Simple Decision Aids and Consumer Decision Making

Nicholas H. Lurie a,1, Na Wen b,*

a School of Business, University of Connecticut, United States
b College of Business, City University of Hong Kong, Hong Kong

Abstract

To help consumers deal with increasing amounts of information, many online retailers offer simple decision aids, such as the ability to sort on a particular attribute or eliminate undesired alternatives. The authors propose that consumers use simple decision aids as substitutes for cognitive effort, potentially with adverse consequences for decision making. An experimental study shows that providing unrestricted sorting increases decision quality only when choice conflict is low; beyond a certain point, greater use of the decision aid is associated with declines in decision quality. A second study shows that allowing consumers to sort alternatives only one time enhances decision quality and, when choice conflict is high, reduces decision effort. A third study shows that providing elimination as well as sorting tools helps mitigate the negative effects of simple decision aids. Although the availability of sorting alone hurts decision quality when choice conflict is high, decision quality under choice conflict is improved when both sorting and elimination tools are provided. Implications for retail practice are discussed.

Keywords: Simple decision aids; Sorting; Elimination; Choice conflict; Decision making

Introduction

In effort to help consumers deal with large amounts of information, many online retailers provide simple decision aids that can be used to sort or eliminate alternatives. Retailers favor simple decision aids since they are easy to deploy and consumers perceive them as helpful.1 However, simple decision aids fail to account for the compensatory nature of many decision tasks.

This raises the question: Can simple decision aids hurt consumer decision making?

In this paper, we examine how simple decision aids affect the quality of and effort associated with consumer decisions in online retail environments. We define simple decision aids as interactive tools that change the way in which products are displayed through direct manipulation by the consumer on a single aspect (i.e., attribute or product) at a time. For example, clicking the “sort” function on many retail websites orders products on a single attribute while marking a product for elimination removes it from display. Simple decision aids may be distinguished from comprehensive decision aids that recommend, and sometimes sort, products by first eliciting the relative importance of each attribute then simultaneously weighting each attribute by its importance to calculate each product’s multi-attribute utility (Diehl 2005; Häubl and Trifts 2000; Komiak and Benbasat 2006).

Although theoretically superior to simple decision aids, in that they account for tradeoffs among multiple product attributes, comprehensive decision aids require information about individual consumer preferences for different attributes, either directly through importance scales (Diehl, Kornish, and Lynch 2003; Häubl and Trifts 2000), or indirectly, through prior behavior (Ansari, Essegaiher, and Kohli 2000), through questions
about related demographic characteristics or usage intentions, or through conjoint tasks (De Bruyn et al. 2008; Diehl, Kornish, and Lynch 2003).\(^3\) Given the difficulty of collecting information on individual preferences for each of the many product categories a consumer might consider, it is perhaps unsurprising that few retailers have adopted comprehensive decision aids; yet many offer simple aids. Relative to simple decision aids, deploying comprehensive decision aids involves more complexity, risk, and cost to the retailer. In addition, the need for additional information such as attribute weights from the consumer, the difficulty of explaining multi-attribute utility to the average consumer (Aksoy et al. 2006), and greater feelings of control when using simple (vs. comprehensive) decision aids, further explain the paucity of comprehensive decision aids and the ubiquity of simple decision aids in online retail environments (Murray and Häubl 2009).\(^4\)

Comprehensive decision aids are the subject of much research (De Bruyn et al. 2008; Murray and Häubl 2009) but relatively little is known about how simple decision aids affect consumer decision making. This gap, between the academic focus on comprehensive decision aids and the common retail practice of deploying simple decision aids, suggests an intriguing research direction. While prior research has found that simple decision aids reduce decision effort without improving decision quality (Häubl and Trifts 2000; Todd and Benbasat 1992, 1999), this research has not considered how these effects depend on the choice context. Although prior research has convincingly demonstrated that consumers are quite good at adapting their unassisted decision strategies to different choice contexts in ways that maximize decision quality while minimizing effort (Bettman et al. 1993); for example reducing their use of non-compensatory choice strategies under choice conflict, in which tradeoffs must be made among product attributes (Bettman et al. 1993; Payne, Bettman, and Johnson 1988), it is unclear whether consumers are similarly adaptive in their use of simple decision aids.

In addition to being counter to consumer intuitions that (simple) decision aids are helpful, the idea that decision aids can harm consumer decision making runs counter to a large literature calling for greater use of decision aids; particularly in online retail environments (Bellman et al. 2006; Van Bruggen, Smidts, and Wierenga 1998; West et al. 1999). Finding that simple decision aids can sometimes hurt consumer decision making has important implications for online retailers, who have widely deployed such aids.

In contrast to prior research, we propose that, because they trust decision aids to help them make good decisions (Alba et al. 1997; Bechwati and Xia 2003; Häubl and Trifts 2000; Hoch and Schkade 1996), and reduce decision effort (Todd and Benbasat 1992, 1999), consumers will over-rely on simple decision aids with potentially adverse consequences. This means that simple decision aids will not always help consumers make better decisions or reduce decision effort; beyond a certain point, greater use of simple decision aids will be associated with lower decision quality. Limiting decision aid use, or providing additional tools that allow consumers to eliminate low quality alternatives, can enhance decision quality.

We test these ideas in three laboratory experiments. We focus our attention on two of the most widely deployed simple decision aids—sorting and elimination. In Study 1, we identify the conditions under which the availability of a simple sorting tool helps or harms decision making. We predict and empirically find that the unrestricted availability of a sorting tool only improves decision quality when choice conflict is low. In addition, we find that, beyond a certain point, greater use of a sorting tool is associated with declines in decision quality. A second study shows that limiting the number of times a sorting tool can be used enhances decision quality and, when choice conflict is high, reduces decision effort. A third study examines whether combining two simple decision aids—sorting and elimination—can overcome the drawbacks of simple decision aids by encouraging consumers to systematically evaluate alternatives after sorting. Replicating the earlier results, this study shows that the availability of sorting alone helps decision quality when choice conflict is low and hurts decision quality when choice conflict is high. However, when both sorting and elimination tools are available, decision quality is improved under high choice conflict.

By examining how and when simple decision aids affect consumer decision making, this research helps fill the gap between the academic focus on comprehensive decision aids and the common practice of deploying simple decision aids in online retail environments. Our results suggest that consumers excessively rely on simple decision aids in contexts in which they are least helpful and that, beyond a certain point, use of simple decision aids can be harmful—lowering decision quality without reducing decision effort. Limiting the use of simple decision aids, or providing the ability to eliminate low quality alternatives, can help consumers make better decisions. For retailers, we suggest ways to increase the benefits, and reduce the potential harms, of simple decision aids.

**Theoretical Background**

**Comprehensive Decision Aids**

Based on the idea that humans have limited information processing abilities (Simon 1957), while a computer’s ability to process information is virtually limitless (Bucklin, Lehmann, and Little 1998), there was a belief among many researchers that decision aids would “rescue” consumers from their cognitive shortcomings; particularly in electronic environments (Bellman et al. 2006; Van Bruggen, Smidts, and Wierenga 1998; West...
Early research examined how decision aids could be used to help managers make better decisions (Kasper 1996; Little 1970). The growth of the Internet as an online channel, the accompanying increase in the number of alternatives that consumers have to choose from, and the ability to customize the way in which information is displayed, led to substantial interest in aids (or recommendation agents) to assist online consumers (Alba et al. 1997; De Bruyn et al. 2008; Diehl, Kornish, and Lynch 2003; Häubl and Trifts 2000; Komiak and Benbasat 2006; Murray and Háubl 2009; Xu and Kim 2008). This research shows that comprehensive decision aids (i.e., those that recommend alternatives based on weighted-additive utility as derived from elicited or revealed preferences) can reduce consumer effort, allow them to focus on fewer but higher quality alternatives, and make better choices (Häubl and Trifts 2000).

At the same time, prior research suggests that providing consumers with comprehensive decision aids does not always lead to improvements in decision quality and that consumers do not always follow decision aid recommendations—even if doing so would improve decision quality. For example, when search costs are low, consumers search too much, consider inferior alternatives, and make poorer quality choices among alternatives ranked by decision aids (Diehl 2005). Other research shows that consumers react negatively to comprehensive decision aids that recommend dominated options (Fitzsimons and Lehman 2004).

Additional research shows that the perceived usefulness of, and the extent to which consumers follow, recommendations from online agents depends on the perceived similarity between the agent’s and the consumer’s decision processes (Aksoy et al. 2006; Breugelmans et al. 2012), whether agent recommendations are based on responses to questions about consumer needs rather than direct elicitations of preferences (Komiak and Benbasat 2006), and the extent to which the elicitation process is transparent to consumers (Jarvenpaa 1989; Kramer 2007). Notwithstanding these limitations, most research suggests that comprehensive decision aids are generally helpful—or at least not harmful—to consumers.

**Simple Decision Aids**

Despite their potential advantages, the comprehensive consumer decision aids shown to be most helpful by academic research (e.g., De Bruyn et al. 2008; Diehl, Kornish, and Lynch 2003; Gupta, Yadav, and Varadarajan 2009; Häubl and Trifts 2000; Senecal and Nantel 2004), have gained little traction in the marketplace (Murray and Háubl 2009). Instead, most online retailers offer simple decision aids that allow consumers to sort alternatives on single attribute at a time (Alexa 2013; De Bruyn et al. 2008; Murray and Háubl 2009).

There are several reasons why online retailers are unlikely to deploy comprehensive decision aids. These include the complexity and cost of deploying such aids, the risks associated with making recommendations if consumers are not satisfied with their purchases, and the difficulty in assessing financial returns from investing in such technology. Given these issues, as well as lack of consumer interest in providing the information needed to deploy comprehensive aids (Murray and Háubl 2009), and the relative ease of providing simple decision aids, it is not surprising that most online retailers offer simple decision aids to their customers.

Large differences exist between comprehensive decision aids that account for the relative importance of multiple attributes and the simple decision aids available in most online retail environments. A decision aid that uses a weighted-additive model to rank alternatives from highest to lowest utility based on the relative importance to the consumer of different attributes (e.g., De Bruyn et al. 2008; Diehl, Kornish, and Lynch 2003; Häubl and Trifts 2000) will, by definition, order alternatives such that the top-most listed alternative will be the best choice for the consumer. Similarly, a decision aid that weights attributes equally (Olson and Widing 2002) will, at a minimum, rank dominant alternatives above dominated ones. On the other hand, a decision aid that sorts alternatives on a single attribute may not lead to an ordering in which top alternatives are ranked first in terms of consumer utility; particularly when product attributes are negatively correlated and choice conflict is high.

There is some research on simple decision aids. For example, prior research has found that the ability to sort alternatives by attribute can lead to improvements in the quality of considered alternatives but marginal improvements in decision quality (Häubl and Trifts 2000). Other research shows that decision makers use simple decision aids to reduce effort without experiencing improvements in decision quality (Todd and Benbasat 1999). However, prior research has not examined whether, and the conditions under which, simple decision aids can hurt consumer decision making. Given the ubiquity of simple decision aids in online retail environments, examining these issues is important.

In the next sections, we develop and test our hypotheses about how the availability of simple sorting should have different effects on the quality of consumer decisions in high vs. low-conflict choice environments and how, beyond a certain point, greater use of simple decision aids should be associated with declines in decision quality. Next, we predict and find that restricting consumer use of simple decision aids improves decision quality. Finally, we examine whether the negative effects of simple decision aids can be overcome by providing consumers with a second aid to eliminate low quality alternatives.

**Simple Decision Aid Availability and Choice Quality**

Prior research on unaided decision making shows that consumers seek to minimize decision effort while maintaining high levels of decision quality (Payne, Bettman, and Johnson 1993). To achieve these goals, consumers adapt their decision strategies to task and context variables in choice environments (Bettman et al. 1993; Jarvenpaa 1989; Payne, Bettman, and Johnson 1993). Task variables are general characteristics of choice environments, such as the number of alternatives in a choice set and how the decision maker can interact and respond to information, whereas context variables refer to data values specific to a given decision problem, such as whether product attributes are positively or negatively correlated with one another (Bettman et al. 1993). For example, when product attributes are
negatively correlated with one another, choice conflict is high, and tradeoffs must be made among multiple attributes (Bettman et al. 1993; Payne, Bettman, and Johnson 1988), consumers are more likely to use compensatory decision making strategies, in which multiple attributes are considered at a time, because the gains in accuracy outweigh the additional effort involved in using such strategies. However, when choice conflict is low, consumers are more likely to employ non-compensatory heuristics that evaluate alternatives on a single attribute at a time, because, in low choice-conflict environments, heuristic strategies involve less effort yet lead to high-quality choices (Bettman et al. 1993; Huber and Klein 1991; Johnson, Meyer, and Ghose, 1989; Payne, Bettman, and Johnson 1988).

Although prior research shows that consumers are adaptive in their unaided decision making, we propose that consumers will not be similarly adaptive when using simple decision aids. In particular, because they trust decision aids to help them make good decisions (Alba et al. 1997; Bechwati and Xia 2003; Häubl and Trifts 2000; Hoch and Schkade 1996), and use decision aids as substitutes for cognitive effort (Todd and Benbasat 1992, 1999), they may overuse simple decision aids and fail to engage in sufficient (unaided) cognitive effort. This failure to adapt their behavior to account for the limitations of simple decision aids will, in some circumstances, lower decision quality.

Simple decision aids will be most beneficial in environments in which heuristic decision making can lead to good decisions and least beneficial in decision environments that require compensatory decision processes. For example, when product attributes are positively correlated and choice conflict is low, non-compensatory heuristic processes lead to relatively good decisions with low effort (Bettman et al. 1993). To the extent that simple decision aids such as sorting encourage such heuristic processes, there will be a strong fit between the decision processes afforded by the decision aid and those required by the choice environment. In contrast, when attributes are negatively correlated and choice conflict is high, compensatory decision processes are required and there will be a weak fit with the heuristic processes afforded by simple decision aids.

If consumers fail to properly adapt their use of simple decision aids to the decision environment by, for example, reducing their use of simple decision aids in environments characterized by high choice conflict, the quality of consumer decisions will depend on the fit between the aid and the decision environment. Because heuristic decision processes lead to good decisions in low choice conflict environments (Bettman et al. 1993), the availability of simple decision aids in such environments should enhance decision quality. However, because making good choices in high choice conflict environments requires the use of compensatory decision strategies, the availability of simple decision aids in such environments will not enhance decision quality. More formally:

**H1.** The unrestricted availability of a simple sorting tool improves decision quality to a greater extent when choice conflict is low vs. high.

**Simple Decision Aid Use and Choice Quality**

In addition to examining how the availability of a simple decision aid affects consumer decision making in different contexts, it is important to examine how the use of a simple decision aid affects decision outcomes. If consumers rely on an external decision aid to reduce their cognitive effort (Todd and Benbasat 1992), and trust decision aids to help them make good decisions (Alba et al. 1997; Bechwati and Xia 2003; Häubl and Trifts 2000; Hoch and Schkade 1996), they may fail to recognize the limitations of such aids and over use them. Importantly, sorting alternatives multiple times on different attributes is unlikely to enhance choice quality in either low or high-choice conflict environments. In particular, when choice conflict is low and attributes are positively correlated, sorting multiple times is unlikely to identify a different top alternative. Alternatively, sorting multiple times when choice conflict is high, and attributes are negatively correlated, should identify a different top alternative with each sort. Meanwhile, excessive reliance on simple decision aids should reduce the cognitive resources consumers dedicate to examining alternatives. Together, this suggests that greater use of simple sorting aids should, beyond a certain point, reduce decision quality:

**H2.** Greater use of a simple sorting tool has a curvilinear (inverted U) relationship with decision quality such that, beyond a certain point, increased use of the aid is associated with declines in decision quality.

We conducted an experimental study to examine how the unrestricted availability of a simple sorting tool affects decision quality under high and low choice conflict. Study 1 also measures the use of simple decision aids to assess whether greater use of simple decision aids has a curvilinear effect on decision quality.

**Study 1**

**Stimuli and Procedure**

Participants (116 undergraduate students) took part in a study for course credit in which they were asked to imagine they were buying a calculator for a friend’s birthday and had decided to order the calculator from an online retailer of consumer electronics, Electronics USA. They were told that all of the calculators cost $29.95, which was within their budget. Next, participants were told that a recent article in Consumer Reports suggested there were several attributes they should consider when buying a calculator: versatility, ease of use, battery life, warranty, weight, and memory. To help participants in their decisions, their friend had indicated the importance of these attributes on a scale from 1 to 100, where 100 was the most important and the sum of the attributes was 100. Participants were told to use these weights in their decisions. This agent task provides a normative sense of choice goodness and avoids potential measurement errors associated with using participants’ own preferences to determine the best choice (Payne, Bettman, and Johnson 1993).

Following previous research (Bettman et al. 1993), attribute values were randomly generated from a multivariate normal
distribution that ranged from 1 to 1000—with 1 as the worst and 1000 as the best. Attribute weights were randomly chosen from a uniform distribution and rescaled to sum to 100. Each choice set was presented as an 18 × 6 matrix with alternatives in rows and attributes in columns. Participants were told that the first row contained the friend’s attribute weights for the six attributes. The next eighteen rows contained the attribute values for each alternative. At the bottom of the screen, participants could select their preferred alternative among the eighteen available alternatives. At the top of the screen, an indicator showed the decision number. Participants were instructed to take as much time as they wished to view information about attribute weights and values and to make a decision. Participants made a practice decision followed by ten actual decisions. For each decision, participants were reminded that the first row contained the friend’s attribute weights and they needed to use those weights to make the best choice for their friend. The experimental session took roughly 20 min.

Participants were randomly assigned to make decisions either using an interface that offered a sorting tool or an interface that did not offer a sorting tool. To sort, participants in the sorting-present condition just needed to select an attribute and then click the “sort” button. Consistent with most e-commerce websites, participants could sort as many times as they wished. Alternatives were then sorted in descending order (best at the top) by that attribute. Other aspects of the interface were identical across conditions. For those for whom unRestricted sorting was available, decision aid use was measured as the number of times the sorting tool was used for a given decision.

Following prior research (Bettman et al. 1993), choice conflict was manipulated through the correlation among product attributes. To provide a strong test of adaptivity, attribute correlation was manipulated within subjects (Bettman et al. 1993). Choice sets were randomly generated from a multivariate normal distribution to create five positively correlated choice sets (mean pairwise attribute correlation = .60) and five negatively correlated choice sets (mean pairwise attribute correlation = −.20). The order of choice sets was random but the same for all participants. In summary, the availability of a simple decision aid was manipulated between subjects and choice conflict and trial were manipulated within subjects.

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\text{Choice Quality} = \frac{\text{Weighted Additive Value}_{\text{Choice}} - \text{Weighted Additive Value}_{\text{Worst}}}{\text{Weighted Additive Value}_{\text{Best}} - \text{Weighted Additive Value}_{\text{Worst}}}
\]

Although we proposed that over-sorting lowers decision quality by reducing the cognitive resources invested in decision making, an alternative explanation is that consumers who sort more extensively do so to increase certainty in their choices. To test this idea, subjective decision quality was assessed by averaging two 7-point scales (r = .78) measuring confidence and satisfaction after participants made all their choices: “How confident are you that you made the right choices?” and “How satisfied are you with your choices?” (1 = not at all, 7 = very much so).

Results

Because the range of expected utility is smaller for alternatives in negatively correlated sets than positively correlated sets (Bettman et al. 1993), we use Generalized Estimating Equations (GEE; Diggle et al. 2002; Häubl and Trifts 2000) repeated-measures regressions, with the availability of sorting (absent vs. present) and inter-attribute correlation (negative vs. positive) as factors, and the range of expected values in each choice set as a trial-specific covariate. (Results are similar using repeated-measures GLM analyses that do not control for the range of expected values.)

Decision aid availability. In support of Hypothesis 1, that the unrestricted availability of a simple decision aid improves decision quality to a greater extent when choice conflict is low vs. high, there was a significant interaction between choice conflict and the availability of a simple decision aid (χ²(1) = 11.00, p < .01) as shown in Figure 1. Pairwise comparisons show that the availability of a sorting tool helped when choice conflict was low (M_{available} = .91 vs. M_{unavailable} = .85, t(1160) = 2.37, p < .05) but not when it was high (M_{available} = .79 vs. M_{unavailable} = .82, t(1160) = .88, p = .38). Following previous research (Bettman et al. 1993).
Fig. 2. Study 1: curvilinear relationship between decision aid use and decision quality.

decision quality was higher when choice conflict was low vs. high ($M_{\text{LowConflict}} = .88$ vs. $M_{\text{HighConflict}} = .80$, $\chi^2(1) = 35.22, p < .001$). The main effect of the availability of a simple decision aid on decision quality was not significant ($M_{\text{available}} = .85$ vs. $M_{\text{unavailable}} = .84$, $\chi^2(1) = .36, p = .55$).

Decision aid use. To examine the predicted curvilinear relationship between decision aid use and decision quality, for those for whom the simple decision aid was available, decision quality was regressed on the number of sorts and the number of sorts squared (Mittal, Ross, and Baldasare 1998). In support of Hypothesis 2, that greater use of simple decision aids has a curvilinear effect on choice quality, results reveal a significant positive main effect of sorting ($\beta = .049$, $\chi^2(1) = 17.23, p < .001$) and a significant negative effect of sorting squared ($\beta = -.003$, $\chi^2(1) = 11.98, p < .01$) on decision quality showing that, beyond a certain point, increased use of a simple decision aid is associated with declining decision quality (see Fig. 2). The interactions between choice conflict and sorting ($\chi^2(1) = .29, p = .59$) and between choice conflict and sorting squared were not significant ($\chi^2(1) = .65, p = .42$).

Additional analysis: subjective decision quality. Providing additional support for the idea that consumers think simple decision aids are helpful, ANOVA results show that subjective decision quality was higher when a sorting tool was available ($M_{\text{available}} = 4.81$ vs. $M_{\text{unavailable}} = 4.15$, $F(1, 115) = 5.50, p < .05$). However, for those for whom sorting was available, regressing the average number of sorts on subjective decision quality does not reveal a significant relationship between them ($\beta = .125, F(1, 58) = .51, p = .48$), suggesting that greater sorting is not associated with enhanced certainty.

Discussion

Study 1 shows that the extent to which the availability of a simple sorting tool improves decision quality depends on the decision context. In particular, the availability of a simple sorting tool only improves decision quality when choice conflict is low. Results from Study 1 also show that there are negative consequences to using simple decision aids; beyond a certain point, increased use is associated with worse decisions. This raises the question: Can limiting the use of simple decision aids improve consumer decision making?

Limiting the Use of Simple Decision Aids

Study 1 demonstrates that, beyond a certain point, greater use of a simple sorting tool is associated with declines in decision quality. However, because decision aid use was measured rather than manipulated in Study 1, this result could also be driven by individual differences among study participants. For example, it may be that those who care less about their decisions are more likely to use simple decision aids and that these individual differences explain the results. More convincing evidence would be shown by directly testing the hypothesis that limiting the use of simple decision aids improves decision quality.

We have argued that consumers use simple decision aids as substitutes for cognitive effort (Todd and Benbasat 1992, 1999). Limiting the use of simple decision aids should encourage consumers to invest greater cognitive (and less aid-based) effort in examining alternatives. This suggests that decision quality may be improved by limiting the use of simple decision aids. More formally:

H3. Restricting the use of a simple sorting tool improves decision quality.

Study 2

Study 2 extends Study 1 to see if the surprising result, in which increased use of the decision aid reduces decision quality, would replicate in a study in which decision aid use was experimentally manipulated rather than measured; more specifically, to see if restricting decision aid use improves decision quality. In addition, to examine our argument that consumers fail to correctly assess the (effort reducing) benefits of greater use of simple decision aids—particularly under high choice conflict, Study 2 also examines whether restricting the use of a simple decision aid decreases decision effort.

Stimuli and Procedure

In Study 2, decision aid availability was manipulated at three levels between subjects. Participants were randomly assigned to either a sorting not available condition, a sort available for single use condition, or a sorting unrestricted condition. As in Study 1, choice conflict was manipulated within subjects through inter-attribute correlation and there were five within-subject replicates of each choice conflict condition. In other words, a $3 \times 2 \times 5$ mixed experimental design was employed. As in Study 1, choice sets consisted of 18 alternatives defined by six attributes. Participants made a practice choice followed by 10 actual decisions. Participants (165 undergraduate students) completed the study for course credit. Choice quality was measured as in Study 1.

Beyond examining effects of simple decision aids on decision quality, it is important to examine effects on decision effort. We have proposed that consumers use simple decision aids as substitutes for cognitive effort without accounting for the
limited marginal benefits of using these aids multiple times. This implies that restricting the use of simple decision aids will reduce decision effort (i.e., the total time spent making a decision). Because high choice conflict environments require greater cognitive effort, yet there are few benefits to additional use of simple decision aids in these environments, restricting the use of simple decision aids should reduce decision effort to a greater extent when choice conflict is high (vs. low). To test this idea, decision effort was measured as the total time spent making a decision (Häubl and Trifts 2000; Payne, Bettman, and Johnson 1988).

Results

Decision quality. GEE model means for the dependent measures are shown in Table 1. As in Study 1, results for the sorting unavailable and unrestricted sorting conditions support Hypothesis 1: The unrestricted availability of a simple sorting tool improved decision quality to a greater extent when choice conflict was low vs. high. The interaction between choice conflict and the unrestricted availability of a decision aid was significant ($\chi^2(1) = 3.90, p < .05$). Pairwise comparisons show that, relative to the sorting unavailable condition, the unrestricted availability of a sorting tool improved decision quality when choice conflict was low ($M_{\text{unrestricted}} = .95$ vs. $M_{\text{unavailable}} = .89$, $t(1110) = 2.45, p < .05$) but not when it was high ($M_{\text{unrestricted}} = .85$ vs. $M_{\text{unavailable}} = .84$, $t(1110) = .22$, $p = .83$). As in Study 1, decision quality was higher under low vs. high choice conflict ($M_{\text{LowConflict}} = .92$ vs. $M_{\text{HighConflict}} = .84$, $\chi^2(1) = 29.86, p < .001$). The main effect of providing an unrestricted simple decision aid on decision quality was not significant ($M_{\text{unrestricted}} = .90$ vs. $M_{\text{unavailable}} = .87$, $\chi^2(1) = 2.41$, $p = .12$).

As in Study 1, we examined the predicted quadratic effect of decision aid use on decision quality for those for whom an unrestricted simple decision aid was available. Again, in support of Hypothesis 2, regressing the number of sorts and the number of sorts squared on decision quality shows a significantly positive main effect of sorting ($\beta = .032$, $\chi^2(1) = 3.91$, $p < .05$) and a significantly negative effect of sorting squared ($\beta = -.002$, $\chi^2(1) = 4.09$, $p < .05$) on decision quality. As in Study 1, this shows that, beyond a certain point, increased use of a simple decision aid is associated with lower decision quality. The interactions between choice conflict and sorting ($\chi^2(1) = 2.82, p = .09$) and between choice conflict and sorting squared ($\chi^2(1) = 1.64, p = .20$) were not significant.

Comparing the sorting unavailable, sorting restricted, and sorting unrestricted conditions, however, showed a significant main effect of decision aid availability on decision quality ($\chi^2(2) = 15.69, p < .001$). Results support Hypothesis 3: Restricting the use of a simple decision aid improves decision quality. Consistent with Study 1, in which use of the decision aid was measured rather than manipulated, restricting sorting to a single use per decision led to higher decision quality ($M = .93$) than sorting not being available ($M = .87$) or unrestricted ($M = .90$). A polynomial contrast revealed a significant quadratic effect ($\beta = -.038$, $\chi^2(1) = 13.88, p < .001$; see Fig. 3). The linear trend was not significant ($\beta = .023$, $\chi^2(1) = 2.41, p = .12$) and the interaction between decision aid availability and choice conflict was marginal ($\chi^2(2) = 5.24, p = .07$).

Decision effort. In support of the proposal that consumers use simple decision aids as substitutes for cognitive effort without accounting for the fit of these aids with the decision environment, decision effort was affected by the interaction between choice conflict and decision aid availability ($\chi^2(2) = 28.98, p < .001$; see Fig. 4). Under choice conflict, decision effort was lowest when the decision aid could only be used once per decision. Restricting sorting to a single use decreased total decision time relative to sorting being unavailable ($M_{\text{restricted}} = 51.62$ s vs. $M_{\text{unavailable}} = 63.16$ s, $t(1650) = 6.62, p < .001$) or unrestricted ($M_{\text{restricted}} = 51.62$ s vs. $M_{\text{unrestricted}} = 66.04$ s, $t(1650) = 7.31, p < .001$). Under choice conflict, differences in decision effort between the sorting unavailable and unrestricted conditions were not significant ($M_{\text{unavailable}} = 63.16$ s vs. $M_{\text{unrestricted}} = 66.04$ s, $t(1650) = 1.53, p = .13$). In contrast, when choice conflict was low, restricting the use of the decision aid decreased total decision time compared to sorting being unavailable ($M_{\text{restricted}} = 44.94$ s vs. $M_{\text{unavailable}} = 55.93$ s, $t(1650) = 6.11, p < .001$) but not relative to unrestricted sorting ($M_{\text{restricted}} = 44.94$ s vs. $M_{\text{unrestricted}} = 48.06$ s, $t(1650) = 1.58, p = .11$). When choice conflict was low, decision effort was also lower when sorting was unrestricted ($M_{\text{unrestricted}} = 48.06$ s).
than when sorting was unavailable ($M_{\text{unavailable}} = 55.93$, $t(1650) = 4.91$, $p < .0001$).

In addition to the predicted interaction, there was also a main effect of decision aid availability on decision effort. The ability to sort one time, compared to not being able to sort or the ability to sort multiple times, reduced the total time spent making a decision ($M_{\text{restricted}} = 48.28$ s vs. $M_{\text{unrestricted}} = 57.05$ s vs. $M_{\text{unavailable}} = 59.55$, $\chi^2(2) = 52.59$, $p < .001$). Overall, differences in decision effort between unavailable and unrestricted sorting conditions were not significant ($M_{\text{unavailable}} = 59.55$ s vs. $M_{\text{unrestricted}} = 57.05$, $t(1650) = 1.88$, $p = .06$). Decision effort was also greater under choice conflict, as shown by an increase in the total time spent making a decision ($M_{\text{High Conflict}} = 60.28$ s vs. $M_{\text{Low Conflict}} = 49.64$, $\chi^2(1) = 157.14$, $p < .001$). These results indicate that consumers are not simply using decision aids to reduce effort without accounting for decision quality but are, instead, failing to account for limited extent to which greater use of such aids is an effective substitute for cognitive effort.

**Discussion**

As in Study 1, Study 2 shows that the unrestricted availability of a simple decision aid improves choice quality when choice conflict is low but not when it is high. In other words, providing a simple decision aid is not always helpful; surprisingly, simple decision aids help consumers most when they least need it. Study 2 also replicates the earlier results showing that greater use of simple decision aids is associated with declines in decision quality.

Interestingly, Study 2 finds that decision quality is actually improved by restricting the use of a simple decision aid. That is, a simple decision aid that can only be used once per decision is more helpful than one that can be used an unlimited number of times. In addition, under choice conflict, providing a restricted simple decision aid significantly reduces decision making effort while providing an unrestricted decision aid does not benefit decision effort. These results are interesting because they suggest that consumers are maladaptive in their use of unrestricted aids. In contrast to the adaptive decision making literature (Payne, Bettman, and Johnson 1993) and consumer beliefs about simple decision aids, these results show that, under choice conflict, unrestricted aids neither improve decision quality nor reduce decision effort. Instead, preventing consumers from over-relying on simple decision aids improves their decision making.

**Study 3: Sorting and Elimination**

Studies 1 and 2 show that the availability of a simple sorting tool only enhances decision quality when choice conflict is low; beyond a certain point, greater use of simple sorting is associated with lower decision quality. Restricting the use of simple sorting improves decision quality and, when choice conflict is high, reduces decision effort. We have argued that these effects are due to the tendency for consumers to use simple decision aids as substitutes for cognitive effort even when such substitution is inappropriate.

While sorting is the most commonly deployed simple decision aid, many online retailers also allow consumers to eliminate alternatives from consideration. Although, beyond a certain point, greater use of simple sorting alone is unlikely to reduce the cognitive load faced by a consumer, the combination of simple sorting with elimination should reduce cognitive load; particularly under high choice conflict. More specifically, while an initial sort may be insufficient to identify the best alternative under high choice conflict, it should allow consumers to better identify a subset of alternatives for consideration. Using an elimination tool to remove the lowest quality alternatives should reduce the number of alternatives that need to be evaluated and enhance decision quality. Study 3 examines this idea.

**Procedure**

Experimental variables in Study 3 were identical to those in Study 1 except that, in addition to manipulating the availability of unrestricted sorting between subjects, Study 3 also manipulated the availability of an unrestricted elimination tool as a between subjects factor. To hide alternatives from view, participants for whom an elimination tool was available just needed to select one or more alternatives and then click the “update” button. Deselecting alternatives and clicking “update” restored those alternatives to view. Because usability testing suggested that having more than one decision aid increased the perceived complexity of the decision task, the size of the choice set was reduced to 12 alternatives × 6 attributes. Participants (122 undergraduates) were randomly assigned to one of the four between-subjects conditions. As in Studies 1 and 2, choice conflict was manipulated within subjects through inter-attribute correlation. Dependent measures in Study 3 were identical to those in Study 1, except that the number of alternatives eliminated and decision effort were also measured.
Results

GEE model results are presented in Table 2. The mean quality of choices was high (M = .84). On average, when sorting was available, participants sorted an average of 2.85 times per decision; when elimination was available, participants used this tool an average of 1.56 times per decision and eliminated an average of 3.5 alternatives. Participants sorted more often (M_{HighConflict} = 3.20 vs. M_{LowConflict} = 2.50, \chi^2(1) = 11.32, p < .01) and eliminated alternatives more often (M_{HighConflict} = 1.79 vs. M_{LowConflict} = 1.32, \chi^2(1) = 10.41, p < .01) when choice conflict was high than low.

**Decision quality.** Providing additional support for Hypothesis 1, there was a significant interaction between choice conflict and the availability of sorting tools (\chi^2(1) = 7.89, p < .01) such that the availability of sorting tools increased decision quality when choice conflict was low (M_{Available} = .95 vs. M_{Unavailable} = .91, t(1220) = 2.07, p < .05) but not when choice conflict was high (M_{Available} = .74 vs. M_{Unavailable} = .76, t(1220) = .76, p = .44). Interestingly, there was also a significant interaction between choice conflict, the availability of sorting tools, and the availability of elimination tools (\chi^2(1) = 16.51, p < .001; see Fig. 5). Planned comparisons show that, when choice conflict was high, the availability of sorting tools increased decision quality when an elimination tool was also present (M_{SortingAvailable} = .79 vs. M_{SortingUnavailable} = .73, t(1220) = 2.06, p < .05) but decreased decision quality when the elimination tool was absent (M_{SortingAvailable} = .69 vs. M_{SortingUnavailable} = .78, t(1220) = 3.01, p < .01). However, when choice conflict was low, the availability of a sorting tool increased decision quality regardless of the availability of an elimination tool (t(1220) < 1.96, ns). As in Studies 1 and 2, decision quality was lower when choice conflict was high than low (M_{HighConflict} = .75 vs. M_{LowConflict} = .93, \chi^2(1) = 319.54, p < .001). Other effects were not significant.

In further support of Hypothesis 2, results reveal a significant positive main effect of sorting (\beta = .024, \chi^2(1) = 15.96, p < .001) and a significant negative effect of sorting squared (\beta = -.002, \chi^2(1) = 15.65, p < .001) on decision quality showing that, beyond a certain point, increased use of a sorting tool hurts decision quality. The interactions between choice conflict and sorting (\chi^2(1) = 1.04, p = .31) and between choice conflict and sorting squared were not significant (\chi^2(1) = 3.55, p = .06). Neither eliminations (\beta = .002, \chi^2(1) = .03, p = .87) or eliminations squared (\beta = .000, \chi^2(1) = .03, p = .87) had significant effects on decision quality.

**Decision effort.** GEE results show a significant main effect of the availability of elimination tool on total decision time (M_{EliminationAvailable} = 45.65 s vs. M_{EliminationUnavailable} = 30.53 s, \chi^2(1) = 21.87, p < .001). The availability of a sorting tool did not significantly affect decision effort (\chi^2(1) = .35, p = .55). As in Study 2, total decision time was greater when choice conflict was high vs. low (M_{HighConflict} = 45.77 s vs. M_{LowConflict} = 30.46 s, \chi^2(1) = 236.30, p < .001). Other effects were not significant.

**Table 2** Study 3: means.

<table>
<thead>
<tr>
<th></th>
<th>Sorting unavailable</th>
<th></th>
<th>Unrestricted sorting</th>
<th></th>
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<tbody>
<tr>
<td></td>
<td>Elimination unavailable</td>
<td>Unrestricted elimination</td>
<td>Elimination unavailable</td>
<td>Unrestricted elimination</td>
</tr>
<tr>
<td>Decision quality</td>
<td>.91 (22)</td>
<td>.78 (22)</td>
<td>.91 (33)</td>
<td>.73 (27)</td>
</tr>
<tr>
<td></td>
<td>.94 (12)</td>
<td>.69 (26)</td>
<td>.95 (19)</td>
<td>.79 (16)</td>
</tr>
<tr>
<td>Total decision time</td>
<td>27.29 (11.82)</td>
<td>39.75 (11.89)</td>
<td>35.72 (12.10)</td>
<td>55.55 (12.01)</td>
</tr>
<tr>
<td></td>
<td>23.22 (11.93)</td>
<td>34.51 (12.16)</td>
<td>38.03 (12.40)</td>
<td>57.58 (12.21)</td>
</tr>
</tbody>
</table>

^a Quality of choice relative to the best and worst alternatives in the choice set. Standard deviations are in parentheses.
Discussion

Results from Study 3 provide further insights into the effects of simple decision aids on decision quality and effort. As in the earlier studies, Study 3 shows that the availability of unlimited sorting alone leads to improvements in decision quality only when choice conflict is low. Under high choice conflict, only providing an unlimited sorting tool reduces decision quality. As in Study 2, the availability of unlimited sorting does not significantly affect decision effort, again, showing that declines in choice quality are not offset by decreased decision effort. Together, these results provide additional evidence that consumers are maladaptive in their use of simple sorting tools.

However, Study 3 further shows that the negative effects of simple sorting can be overcome by providing consumers with elimination as well as sorting tools. Under high choice conflict, providing both tools improves decision quality. Results from Study 3 also suggest that providing elimination tools can increase decision effort. The benefits of this greater effort depend on whether sorting and elimination tools are available and whether decision conflict is high. In other contexts, providing consumers with elimination tools may increase decision effort without enhancing decision quality.

General Discussion

Simple decision aids offer consumers a greater role in controlling the information environment (Ariely 2000; Hoffman and Novak 1996; Lurie and Mason 2007). In theory, simple decision aids should allow consumers to make better decisions and be more efficient processors of information (Bellman et al. 2006; Van Bruggen, Smidts, and Wierenga 1998; West et al. 1999). The widespread deployment of simple decision aids and our pretest suggests that online retailers and consumers expect such aids to be helpful. However, results from three experimental studies show this is not always true.

Study 1 shows that, although the unrestricted availability of a simple sorting aid improves decision quality when choice conflict is low, improvements in decision quality are not found when choice conflict is high. This does not mean that simple decision aids are benign; however; beyond a certain point, greater use of a simple sorting decision aid is associated with declines in decision quality. Study 2 replicates and extends these results to show that decision quality is highest when use of a simple sorting decision aid is limited. Furthermore, under choice conflict, decision effort is actually reduced by restricting the use of the sorting aid. In other words, preventing consumers from relying too much on simple decision aids increases decision quality and reduces decision effort.

Study 3 examines whether other simple decision aids, such as elimination, can be combined with sorting to reduce cognitive load and improve decision quality. Results from Study 3 show that, although providing sorting alone hurts decision quality when choice conflict is high, decision quality is improved when both elimination and sorting are available. In other words, providing multiple simple decision aids is one way to overcome the limitations of these aids.

To gain a better sense of the real-world implications of our results, we conducted an additional analysis of Study 1 data to examine how decision aids affect decision optimality (i.e., selection of the best option in a choice set). Results from Study 1 show that the average probability of optimal choice across all conditions was only 37.5%. Consistent with the continuous measure of decision quality, the availability of a simple decision aid increased the probability of making an optimal choice when choice conflict was low ($M_{\text{available}} = 44\%$ vs. $M_{\text{unavailable}} = 34\%$, $\chi^2(1, N=580) = 5.69, p < .05$) but not when it was high ($M_{\text{available}} = 35\%$ vs. $M_{\text{unavailable}} = 38\%$, $\chi^2(1, N=580) = .43, p = .51$). In addition, as with the continuous measure of decision quality, greater use of simple decision aids had a curvilinear relationship with optimal choice; there was a positive effect of sorting ($\beta = .564$, $\chi^2(1) = 9.52, p < .01$) and a negative effect of sorting-squared ($\beta = -.086$, $\chi^2(1) = 6.26, p < .05$) on the probability of choosing the best alternative; implying that overusing a simple decision aid is associated with a lower likelihood of optimal choice. These results suggest that, within our data, (1) most choices are not optimal and there is an opportunity to improve the optimality of consumer decisions and (2) the positive and negative effects of simple decision aids are important and likely to be exacerbated in real-world online settings characterized by large choice sets or high choice conflict.

Our results run counter to academic, consumer, and managerial intuition. In addition to offering an alternative perspective to the large literature which suggests that decision aids will help consumers, particularly in complex decision environments (West et al. 1999), our results show that, although consumers expect simple decision aids to help them make good decisions, unrestricted access to simple decision aids can sometimes be detrimental. Although most would argue that greater use of decision aids should not be harmful, our results show that limiting the use of simple decision aids or providing additional tools, such as elimination, can improve the quality of consumer decisions.

This article also contributes to research on adaptive decision making as it shows that, although consumers are highly adaptive in their use of different decision strategies in the absence of decision aids (Payne, Bettman, and Johnson 1988, 1993), they can be maladaptive in their use of simple decision aids. In contrast to prior research using consumer or judge based attribute weights to sort alternatives based on utility, which finds that consumers fail to sufficiently rely on comprehensive decision aids (Diehl 2005; Diehl, Kornish, and Lynch 2003), we find that consumers over rely on simple decision aids that sort alternatives on a single attribute. Both Diehl’s and our results suggest that consumers are less adaptive when using decision aids than when making unassisted decisions.

Finally, this article adds to research on the relationship between effort and accuracy in decision making (Payne, Bettman, and Johnson 1993). Prior research on unassisted decision making has shown that consumers tend to adjust their decision making effort in order to maintain decision quality.
in different choice contexts. That is, consumers make tradeoffs between decision accuracy and effort. In contrast, this article shows that, depending on the choice context and whether or not their use is restricted, simple decision aids can simultaneously reduce effort and improve decision accuracy or, conversely, simultaneously increase effort and lower decision accuracy. In other words, the tradeoff between effort and accuracy found in unassisted decision making does not appear to hold for simple decision aids.

**Implications for Retail Management**

The results from this research have important practical implications for retailers and consumer welfare. From a managerial standpoint, our findings are important since choice conflict, in which tradeoffs must be made among different attributes, is characteristic of most consumer settings. Environments in which attributes are positively correlated, and a few alternatives dominate all other alternatives on most dimensions, are rare. Although simple decision aids have the potential to reduce cognitive load and improve decision quality, our results show that care should be taken in deploying simple decision aids in online retail environments.

Our results suggest that restricting the use of decision aids, or offering both sorting and elimination tools rather than sorting alone, can overcome some of the shortcomings of simple decision aids in online decision environments. In deciding how to deploy decision aids, retailers should consider their match with consumers’ decision processes. For example, for retail contexts in which consumers make low-involvement non-compensatory decisions, providing a restricted simple decision aid, in which sorting is limited, should improve decision quality and reduce decision effort. However, for high-involvement compensatory decisions, providing multiple aids should benefit decision quality but at the expense of greater decision effort. An additional way that simple decision aids can be deployed to maximize their benefits is to provide sorting on gestalt characteristics, such as star ratings from consumers or expert judges (Diehl 2005). Such an approach allows utility-like sorting without the need to elicit consumer preferences.

**Limitations and Future Research**

It is important to point out several limitations of this work. First, for experimental control, these studies were limited to a product category of interest to our participants and lacked much of the richness of real websites. Future research could seek to address these issues, perhaps examining the use of simple decision aids on real websites. In manipulating choice conflict, we followed prior research and manipulated the correlations among all attributes. An alternative approach would be to only manipulate the correlations of the two most important attributes. Also, to control for potential measurement errors associated with using participants’ own preferences to determine the best choice (Payne, Bettman, and Johnson 1993), our studies used agent tasks, in which preferences were externally provided; future research could examine how simple decision aids affect decision making in more realistic non-agent tasks. Other research could examine how differences in consumer motivation, or need for cognition (Levin, Huneke, and Jasper 2000), moderate the relationship between the availability of simple decision aids and decision quality.

Although we studied sorting and elimination tools, future research could examine other types of simple decision aids. For example, future research could examine filtering tools that help consumers select alternatives that meet certain criteria on certain attributes. To the extent that this reduces choice set size, cognitive load should be lower, and the negative effects of sorting under high choice conflict should be minimized. At the same time, filters are of limited use when consumers must make tradeoffs among attributes—such as the high choice conflict environments studied here. Other research could examine when providing multiple simple decision aids is beneficial. Our results suggest that, when choice conflict is low, providing additional aids such as elimination increases decision effort without enhancing decision quality. Future research could further explore the conditions under which providing additional aids helps and hurts consumer decision making. As new technologies continue to blur the boundaries between computer and consumer information processing, it is important to test their implications for human behavior.

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6 In a separate study, we manipulated choice set size and found that when choice sets were small (vs. large), availability of a sorting tool had limited effects on decision quality and effort.
Appendix. Preliminary Study Interfaces

Without Sorting Tool

With Sorting Tool
References


Xu, Yunjie (Calvin) and Hee-woong Kim (2008), “Order Effect and Vendor Inspection in Online Comparison Shopping,” Journal of Retailing, 84 (4), 477–86.