when price was visually salient ($S_3\_P_{Price}$=30%, $S_3\_P_{Atmosphere}$=18%, F(1, 68)=7.29, p<.01; $S_4\_P_{Price}$=24%, $S_4\_P_{Atmosphere}$=13%, F(1, 68)=5.05, p<.05) (see Fig. 4). However, there was no significant difference in S_5_P between the two conditions (F(1, 68)=.02, N.S.), which could be attributed to the fact that the restaurants in subset 5 were too poor to be considered. In the sorted by the non-visually-salient attribute conditions, attribute visual salience did not significantly influence the percen-

tages of alternatives examined in each subset (*Wilk's* λ=.90, $F(4, 49)$=1.37, N.S.). There was no significant difference in S_1_P, S_2_P, S_3_P, S_4_P, and S_5_P between the salient atmosphere and salient price conditions (see Fig. 6). Thus, participants examined more alternatives with better values on the salient attribute when alternatives were listed in random order, but sorting alternatives by the non-visually-salient attribute attenuated such an effect. Thus, hypothesis 4 was supported.

Effects on choice

Hypothesis 5 predicts that selective processing of alternatives mediates the effect of attribute prominence on choice under the negative attribute correlation conditions. In this study, attribute prominence was determined by two display factors: attribute visual salience and attribute organization (sorting). Hence, we tested whether selective alternative processing mediates the interaction effect

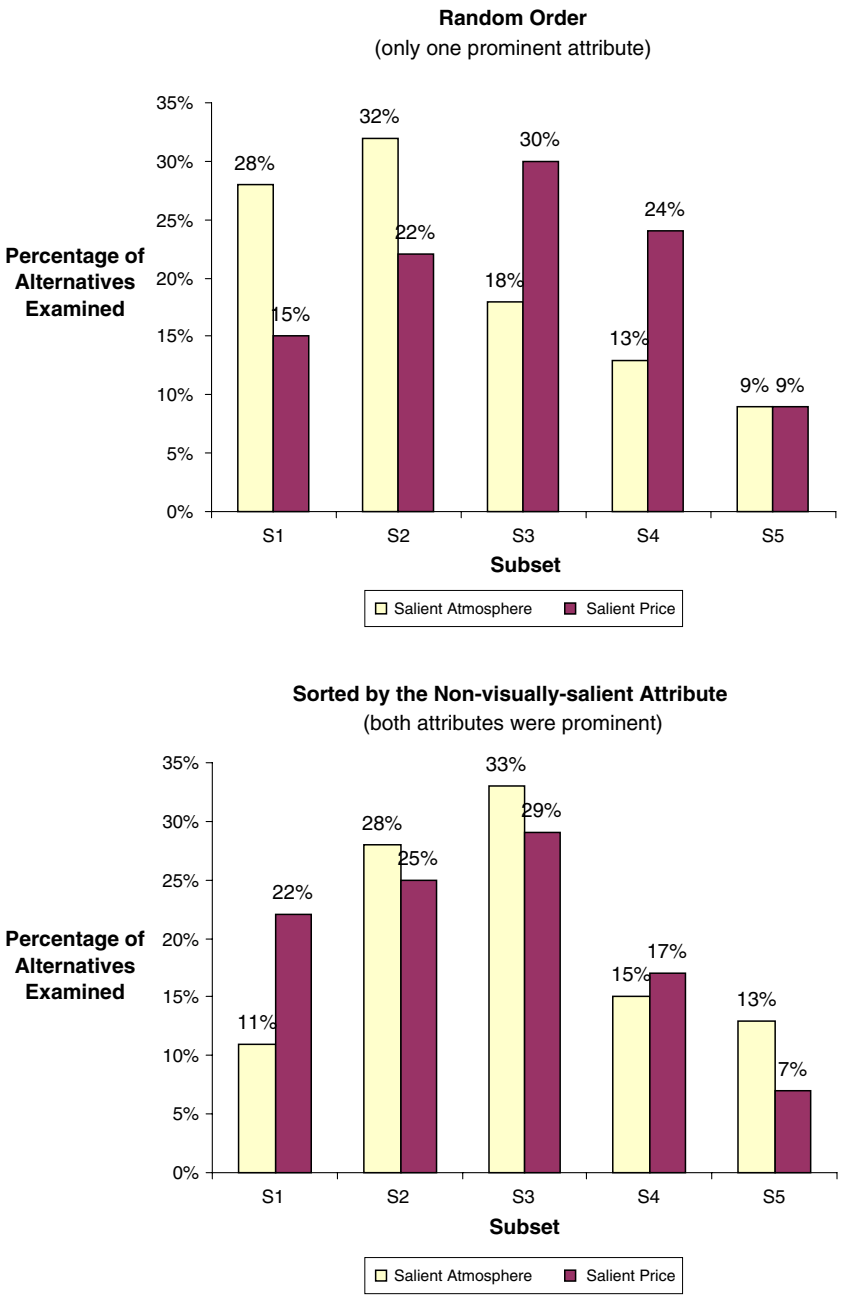


Figure 6 Study 2: effect of attribute prominence on selective alternative processing (H4).

Note: S1 refers to restaurant subset 1 with the best atmosphere but the highest price. S5 refers to restaurant subset 5 with the worst atmosphere but the lowest price.

of visual salience by alternative organization on choice. First, the findings from hypothesis 4 showed a significant attribute visual salience by alternative organization interaction effect on selective alternative processing. Second, the results of multiple regression showed that selective alternative processing, S_1_P (β=−.72, p<.001), S_2_P (β=−.58, p<.001), S_3_P (β=−.45, p<.001), and S_4_P (β=−.37, p<.01), significantly affected choice (S_5_P was not entered in the regression in order to avoid multicollinearity). Third, the results of ANCOVA showed that there was a significant attribute visual salience by alternative organization interaction effect on choice (F(1, 118)=5.32, p<.05). When alternatives were listed in random order, participants in the salient atmosphere (vs. price) conditions chose restaurants with better atmosphere and higher price ($C_{\text{Atmosphere}}$=2.03, C_{Price}=2.62, F(1, 66)=5.08, p<.05). However, when alternatives were sorted by the non-visually-salient attribute, there was no significant difference in choice between the two conditions (F(1, 50)=.85, N.S.). Therefore, choice was also affected by the interaction between attribute visual salience and alternative organization. Finally, when S_1_P, S_2_P, S_3_P, and S_4_P (S_5_P was not entered in the regression in order to avoid multicollinearity) were included in the previous ANCOVA as covariates, the interaction between attribute visual salience and alternative organization was no longer significant (F(1, 114)=.43, N.S.). Therefore, the selective processing of alternatives mediated the effect of attribute prominence on choice under the negative attribute correlation conditions. Conversely, as shown earlier, attribute prominence did not affect the selective processing of alternatives under the positive attribute correlation conditions. Therefore, the selective processing of alternatives mediated the effect of attribute prominence on choice only under the negative attribute correlation conditions, which supports hypothesis 5.

Discussion

Study 2 examined the effect of attribute prominence created by visually salient displays on selective processing and choice. It also investigated how attribute prominence created by different methods (visual displays and sorting) interacts with each other. We found that when alternatives were listed in random order (i.e., when there was only one prominent attribute), consumers processed more alternatives with better values on the visually salient attribute and were more likely to choose such an alternative. In contrast, when alternatives were sorted by a non-visually-salient attribute (i.e., there were two prominent attributes), the effect of attribute visual salience on selective alternative processing and choice was attenuated. Further, we also demonstrated that selective alternative processing mediated the effect of attribute prominence on choice.

The findings of study 2 suggest that consumers tend to screen alternatives by the visually salient attribute, which can bias their search toward alternatives with better values on the salient attribute. Interestingly, the findings of study 1 also suggest that sorting tends to make consumers search more alternatives in the subset with better values on the sorting attribute. Therefore, although study 1 and 2 used two different methods to increase attribute prominence, the results from the two studies provide convergent support that attribute prominence increases selective alternative processing. Moreover, such effects are more evident under the negative attribute correlation conditions, which is consistent with the findings of Häubl and Murray (2003). Further, the findings regarding the effect of sorting in study 2 replicate the results of study 1 in that sorting increased the prominence of the non-visually-salient attribute and in relative terms decreased the prominence of the visually salient attribute. Finally, the mediating role of selective alternative processing between attribute prominence and choice found in study 2 is also consistent with the findings of study 1. In summary, the findings from both study 1 and 2 indicate that attribute prominence influences selective alternative processing, which in turn affects choice.

General discussion

Theoretical contributions

The research reported here demonstrates that two important information display factors, attribute concreteness and attribute prominence, together with attribute correlation influence consumer selective information processing and choice. Moreover, selective processing mediates the effect of attribute concreteness and prominence on choice, and both forms of selective processing reduce information search while also affecting consumers' subjective search experience.

These findings make important theoretical contributions to the information environment effects literature (e.g., Johnson et al. 1988; Lurie 2004). First, we further our understanding of the "concreteness principle" (Slovic 1972) by showing that the processing difficulties associated with abstract information result in a desire to selectively (vs. consistently) process such information. However, the "concreteness principle" alone does not lead consumers to decide when to disregard information. Rather, it is attribute correlation that assures consumers when it is safe or unsafe to ignore information. Second, we add to our knowledge of the "prominence hypothesis" (Tversky et al. 1988) by demonstrating that the attention-getting nature of prominent

information tends to guide consumers toward particular alternatives. However, attribute correlation again determines how and when selective alternative processing affects decision accuracy.

The finding that the effect of a perceptual influence (attribute prominence) is moderated by a task complexity factor (attribute correlation) is in line with the proposition advanced by Bettman et al. (1998) that the perceptual and accuracy-effort approaches need to be integrated to better understand consumer decision making. Interestingly, consumers continue to selectively process information at a moderate level even when they are aware that attributes are negatively correlated; this suggests that the effect of perceptual influences may be stronger than accuracy-effort considerations in the selection of an information processing strategy. However, more confirmation of the relative strength of these effects is needed.

Finally, through a series of mediation analyses, our findings reveal the causal chain that links information display factors, selective processing strategies, consumer choice and search outcomes. These findings provide additional support for the notion that how consumers search and where they search (e.g., Moorman et al. 2004) influences choice. Further, we also contribute to the literature on search outcomes by showing that search experience (experienced cognitive effort and affect) is not just passively influenced by the decision task, but it is the result of a dynamic process that involves processing strategy selection.

Marketing implications

This research is important from a marketing strategy perspective because it examines how a marketer can influence consumer choice by merely changing the manner in which attribute information is displayed or how alternatives are initially organized. The findings of this research particularly apply to shopping environments where retailers have relative freedom in presenting their product assortments to consumers (e.g., online stores). First, retailers can help consumers to consistently process attributes by transforming abstract attributes (e.g., verbal narratives) to concrete attributes (e.g., numerical or symbolic ratings). Such a strategy can be especially helpful for alternatives with better values on abstract attributes but mediocre values on concrete attributes. Second, retailers can encourage consumers to choose particular products (e.g., sponsored products, products with better quality or higher price) by pre-sorting alternatives by a particular attribute or presenting it in a visually salient way. However, retailers need to keep in mind that the boundary conditions of such strategies, i.e., creating two different prominent attributes (e.g., one by sorting and the other by visually salient displays), may in fact cancel out the effects of each strategy. Third, as attribute correlation determines the extent of selective information processing, retailers may want to remind or educate consumers of the correlation among attributes in order to encourage or discourage selective processing tendencies. For example, for price conscious consumers, retailers can emphasize the negative correlation between price and other quality indicators to make consumers put less emphasis on price. For products with more abstract attributes, such as experience products, online retailers can emphasize the correlation between brand names and quality to assist consumers in processing information on these products.

The research is also important from a public policy perspective because it can be used to educate consumers on the surreptitious impact of information display factors on their choices. For example, consumers can be encouraged to use consistent (vs. selective) processing strategies to avoid making choices that favor retailers; they can also be educated to base their decisions on the attributes are important to them, rather than on those which are easier to process or made visually salient by the marketer.

Limitations and future research

The research has several limitations that need to be kept in mind while interpreting the findings reported here or in designing future research. First, we examined how attribute prominence increased by alternative organization (i.e., pre-sorting alternatives on an attribute) influences selective alternative processing. But, we only considered a one-dimensional array. Future research can be designed to identify the factors that influence selective information processing strategies for two dimensional or matrix displays. Second, while we present circumstantial evidence that subjective search experience is a dynamic construct, we did not actually measure how it changes over the course of the search task. Future research can be designed to investigate the exact process by which consumers anticipate, monitor and manage their subjective search experience. Third, while we demonstrate how a perceptual influence (attribute prominence) can interact with a task complexity factor (attribute correlation) to influence selective processing, a broader set of effects need to be considered to see how the perceptual and accuracy-effort approaches to decision making may be integrated. A promising direction forward may be through the incorporation of thinking styles (rational and experiential) while examining the effect of perceptual influences on task complexity factors (Novak and Hoffman 2009).

Lastly, there were a few constraints in the setup of the experiments, which might affect the external validity of the results reported here. First, participants were informed of

the nature of attribute correlation in study 1, which excludes the process by which participants come to realize inter-attribute correlations on their own. However, in study 2, we did not provide such information to participants given that the relationship between price and atmosphere might be well known to them. Thus, the results reported in this research apply to situations when consumers already know the nature of attribute correlation or such correlation is very obvious. Second, given the fact that the participants showed moderate involvement in the experimental tasks, the results reported here may not apply to situations when consumers are searching for information for an extremely important task. Further research can be conducted to examine consumer selective information processing when completing tasks with extremely high importance.

References

Alba, J. W., Lynch, J., Weitz, B., Janiszewski, C., Lutz, R., Sawyer, A., et al. (1997). Interactive home shopping: consumer, retailer, and manufacturer incentives to participate in electronic marketplaces. *Journal of Marketing, 61*, 38–53.

Areni, C. S., Duhan, D. F., & Kiecker, P. (1999). Point-of-purchase displays, product organization, and brand purchase likelihoods. *Journal of the Academy of Marketing Science*, *27*(4), 428–441.

Ariely, D. (2000). Controlling the information flow: effects on consumers' decision making and preference. *Journal of Consumer Research*, *27*(2), 233–248.

Bettman, J. R., & Sujan, M. (1987). Effects of framing on evaluation of comparable and noncomparable alternatives by expert and novice consumers. *Journal of Consumer Research*, *14*(2), 141–154.

Bettman, J. R., Johnson, E. J., & Payne, J. W. (1991). Consumer decision making. In T. S. Robertson & H. H. Kassarjian (Eds.), *Handbook of consumer research* (pp. 50–84). Englewood Cliffs: Prentice Hall.

Bettman, J. R., Johnson, E. J., Luce, M. F., & Payne, J. W. (1993). Correlation, conflicts, and choice. *Journal of Experimental Psychology*, *19*(4), 931–951.

Bettman, J. R., Luce, M. F., & Payne, J. W. (1998). Constructive consumer choice process. *Journal of Consumer Research*, *25*, 187–217.

Diehl, K. (2005). When two rights make a wrong: searching too much in ordered environments. *Journal of Marketing Research*, *42*, 313–322.

Diehl, K., Kornish, L. J., & Lynch, J. G., Jr. (2003). Smart agents: when lower search costs for quality information increase price sensitivity. *Journal of Consumer Research*, *30*, 56–71.

Garbarino, E. C., & Edell, J. A. (1997). Cognitive effort, affect, and choice. *Journal of Consumer Research*, *24*, 147–158.

Häubl, G., & Trifts, V. (2000). Consumer decision making in online shopping environments: the effects of interactive decision aids. *Marketing Science*, *19*, 4–21.

Häubl, G., & Murray, K. B. (2003). Preference construction and persistence in digital marketplaces: the role of electronic recommendation agents. *Journal of Consumer Psychology*, *13* (1), 75–91.

Häubl, G., & Murray, K. B. (2006). Double agents: assessing the role of electronic product recommendation systems. *Sloan Management Review*, *47*(3), 8–12.

Horsky, D., Paul, N., & Posavac, S. S. (2004). Stating preference for the ethereal but choosing the concrete: how the tangibility of attributes affects attribute weighting in value elicitation and choice. *Journal of Consumer Psychology*, *14*(1, 2), 132–140.

Huang, P., Lurie, N. H., & Mitra, S. (2009). Searching for experience on the web: an empirical examination of consumer behavior for search and experience goods. *Journal of Marketing*, *73*, 55–69.

Huber, O. (1980). The influence of some task variables on cognitive operations in an information processing decision model. *Acta Psychologica*, *45*, 187–196.

Huber, J., & Klein, N. M. (1991). Adapting cutoffs to the choice environment: the effects of attribute correlation and reliability. *Journal of Consumer Research*, *18*, 346–357.

Hutchinson, J. W., & Alba, J. W. (1991). Ignoring irrelevant information: situational determinants of consumer learning. *Journal of Consumer Research*, *18*(3), 325–345.

Iacobucci, D., Saldanha, N., & Deng, X. (2007). A mediation on mediation: evidence that structural equations models perform better than regression. *Journal of Consumer Psychology*, *17*(2), 139–153.

Janiszewski, C. (1998). The influence of display characteristics on visual exploratory search behavior. *Journal of Consumer Research*, *25*, 290–301.

Jarvenpaa, S. L. (1989). The effect of task demands and graphical format on information processing strategies. *Management Science*, *35*(3), 285–303.

Jarvenpaa, S. L. (1990). Graphic displays in decision making- the visual salience effect. *Journal of Behavioral Decision Making*, *3*, 247–262.

Johnson, E. J., & Fornell, C. (1987). The nature and methodological implications of the cognitive representation of products. *Journal of Consumer Research*, *14*(2), 214.

Johnson, E. J., Payne, J. W., & Bettman, J. R. (1988). Information displays and preference reversals. *Organizational Behavior and Human Decision Processes*, *42*(1), 1–21.

Kieras, D. E. (1978). Beyond pictures and words: alternative information processing models of imagery effects in verbal memory. *Psychological Bulletin*, *85*(3), 532–554.

Lurie, N. H. (2004). Decision making in information-rich environments: the role of information structure. *Journal of Consumer Research*, *30*, 473–486.

Lynch, J. G., Jr., & Ariely, D. (2000). Wine online: search costs affect competition on price, quality, and distribution. *Marketing Science*, *19*, 83–103.

Moorman, C., Diehl, K., Brinberg, D., & Kidwell, B. (2004). Subjective knowledge, search locations, and consumer choice. *Journal of Consumer Research*, *31*, 673–690.

Nisbett, R. E., & Ross, L. (1980), *Human inference: Strategies and shortcomings of social judgment*. Prentice-Hall.

Novak, T. P., & Hoffman, D. L. (2009). The fit of thinking style and situation: new measures of situation-specific experiential and rational cognition. *Journal of Consumer Research*, *36*(June).

Paivio, A. (1971). *Imagery and verbal processes*. Holt, Rinehart and Winston.

Payne, J. W., Bettman, J. R., & Johnson, E. J. (1993). *The adaptive decision maker*. Cambridge.

Pereira, R. E. (2000). Optimizing human-computer interaction for the electronic commerce environment. *Journal of Electronic Commerce Research*, *1*(1).

Richins, M. L. (1997). Measuring emotions in the consumption experience. *Journal of Consumer Research*, *24*, 127–146.

Russo, J. E. (1977). The value of unit price information. *Journal of Marketing Research*, *14*, 193–201.

Schkade, D. A., & Kleinmuntz, D. E. (1994). Information displays and choice processes: differential effects of organization, form and sequence. *Organizational Behavior and Human Decision Processes*, *57*, 319–337.

Shavitt, S., & Fazio, R. H. (1991). Effects of attribute salience on the consistency between attitudes and behavior predictions. *Personality and Social Psychology Bulletin*, *17*, 507–516.

Slovic, P. (1972). From Shakespeare to Simon: speculation—and some evidence about man's ability to process information. *Oregon Research Institute Bulletin*, *12*(3).

Stone, D. N., & Schkade, D. A. (1991). Numeric and linguistic information representation in multiattribute choice. *Organizational Behavior and Human Decision Processes*, *49*, 42–59.

Swaminathan, V. (2003). The impact of recommendation agents on consumer evaluation and choice: the moderating role of category risk, product complexity, and consumer knowledge. *Journal of Consumer Psychology*, *13*(1 & 2), 93–101.

Tversky, A., Sattath, S., & Slovic, P. (1988). Contingent weighting in judgment and choice. *Psychological Review*, *95*, 371–384.

Viswanathan, M., & Childers, T. C. (2001). Processing of numerical and verbal product information. *Journal of Consumer Psychology*, *5*(4), 359–385.

West, P. M., Ariely, D., Bellman, S., Bradlow, E., Huber, J., Johnson, E., et al. (1999). Agents to the rescue? *Marketing Letters*, *10*(3), 285–300.