Satisfaction in choice as a function of the number of alternatives: When "goods satiate" but "bads escalate" [*]

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Abstract

Whereas people are typically thought to be better off with more choices, studies show that they often prefer to choose from small as opposed to large sets of alternatives. We propose that satisfaction from choice is an inverted U-shaped function of the number of alternatives. This proposition is derived theoretically by considering the benefits and costs of different numbers of alternatives and is supported by four experimental studies. We also manipulate the perceptual costs of information processing and demonstrate how this affects the resulting "satisfaction function." We further indicate that satisfaction when choosing from a given set is diminished if people are made aware of the existence of other choice sets. The role of individual differences in satisfaction from choice is documented by noting effects due to gender and culture. We conclude by emphasizing the need to have an explicit rationale for knowing how much choice is "enough."

Keywords: Consumer choice; perception of variety; tyranny of choice; visual perception; cultural differences.

Recent research has drawn attention to the fact that, in today's world, people often face an embarrassment of riches in the form of the numbers of alternatives available for decisions involving both small and large stakes, e.g., from chocolates and yogurts to health plans and pension schemes. And yet, although both economic theory and the psychological literature emphasize that people are better off with more choice (see, e.g., Langer & Rodin, 1976; Zuckerman et al., 1978; Ryan & Deci, 2000), having many alternatives can be dysfunctional (Schwartz, 2000; 2004; Iyengar, Wells, & Schwartz, 2006). Rather than choosing from many alternatives, people sometimes forego or delay decisions even though this can be costly (Iyengar, Huberman, & Jiang, 2004). At the same time, some studies report greater satisfaction when choice involves limited numbers of alternatives (say six as opposed to thirty, Iyengar & Lepper, 2000).

This paper explores how satisfaction from choice varies as a function of set size (i.e., the number of alternatives faced). In doing so, we first note that, at an empirical level, the set sizes examined in previous studies favoring choice are typically limited (up to 6 options) while the sets claimed to be demotivating are typically large (24-30 options) (Iyengar & Lepper, 2000; Kahn & Wansink, 2004). Curiously, little attention has been paid to choices involving intermediate numbers of alternatives (between 10 and 20 options, for example). Second, at a theoretical level we note that authors of these empirical studies have not provided an *explicit* underlying rationale for the phenomena. There seems, however, to be an implicit argument that the perceived "benefits" of choice outweigh the "costs" when set sizes are small, but that the reverse obtains for large set sizes.

The goal of this paper is to provide and test an explicit theoretical rationale for how satisfaction from choice varies as a function of set size. We emphasize that such an explanation should not just predict that more (less) choice is preferred when set size is

small (large) but also what happens at intermediate levels. It should also indicate how characteristics of choice alternatives as well as people can affect the relation between satisfaction and set size. In addition to intrinsic theoretical interest, we stress that developing an explicit account of the relation between satisfaction and set size is important from a practical perspective. From the viewpoint of public policy, for example, it is important to understand how this tradeoff affects people's choices when they are confronted with important decisions such as pension schemes and health plans (cf., Botti & Iyengar, in press).

More specifically, we build on the idea that perceived benefits and costs (defined below) impact satisfaction with choice – positively and negatively, respectively. Moreover both benefits and costs increase with the number of alternatives. However, we assume that the latter increase faster than the former (e.g., the benefits increase at a decreasing rate whereas the costs increase at an increasing rate). This assumption – that "goods satiate" while "bads escalate" (Coombs & Avrunin, 1977) – is not trivial and leads to predicting that satisfaction, which is defined as net benefits (i.e., benefits less costs), is an inverted U-shaped function of set size as illustrated in Figure 1.

Insert Figure 1 about here

Two clear implications of this function are that, first, greater satisfaction will be experienced from choices made from intermediate as opposed to large or small set sizes; and second, changes in perceived costs and benefits will shift the position of the peak of the satisfaction function. For example, holding benefits constant, lower costs will shift the peak to the right whereas greater costs will shift it to the left. We test these two implications in a series of four experiments in which participants were asked to choose between gift boxes presented in different set sizes. We emphasize the explicit nature of

our theoretical rationale and, in particular, the predicted shape of the satisfaction function. Our model implies much more than the extant empirical observations of greater satisfaction with more alternatives in "small" sets and less alternatives in "large" sets. More critically, it can be falsified empirically. In addition, our model contributes to the psychological literature on inverted U-shaped phenomena (Miller, 1956; Berlyne, 1971) by focusing on tasks involving choice rather than perception or the elicitation of the "pleasantness" of stimuli. This is important because choice and perception are not tasks that can be considered as equivalent (Tversky & Kahneman, 1986, p. S257).

Critical to our analysis are the definitions of perceived costs and benefits. We consider these to have two components that can be thought of as situational, on the one hand, and psychological, on the other. By situational we mean considerations of utility as well as the cost of time needed to make a decision. For example, what value does the decision maker attribute to having more alternatives? How important is the decision? And so on. By psychological we refer to both cognitive and psychic costs. In our experimental work, we explicitly manipulate cognitive costs of information processing by varying the visual attributes of choice alternatives and demonstrate how this affects the shape of the satisfaction function. Coincidentally, our experimental participants differed on two important personal dimensions, gender and culture. Moreover, whereas the general shapes of the satisfaction functions for all groups were consistent with our theoretical rationale, differences between groups suggested differences in perceptions of costs and benefits by gender and culture.

This paper is organized as follows. The next section elaborates on the theoretical framework for the experimental studies. This is followed by the presentation of four experiments. Experiment 1 explores the shape of the satisfaction function and examines the effect of costs due to visual characteristics of choices. Experiment 2 is a replication

of Experiment 1 in two Eastern European countries. Experiments 3 and 4 further investigate the effects of varying cognitive and psychic costs respectively. We conclude by discussing implications.

Theoretical Framework

The proliferation of choice alternatives can be thought of as implying benefits and costs at two levels. One is at the level of the collective or society, the other at that of the individual. For the former, the existence of many alternatives is clearly advantageous in that it enables satisfying a multiplicity of different individual preferences. In addition, many choices can lead to the benefits of competition, e.g., lower prices and greater quality (Loewenstein, 1999). Moreover, the mere fact of having choice alternatives can enhance psychological well-being and thus also social welfare (cf., Langer & Rodin, 1976).

At the individual level, however, the perceived benefits and costs of choice depend on both situational and psychological factors. One way of conceptualizing how these affect satisfaction is to specify how their associated benefits and costs vary as the number of alternatives in the choice set increases. This is illustrated in Table 1 where we, first, decompose situational and psychological costs, and, second, indicate how associated costs and benefits increase with set size. Whereas, these costs and benefits may interact in different ways, we simplify the discussion here by concentrating on "main effects."

Insert Table 1 about here

We decompose situational factors into two components: time and economic. For the individual, we simply assume that, ceteris paribus, the cost of time to make a

decision increases linearly with the number of alternatives examined. As to the economic factor – or more broadly the economist's notion of utility – we take it that benefits increase with the number of alternatives but at a decreasing rate.

At the psychological level, the cognitive costs of processing alternatives increase with the number of alternatives but at an increasing rate. Indeed, there is evidence that as the number of alternatives in a choice set increases, people deal with the increasing "cognitive strain" by shifting to less comprehensive information processing strategies (cf., Payne, Bettman, & Johnson, 1993).

At the psychic level, we postulate both benefits and costs. By the former we mean the positive affect that is generated by having more choice. In general, there is an attraction to having more alternatives (cf., Iyengar & Lepper, 2000. As a thought experiment, contrast the emotional feelings experienced when entering a grocery store offering only a few options as opposed to entering a well-stocked competitor.) By psychic costs we mean psychological costs that are emotional as opposed to cognitive in nature. These could be caused by discomfort due to uncertainty concerning one's preferences, lack of expertise, concern or regret about making an incorrect decision, emotional costs of making trade-offs, and so on (cf., Loewenstein, 1999). As indicated in Table 1, although both psychic benefits and costs are assumed to increase with the number of alternatives, the former do so at a decreasing rate and the latter at an increasing rate.

Summing the situational and psychological benefits and costs of choice, our assumptions imply that, whereas both increase with the number of alternatives, benefits do so at a decreasing rate but costs at an increasing rate. Thus, equating satisfaction with the net difference between benefits and costs, we predict that satisfaction is an inverted-

U shaped function of the number of alternatives[1]. This is precisely the type of situation described by Coombs and Avrunin (1977), i.e., when "goods satiate but bads escalate."

The framework implicit in Table 1 also suggests how individual differences will affect the relation between satisfaction and set size. For example, holding other variables constant, relative expertise in a given area or well established preferences would be expected to lower psychological costs and thereby shift the maximum of the satisfaction curve to the right. We do not investigate the effects of such individual differences explicitly in this work but return to discuss the possibility in the General Discussion (below). We also emphasize that we limit our analysis and predictions to situations where people do actually make choices. The issue of when people avoid choice is deferred to the General Discussion.

As noted above, we have simplified the discussion of the benefits and costs of different numbers of alternatives by ignoring possible interactions between different components. However, we believe that the simple structure implied by Table 1 should be investigated prior to considering such factors. This is the purpose of the present paper.

We therefore state our first hypothesis.

Hypothesis 1: Satisfaction from choice is an inverted U-shaped function of the number of alternatives in the choice set.

Effects of different visual presentations. An implication of the model in Table 1 is that changes to benefits and costs will change the satisfaction function. That is, it will maintain its inverted-U shape but maximum satisfaction will be shifted to the right or left, up or down, as appropriate.

Several studies suggest that the manner in which choice sets are presented can affect decisions, especially, when these are large. For example, Miller (1956) noted that

the organization of information into "chunks" or sequences facilitates information processing. More recently, Kahn and Wansink (2004) showed how organization affects consumers' perceptions of the variety of an assortment (i.e., perceived variety).[2] For large choice sets, perceived variety is higher in organized sets; whereas for smaller sets, it is greater in disorganized sets.

Huffman and Kahn (1998) investigated how to present large choice sets without decreasing satisfaction. They demonstrated that, for high-variety sets, consumers were more satisfied (in terms of learning their own preferences), perceived less complexity, and were more willing to make choices when alternatives were presented in attribute- rather than alternative-based formats.

We suggest that satisfaction is also affected by the visual presentation of choice sets in that this impacts the cognitive costs of information processing. Noting the implications of limitations in human visual abilities, Filin (1998) argues that people experience a feeling of discomfort and dissatisfaction in two "poorly organized" visual environments: "aggressive" environments (i.e., those with a great concentration of similar elements) and "homogeneous" environments (i.e., those with monotonic visual scenes, like plain white walls).

In our work, we consider the effect of two visual qualities – color and shape.[3] We suggest that if a choice set is large and the alternatives differ only in shape, the assortment has a "monotonic" look such that the consumer faces a "homogeneous" visual environment that imposes costs of discomfort (i.e., cognitive costs increase). Provision of colors, however, may resolve the problem of monotonicity by making the items more distinct thereby reducing costs for the human visual system.

Indeed, Spring and Jennings (1993) claim that hue is recognized pre-attentively, while complex shape is a non-preattentive stimulus that requires more time to be

processed. Thus, to the extent that hue is a pre-attentive stimulus, its detection should not depend on the size of the set in which it is presented (Spring & Jennings, 1993). On the other hand, since shape is a non-preattentive stimulus, the time and effort involved in processing shapes should be particularly high in larger sets.

We therefore propose that, when the set of alternatives is large, the cost of choice is higher for sets with alternatives differing in shape than for those differing in color. As a result, we expect people to be more satisfied when they are presented with large sets with options that differ in color as opposed to shape. In other words, the peak of the satisfaction function for colors will lie to the right of that for shapes.

However, when the choice set is small (i.e., within human information processing limits), the negative impact on the human visual system should not be significant and we expect no such difference. More formally, we state:

Hypothesis 2: Visual presentation of sets affects satisfaction. People experience higher satisfaction when the alternatives in large choice sets are different in color but not in shape. However, for small choice sets, they are equally satisfied when alternatives are presented in either different colors or shapes.

Experiment 1

The aim of Experiment 1 was to explore how satisfaction from choice varies as a function of the number of alternatives and to examine how changes in cognitive costs affect satisfaction. In this laboratory experiment, participants were given a picture representing a set of gift boxes with a certain number of alternatives (*5*, *10*, *15*, or *30*). They were asked to choose one gift box they would buy to pack a present for a friend and to report their levels of satisfaction. We manipulated cognitive costs imposed on individuals by varying two visual attributes of the gift boxes – color and shape.

Method

Choice sets. Choice sets consisted of *5*, *10*, *15*, or *30* gift boxes. The gift boxes differed from each other on two visual attributes: color and/or shape. Three types of sets were created representing gift boxes of: (1) the **s**ame **s**hape and **d**ifferent **c**olors (SSDC sets); (2) the **s**ame **c**olor and **d**ifferent **s**hapes (SCDS sets); (3) and **d**ifferent **c**olors and **d**ifferent **s**hapes (DCDS sets). The gift boxes did not contain anything and, except for visual attributes, were said to be identical. We refer to the SSDC and SCDS sets as "simple" since they vary on only one attribute and to the DCDS sets as "complex" since alternatives differ on two dimensions.

Previous research demonstrates that perceived variety is affected by how sets are organized and by relative symmetry in the frequency of items (Kahn & Wansink, 2004). To control for these effects, no choice sets contained identical alternatives and all sets were organized (e.g., by shading of colors).

Participants and procedure. The 120 participants were students and professors at several universities in Barcelona (53% females, mean age of 23.7 years). All spoke English and received no financial remuneration.

The participants were randomly divided into 12 experimental groups formed by crossing two between-subject factors – number of choice options with four levels (*5*, *10*, *15* or *30*), and three types of choice sets, SSDC, SCDS, and DCDS.

The experimenter invited one participant at a time into the experimental laboratory and showed him/her a picture representing a set of gift boxes. (Participants were unaware of the existence of other choice sets.) Each participant had to examine the picture and state which box s/he would buy to pack a present for a friend. After

choosing, participants answered a paper-based questionnaire, evaluating satisfaction from the choice and providing demographic characteristics.

Dependent measures. We measured satisfaction with the option chosen by participants' answers to the question "How much do you like the gift box you decided to pick?" Responses to two further questions were used to measure satisfaction from the process of choice itself. These were "How much did you enjoy making the choice (the decision process)?" and "Did you find it difficult to make your decision of which gift box to purchase?" Responses were provided on a Likert scale ranging from 1 ("not at all") to 10 ("extremely").

To evaluate whether participants felt they had been offered too many, too few, or the right amount of options, the respondents were also asked: "Do you feel you had the right amount of options to choose from?" Responses were provided on a nine-point Likert scale where 1 = "No, I had too few choice options," 5 = "Yes, I had just the right number of choice options," and 9 = "No, I had too many choice options."[4]

Results

Satisfaction from the choice function. The results of Experiment 1 strongly support our first hypothesis. Self-reported satisfaction (both with the gift-box and the process of choosing) is an inverted U-shaped function of the number of alternatives as shown in Figures 2a and 2b. The participants reported lower satisfaction with choice from limited (*5*) and extensive (*30*) options, and higher satisfaction from medium-sized sets (*10* and *15* options). The *10*-option set was found to be the most satisfying. Difficulty of choosing also increased with the set size, though not significantly (see Figure 2c). Participants further believed that the "right number of options" was *10* or *15*

(see Figure 2d). [5] The *30*-option set was considered to be overwhelming, while the *5*-item set was perceived as offering too little choice.

Insert Table 2 and Figure 2 about here

In terms of statistical tests, ANOVA (see Table 2) indicates that the size of the choice set significantly affects satisfaction for all four dependent measures. Statistical tests of the nature of these differences (i.e., whether satisfaction functions have inverted U shapes) are presented in Appendix A. This shows, for example, that for "satisfaction from the gift box picked" (Figure 2a), the mean satisfaction for *10* options (8.5) is significantly greater than both those for *5* and *15* options (i.e., 7.0 and 7.7, respectively), and that satisfaction for *15* options significantly exceeds that for *30* (i.e., 7.7 vs. 7.1).

Gender and complexity. ANOVA revealed significant gender differences in satisfaction from the gift box picked (controlling for the set size). Compared to men, women reported higher satisfaction from the box they decided to pick (see Appendix B).

ANOVA (see Appendix C) also showed that participants facing simple sets were significantly more satisfied both with the gift box picked and with the decision process than those encountering complex choice sets (controlling for the set size). No significant gender or complexity effects were found for the other dependent variables.

Visual presentation. Experiment 1 also aimed to test whether two visual attributes – color and shape – which impose low and high cognitive costs on an individual, respectively – affect satisfaction from different set sizes. We therefore analyzed the responses of the 80 participants who faced SCDS and SSDC sets.

ANOVA supported our second hypothesis. Participants facing large sets (i.e., *30* options) with alternatives varying in color reported significantly higher satisfaction from the box they decided to pick [$F(1, 72) = 10.93$, $p = .002$] than those encountering the sets with items different in shape (Figure 3a). For the small and medium-sized sets, however, this difference was not significant [$F(1, 72) = 0.95$, $p = .334$; $F(1, 72) = 3.06$, $p = .084$; $F(1, 72) = 0.95$, $p = .334$ for *5*-, *10*- , and *15*-option sets respectively]. Moreover, the participants facing SSDC sets were significantly more satisfied with the process of choosing than those who encountered SCDS sets over the *entire* range of sets sizes [$F(1, 75) = 4.15$, $p = .045$] – see Figure 3b.

Insert Figure 3 about here

Visual format also affected participants' beliefs about the right number of options in the set. When facing SSDC sets, the participants believed that *15*- or even *30*-option sets contained "about the right number of options" [$F(1, 72) = 1.65$, $p = .203$; $F(1, 72) = 1.65$, $p = .203$ respectively]. However, *30* options in the SCDS sets were viewed as "more than the right amount" [$F(1, 72) = 26.40$, $p = .000$] – see Figure 3c.

Our results and analysis demonstrated that satisfaction is an inverted U-shaped function of the number of alternatives for the SCDS sets. For the SSDC sets, however, this inverted U-shape relation is not evident as the function did not decrease significantly after the peak. To verify whether satisfaction would fall if the size of the SSDC set would become "too large," we conducted an additional treatment (with procedure identical to the other treatments) where 34 new participants faced an extensive SSDC set of 54 gift boxes. Results indicated that, from the *30* to *54* option set, satisfaction from both the gift box and the decision process did indeed decrease

significantly (from 8.3 to 7.1 [t = -2.31, p = .024], and from 7.1 to 5.2 [t = -2.52, p = .014], respectively – see Figures 3 a and b).

Discussion of Experiment 1

Experiment 1 demonstrated that satisfaction is an inverted U-shaped function of the number of options in the set. It is important to note, however, that the peak of the function, or the highest satisfaction level, may not be a single point, but a range of alternatives. For example, this was the case with the SSDC sets where 10-, 15-, and 30-option sets all belong to "the optimum" of the function and are seen as equally satisfying.

Experiment 1 also provided empirical evidence for the differences in satisfaction due to the visual layout of alternatives. As expected, people experience higher satisfaction when the alternatives in large choice sets differ in color as opposed to shape, whereas we find no such difference for the small sets. We believe that, due to particularities of the human visual system discussed above, the costs of choosing among alternatives differing in shape are greater than among options varying in color, and especially when the choice set is large (otherwise we would find significant differences across the entire range of the sets). Therefore, for the former, the peak of the resulting satisfaction function is shifted to the left relative to the latter.

These findings have important practical implications for people offering choices. The results suggest that presenting alternatives of large sets in different colors can create "comfortable" visual environments and thereby positively influence satisfaction from choice. As a result, people may be able to obtain high benefits from larger set sizes without losing satisfaction.

Experiment 1 suggests that the satisfaction function may depend on gender. For males the function lies below of that for females. Why this occurred is unclear. Several explanations come to mind. First, at a cognitive level, there is some evidence that women are used to paying more attention to detailed information than men and this habit might lower the costs of choice in some tasks (cf., Meyers-Levy & Maheswaran 1991; Meyers-Levy 1998). Second, females may simply care more about items such as gift boxes than males and therefore be motivated to expend more effort. Third, gender effects might be task dependent. For a different kind of choice (e.g., beer or cell telephones), one might find a reversed effect. Therefore, whether gender effects can be generalized across different conditions remains unclear and is an interesting topic for further research.

The findings of Experiment 1 also demonstrated that subjects reported lower satisfaction from the alternative picked and from the decision-making process when encountering complex rather than simple sets over the entire range of set sizes. This finding is consistent with our model. As the complexity of the sets increases, both the psychological costs and benefits rise. On one hand, it is harder to process and compare alternatives varying on two rather than on one attribute. On the other hand, the former may create stronger, pleasant feelings of "having a choice" than the latter. If the shift in costs is greater than that in benefits, the resulting satisfaction function shifts downwards. However, because we only observe "net effects" of perceived benefits and costs in our experimental paradigm, we were unable to test this implication explicitly. The separation of effects of costs and benefits is clearly critical for a deeper understanding of the underlying processes of choice and should therefore be investigated in further research.

The results of Experiment 1 also showed that some sub-samples of individuals with similar cultural background reported similar satisfaction levels (not presented). Whether this was a coincidence or a general trend was impossible to detect due to limited sub-sample sizes. However, recent studies suggest that choice may reflect cultural differences. Iyengar and Lepper (1999), for example, demonstrated cultural effects on intrinsic motivation: European-Americans are more intrinsically motivated by personal choice whereas Asian-Americans may prefer to have choices suggested to them by "valued ingroup members." We therefore took the opportunity to replicate Experiment 1 in an Eastern European sample and to compare results with the data obtained in Western Europe.

Experiment 2

The objective of Experiment 2 was to replicate Experiment 1 in an Eastern European sample and thereby also investigate possible cultural influences. The design was identical to that of Experiment 1. [6] Participants of Experiment 2 were 120 students and professors (mean age of 21 years, 53% males) from several universities in two Eastern European countries: Belarus (85%) and Ukraine (15%). They received no financial remuneration.

Results

Satisfaction from choice. Consistent with the findings of Experiment 1 (and Hypothesis 1), the satisfaction function of the Eastern European sample had an inverted U-shape (see Figure 2, Table 2 and Appendix A). However, participants from Belarus and Ukraine reported the highest satisfaction with the gift box picked from *15*- and *30*-option sets whereas Western Europeans were most satisfied with the box chosen from

medium-sized sets. The peak of the function, therefore, was shifted toward a greater number of alternatives in the Eastern European sample [$F(4, 232) = 4.10$, $p = .003$, Chow test], sets with *15* options being seen as the most satisfying.[7] Interestingly, the participants also reported the lowest difficulty levels when choosing from such sets, and considered that the *15*-option set included exactly the "right number of boxes."

Gender and complexity. We found significant gender and complexity effects for several dependent variables in the Eastern European sample (see Appendices B and C). Eastern European females reported significantly higher satisfaction levels than men both with the box picked and with the decision process. Across all set sizes, satisfaction with the box picked was lower for participants facing complex as opposed to simple sets.

Visual presentation. In line with the findings of Experiment 1 (and Hypothesis 2), ANOVA yielded differences in satisfaction of the Eastern European participants due to the visual layout of alternatives. Eastern Europeans reported higher satisfaction both with the gift box picked [$F(1, 72) = 4.02$, $p = .049$], and with the decision process [$F(1, 72) = 3.13$, $p = .081$], when facing large sets (*30* options) in the SSDC as opposed to SCDS format. Moreover, participants felt they had fewer options when facing SSDC sets rather than the same sized SCDS sets [$F(1, 75) = 8.26$, $p = .01$] – see Figure 4.

Insert Figure 4 about here

Discussion of Experiment 2

Experiment 2 provided support for Hypothesis 1 in a different cultural sample. The inverted U-shaped relation between satisfaction and the number of alternatives was replicated in Eastern Europe. At the same time, the results suggest that cultural background can affect perceptions of the costs and benefits of choice. Participants from

Eastern Europe were more satisfied with larger choice sets as opposed to their Western counterparts, that is, the peak of satisfaction function for former lies to the right of that for the later. The reason for this finding is not apparent and requires further investigation.[8]

Experiments 1 and 2 demonstrated that visual presentation of assortment influences satisfaction. More specifically, participants reported significantly higher levels of satisfaction when the alternatives in the large choice sets were different in color but not in shape (Hypothesis 2). However, does this mean that the sets with alternatives different in color are also more attractive than those that vary in shape? This question becomes relevant when people choose between different sets of offerings rather than selecting an item from a given set.

As a corollary to Hypothesis 2, therefore, we suggest that since visual "comfort" is more pleasing for the eyes (and less "costly" to process), one should also expect large SSDC sets to be more appealing than large SCDS sets. Also – and once again – since the costs of choice from small sets are not unduly taxing, we would not expect such effects with small sets. More formally, we state:

Hypothesis 3**:** Visual properties of the set affect its attractiveness. More people are attracted to large sets when alternatives differ in color as opposed to shape. No such effects exist for small sets.

We conducted Experiment 3 to test this hypothesis

Experiment 3

Method

Procedure. The design of Experiment 3 was similar to that of Experiment 1. The main difference was that, first, participants had to decide which of the sets of gift boxes

they liked the most: that in “shop A” which offered gift boxes varying in shape (SCDS set) or that in “shop B” which offered boxes differing in color (SSDC set). Participants were given pictures representing each of the two sets. The choice sets were identical to those of Experiment 1. Both sets offered to a particular individual were of the same size involving *5*, *10*, *15*, or *30* alternatives.

Participants were 48 undergraduate students (mean age of 19.2 years, 54% females) at a Spanish University. Participants were not remunerated. Groups of 12 participants were assigned at random to each of four groups evaluating the different-sized options.

First, participants had to choose which choice set – shop A or B – they preferred and answer a questionnaire assessing their satisfaction with each set and the difficulty of choosing between them. Second, the participants were left with the picture of the choice set they had selected and asked to choose a gift box and complete the same questionnaire as in Experiment 1.

Measures. First, we simply counted the numbers of participants who chose each “shop” for the different set sizes. Second, we assessed participants’ satisfaction with each choice set and the difficulty of choosing between them by asking “How much do you like the assortment in shop A?”, “How much do you like the assortment in shop B?”, and “How difficult was it for you to decide to which shop to go?” Responses were provided on a Likert scale ranging from one (“Not at all”) to 10 (“Extremely”). Third, satisfaction measures concerning choices of boxes were identical to those used in Experiment 1.

Results

When facing medium or large choice sets (i.e., sets containing *10, 15* or *30* alternatives) 25 out of 36 participants preferred the options in shop B where boxes varied in color but not in shape thereby indicating that the former are more attractive [$p(x \leq 11) = .025$, binomial test]. For small sets (5 options), there was no significant difference [$p(x \leq 5) = .387$]. However, this lack of a significant difference could simply be due to the small sample of participants (12) facing *5*-alternative sets. We therefore recruited 19 additional participants for a *5*-option set treatment of this experiment. Results showed that of the 31 participants who faced *5*-alternative sets, 15 preferred the SSDC sets. In other words, there was no significant difference in choices between the SCDS and SSDC sets [$p(x \leq 15) = 0.500$, binomial test].

Finally, participants reported greater satisfaction levels from the SSDC than SCDS sets when the number of alternatives in the set exceeded 10 ($t = 1.98$, $p = .056$), but similar satisfaction levels for *5*-option sets ($t = 0.98$, $p = .381$).

Discussion of Experiment 3

The results of Experiment 3 provide support for Hypothesis 3. Sets of alternatives differing in color were more attractive than those differing in shape when the sets were large, while both were seen as equally appealing when set size was small. This is consistent with the arguments provided above. Namely, the costs of processing alternatives differing in color are lower for the human visual system than those associated with shape.

Experiment 3 demonstrated that participants, who had to decide which assortment they preferred before picking the gift box, reported lower satisfaction (though not significantly so) than subjects whose task was to choose a gift box from a given set.

This lack of statistical significance (not reported), however, may be a result of limited sub-samples of experimental participants. We therefore took the opportunity to investigate this issue further in a slightly different experimental setting.

In our initial setting, participants face a given set of choice alternatives and are unaware of the possible existence of other sets. However, would satisfaction be affected if participants were aware of the existence of choice sets different from theirs? Clearly, people do not only engage in evaluating trade-offs between the alternatives they face, but also compare their own possibilities with those of others. Indeed, as originally demonstrated by Festinger (1954), when objective measures are not available, people tend to judge their own possibilities by comparison with those of others. Thus, if when presented with a set of alternatives, a person is made aware of the existence of other alternatives, he or she may well feel at a disadvantage and thereby incur psychic costs. In our model, this would imply a shift of the initial cost curve (i.e., due to the fixed psychic costs incurred before even viewing the choice set) with a consequent negative impact on satisfaction. More formally, we hypothesize:

Hypothesis 4: Individuals, who are aware of the existence of choice sets different from theirs and from which they cannot choose, are less satisfied with their choice than those who do not possess such knowledge.

To test this hypothesis we conducted Experiment 4.

Experiment 4

Method.

Experiment 4 was identical to that of Experiment 2 with two exceptions. First, unlike Experiment 2, where only one participant at a time was invited into the experimental laboratory, in Experiment 4 several subjects followed the experimental

procedure simultaneously in the same room. Second, participants of Experiment 4 were *explicitly* told that their colleagues had been given choice sets differing from their own in size and visual properties of the alternatives. The subjects were unaware how many different choice sets there were, which choice set was larger or smaller and could only see the sets offered to their colleagues from a distance. After being given a picture representing a choice set, participants followed the same procedure as in Experiment 2. The choice sets and satisfaction measures were identical to those used in Experiments 1 and 2.

Referring to participants in Experiment 4 as an "aware" sample and those in Experiment 2 as an "unaware" sample, a comparison of the responses of the two samples provides a test of Hypothesis 4.

Participants. These were 120 students and professors (53% females, mean age of 24.3 years) from several universities in Belarus (47%) and Ukraine (53%). They received no financial remuneration.

Results

Consistent with the findings of Experiments 1 and 2, satisfaction with the gift box picked was found to follow an inverted U-shape for the "aware" sample – see Figure 5. However, there were significant differences in satisfaction of subjects in Experiments 2 and 4. Compared to the unaware sample, the aware participants were less satisfied with the gift box picked ($F(4, 232) = 2.72$, $p = .030$, Chow test; "awareness" dummy $F(1, 232) = 4.24$, $p = .041$), and with the process of choosing ($F(1, 235) = 4.96$, $p = .027$), thereby providing support for Hypothesis 4. That is, the satisfaction function for aware participants was shifted downwards in comparison with the unaware group. Moreover, participants of Experiment 4 felt they had "fewer" choices than their counterparts in Experiment 2 ($F(1, 232) = 3.58$, $p = .060$).

Insert Figure 5 about here

Discussion of Experiment 4

Experiment 4 provided additional support for Hypothesis 1. The inverted U-shape of the satisfaction function was replicated in the "aware" sample. Supporting Hypothesis 4, the results of Experiment 4 also demonstrated that knowledge of the existence of choice sets different from one's own decreases satisfaction. As argued above, the effect of telling participants explicitly that others can choose from different sets imposes additional "fixed" psychic costs even before the choice is made. Holding benefits constant, this initial increase in psychic costs results in a downward shift of the satisfaction function.

We cannot exclude the possibility that other factors might also have contributed to the effect we observed. First, given the importance of feelings of control on intrinsic motivation (Taylor & Brown, 1988), the conditions participants faced in Experiment 4 might have increased psychic costs by emphasizing that participants lacked control over the choice situation. Second, Carmon, Wertenbroch, and Zeelenberg (2003) have demonstrated that close consideration of options may induce "attachment" to options, and that people may feel the "loss" of alternatives not chosen. In our case, the participants may have not only felt the "loss" of the foregone boxes in their own sets, but also of those they did not see.

In Experiment 4, satisfaction from the decision process appeared to increase across the entire range of alternatives. However, this does not mean that the function does not have an inverted U-shape. We suggest that after some large number of alternatives (greater than 30), the costs will outweigh the benefits, and the function will decline, exactly as occurred with the SSDC satisfaction function in Experiment 1.[9] This

proposition, however, should be tested in a setting where the number of alternatives is far greater than 30.

General Discussion

This paper has explored the nature of satisfaction from choice as a function of characteristics of choice sets. Building upon the theoretical insights of Coombs and Avrunin (1977), we suggested that as the number of alternatives increases, so do the resulting benefits and costs. However, whereas the former "satiate," the latter "escalate." The net effect is that satisfaction is an inverted U-shaped function of set size. Our experiments provided support for this proposition.

At a theoretical level, our goal was to make explicit the implications of perceptions of costs and benefits of the choice process. To test our theoretical framework, therefore, we manipulated differences in cognitive costs by contrasting satisfaction from choice when sets varied in color as opposed to shape. As predicted, in a between-subjects design participants viewed larger sets with alternatives differing in color as being both more satisfying and attractive than those with alternatives varying in shape. That is, the location of the peak of the satisfaction function was influenced by visual presentation of the choice set.

Costs as well as benefits of choice may also depend on individual characteristics. In this work, we identified three such variables: awareness of the existence of other choice sets, gender, and culture. We interpreted awareness of the existence of alternatives from which choice can not be made as imposing additional psychic costs which, in turn, result in a downward shift of the satisfaction function.

For the choices examined here, the satisfaction curve for women lay above that for men. The peak of the curve for the Eastern-European sample was shifted to the right

of that for Western European sample. As noted earlier, we had no explicit hypotheses concerning these findings but suggest that they provided a useful springboard for future research. In particular, we suspect that the type of choice made could moderate these kinds of individual results. For example, if gender or culture is correlated with expertise in types of choice, one could well find that differential knowledge by decision makers would appear to reveal itself in the form of effects due to gender or culture.

Our investigation was guided by the framework outlined in Table 1 and the simple assumption that satisfaction is the net difference between perceived costs and benefits. Given the support of our experimental evidence, we now outline implications and suggestions for further research.

First, in our experimental tasks, participants were required to make a choice. In many situations, however, people may decide to avoid or defer making choices (cf., Dhar, 1997) and it is also important to predict this phenomenon. One way of thinking about this within the framework of Table 1 is to predict that choice is deferred or avoided when expected satisfaction is negative, i.e., when perceived costs exceed benefits. With this in mind, one can imagine investigations in which variables are manipulated to produce these effects. For example, imagine the effect of imposing time limits on an important choice such that cognitive and psychic costs increase rapidly and the person decides to defer choice (i.e., satisfaction becomes negative). An advantage of our framework is that we can specify the expected effects of different variables in this process as well as predict differences due, for example, to severity of the time limit or importance of the decision.

Second, we did not vary economic considerations in our experimental work. However, our framework suggests how these might affect the satisfaction function. On the one hand, one would expect a desire to see more alternatives as decisions become

more important, i.e., the benefits of choice. At the same time, however, important choices could induce greater psychic costs as people become more concerned about knowing their preferences and the possible regret of making errors (thereby reducing the number of alternatives they would like to see). When economic stakes are high, we would particularly expect to see expertise have a large effect on the location of the peak of the satisfaction function. Thus, for example, in choosing a pension plan, we would predict that the ideal number of alternative portfolios for a specialist (e.g., a security analyst) would far exceed that of a financial novice. More generally, we believe much could be gained by linking our framework to the literature on expertise (Chase & Simon, 1973).

Third, in our study, participants were making choices for themselves. An intriguing change to the implied costs might occur if they were making choices on behalf of others, i.e., as an agent. For example, if a financial specialist were selecting a portfolio for a friend as opposed to herself, would she be willing to examine more alternatives? To the extent that this would make the person feel more responsible, it follows that she probably would (cf., Tetlock, 1991).

Fourth, the optimal number of alternatives (for satisfaction) in our studies was found to be 10 or 15. These numbers are exactly the same as those reported by Miller (1956) for the "channel capacity" of visual positioning, that is, the number of visual positions the human eye can distinguish without making errors. It is unclear whether this is a coincidence. However, it suggests investigating whether satisfaction is an inverted U-shaped function of the number of alternatives when these are not characterized visually but by, say, tone, taste, or odor. Building upon our theoretical framework, we would still expect satisfaction to be an inverted U-shaped function of the numbers of these stimuli. Miller (1956) argued that the "span of absolute

judgment" is greater for visual stimuli than for tones or taste stimuli. Therefore, as the costs of processing the latter are higher, we would also expect the location of the peaks of the satisfaction functions for these to lie to the left of those for visual stimuli.

Fifth, in this experimental work we simplified by focusing on simple objects that differed on only one or two attributes. Clearly, an important next step will be to extend the approach adopted here to more complex products in naturally-occurring field studies.

Sixth, the measures used in our studies were subjective reports of satisfaction. To assess the underlying costs of information processing better, it would be helpful to combine these reports with more objective measures obtained by, say, eye-tracking devices and, possibly, the techniques of neuroscience.

Seventh, both in the current paper and previous research 30-option sets have been considered "large" and five-option sets "small." What, however, do decision makers consider "large," "small," or "medium-sized" and how does this vary by types of choice situations and individuals?

In summary, we have presented a simple theoretical rationale that makes explicit the reasons underlying the inverted U-shaped function that describes the relation between satisfaction from choice and the number of alternatives in a choice set. At one level, good "common sense" suggests that people will be unsatisfied and confused by having "too many" choice alternatives. However, it is quite another matter to understand the point at which there are "too many alternatives" and how different variables contribute to the satisfaction that people experience from choice. The goal of this paper has been to help elucidate this issue.

Footnotes

[1] Desmeules (2002) has suggested that, when evaluating alternatives cognitively, the consumption experience might have an inverted U-shaped relationship across set size. However, his proposition was neither formalized nor tested empirically.

[2] Kahn and Wansink (2004) suggest that actual variety consists of two components: first, "the number of distinct options or the number of conceptually distinct subcategories;" and second, "the number of category replicates."

[3] Our purpose here is not to determine how visual characteristics of separate objects influence decisions but rather how the visual characteristics of the entire set affect satisfaction. Individual preferences for colors and forms are not, therefore, a subject of the current paper.

[4] Most of the measures used in this experiment were similar to those used by Iyengar and Lepper (2000) in their study 3 which motivated the current research.

[5] Recall that on this scale five was "ideal" with one being "too few" and nine "too many."

[6] The studies in Eastern Europe were, however, conducted in Russian.

[7] The overall means of satisfaction with the gift box were not different for the two samples ($t = 0.084$, $p = .933$).

[8] Given the comparative paucity of choice in Eastern Europe until fairly recently, one might have imagined the contrary result, that is, Eastern Europeans would have been more satisfied with fewer alternatives.

[9] Recall that in Experiment 1 the satisfaction function decreased significantly when the size of SSDC sets was increased to 54 alternatives.

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Table 1

Benefits and costs of choice as a function of number of alternatives

Factors		**Benefits**	**Costs**
Situational	**Time**	x	Increasing (linear)
	Economic	Increasing (decreasing rate)	x
Psychological	**Cognitive**	x	Increasing (increasing rate)
	Psychic	Increasing (decreasing rate)	Increasing (increasing rate)

Table 2

Significance of the set size effect on dependent variables

Dependent variable	Statistics		
	Experiment 1	Experiment 2	Experiment 4
Satisfaction from the gift box picked	F(3, 116) = 8.92 p = .000	F(3, 116)= 3.35 p = .022	F(3, 116)= 2.90 p = .038
Satisfaction from the decision process	F(3, 116)= 4.07 p = .009	F(3, 116) = 2.22 p = .089	F(3, 116) = 2.84 p = .041
Difficulty level	F(3, 116) = 2.77 p = .045	F(3, 116) = 4.41 p = .006	F(3, 116) = .66 p = .580
Perception of the right number of options	F(3, 116) = 10.21 p = .000	F(3, 116)= 2.78 p = .044	F(3, 116)= 3.98 p = .010

Figure captions

Figure 1: Satisfaction as a function of the number of alternatives

Figure 2: Dependent variables as a function of the number of alternatives in the choice set, Experiments 1 and 2

Figure 3: Effect of different visual presentation, Experiment 1

Figure 4: Effect of different visual presentation, Experiment 2

Figure 5: Effect of "awareness" of alternatives, Experiment 4 vs. 2

Figure 1a

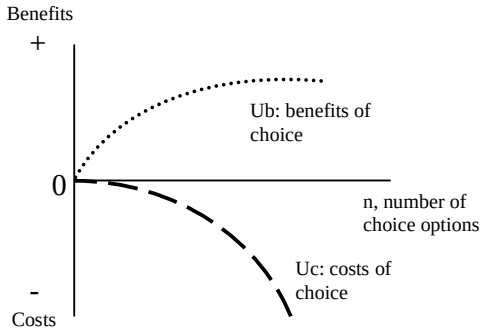

Figure 1b

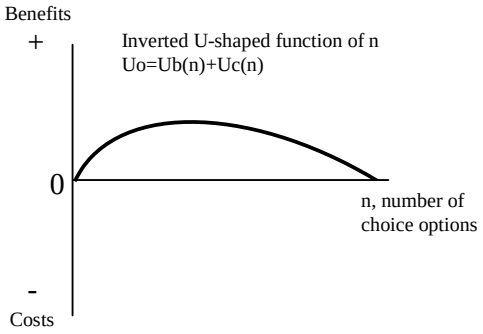

Figure 1: Satisfaction as a function of the number of alternatives

Figure 2a. Satisfaction function from the gift box picked

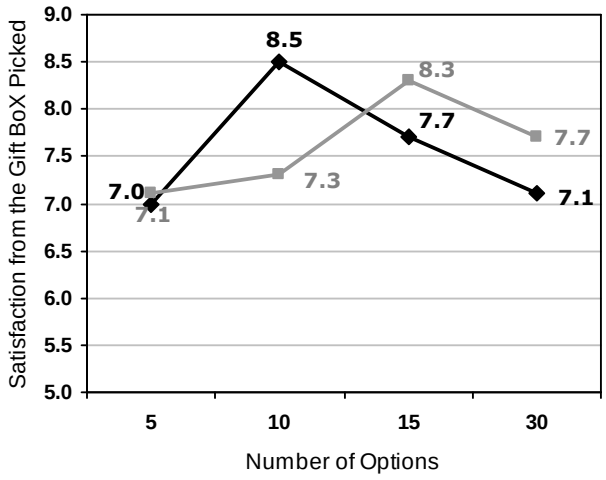

Figure 2B. Satisfaction function from the decision-making process

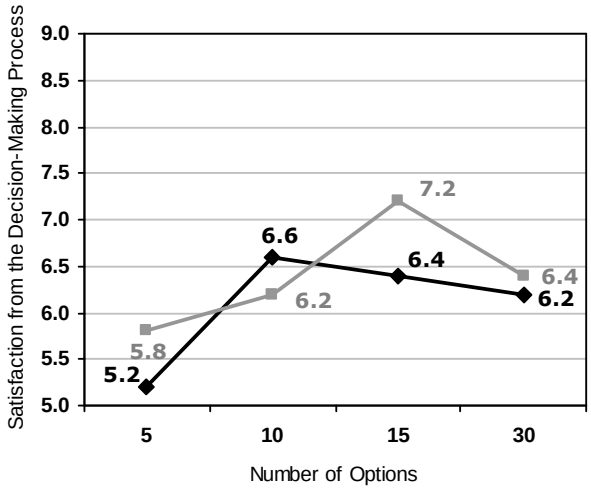

Figure 2c. Difficulty level

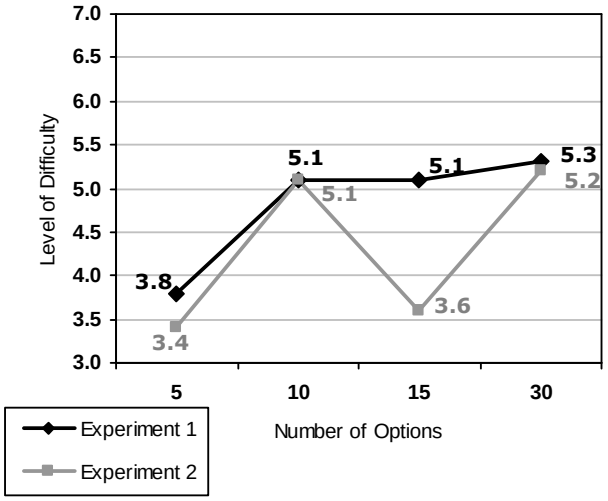

Figure 2d. Perception of the "right number" of options in the choice set

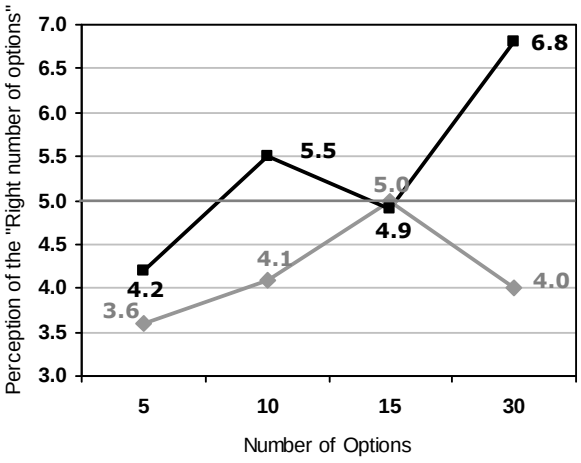

Figure 2: Dependent variables as a function of the number of alternatives in the choice set, Experiments 1 and 2

Figure 3a

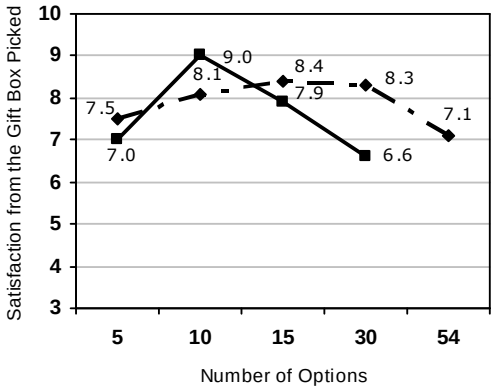

Figure 3b

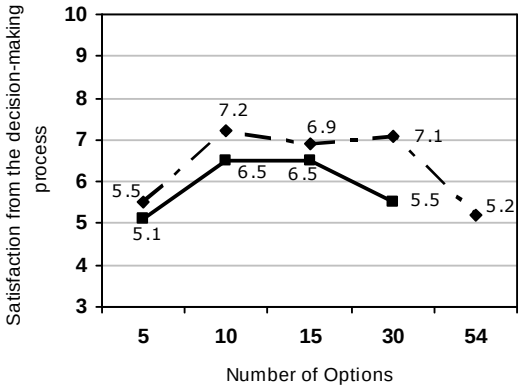

Figure 3c

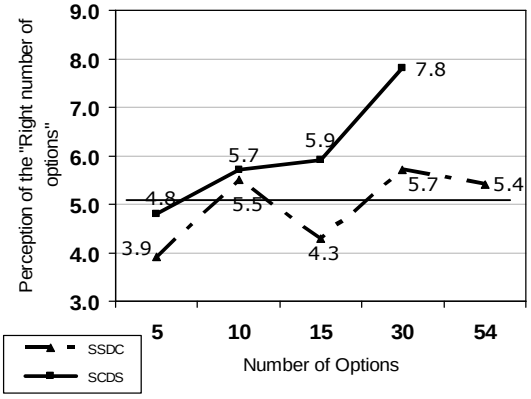

Figure 3: Effect of different visual presentation, Experiment 1

Figure 4a

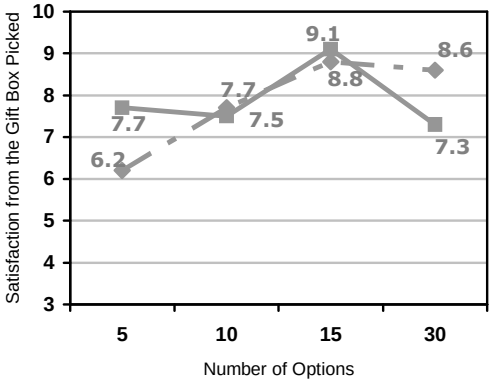

Figure 4b

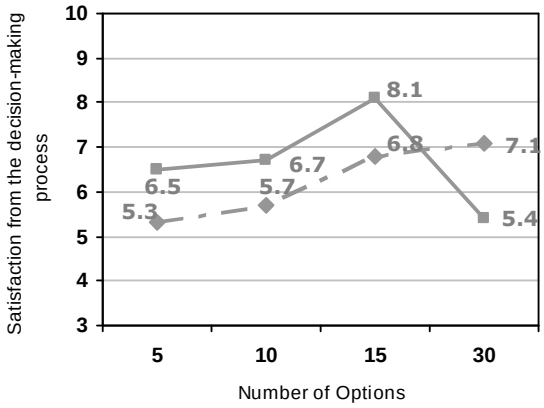

Figure 4c

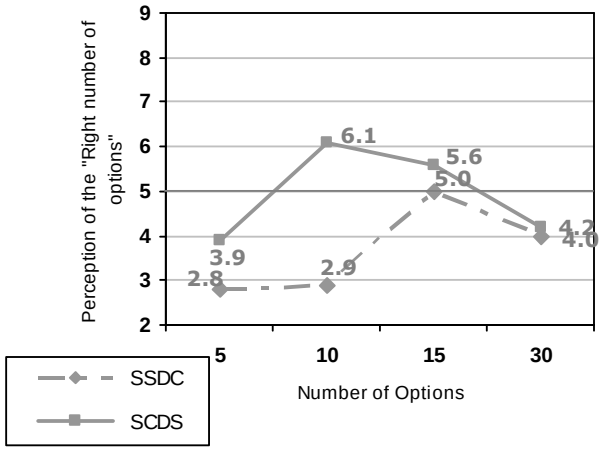

Figure 4: Effect of different visual presentation, Experiment 2

Figure 5a. Satisfaction function from the gift box picked

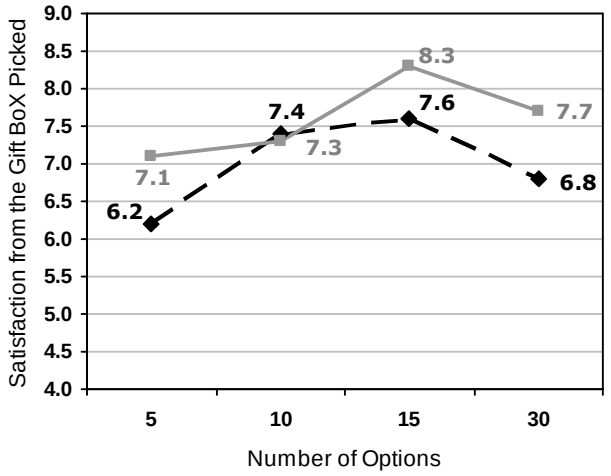

Figure 5b. Satisfaction function from the decision-making process

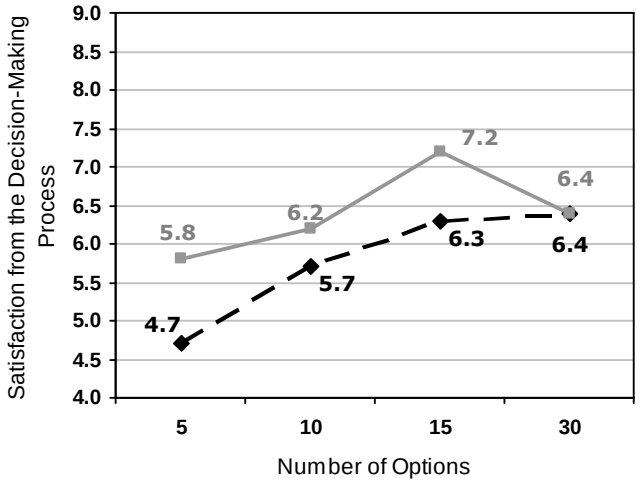

Figure 5c. Difficulty level

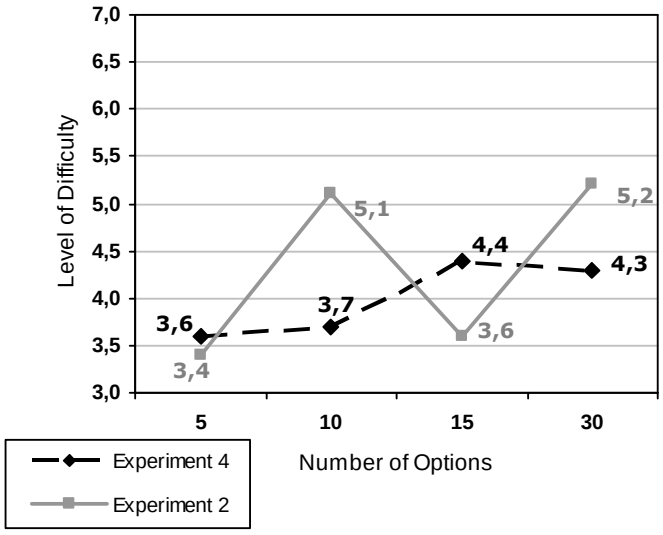

Figure 5d. Perception of the "right number" of options in the choice set

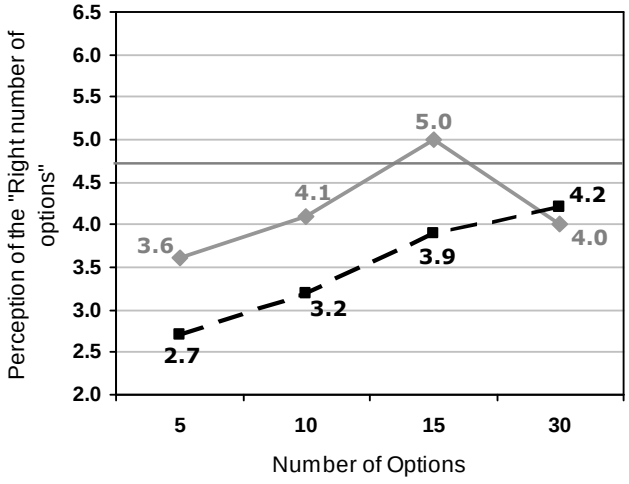

Figure 5: Effect of "awareness" of alternatives, Experiment 4 vs. 2

Appendix A

Increases/ declines of means among choice sets with different numbers of alternatives

Measure	Sample	5 vs 10	5 vs 15	5 vs 30	10 vs 15	10 vs 30	15 vs 30
Satisfaction from the gift box picked	Experiment 1	+1.53***	+0.73**	+0.13	-0.80**	-1.40***	-0.60*
	Experiment 2	+0.14	+1.20***	+0.60	+1.06**	+0.46	-0.60
	Experiment 4	+1.20**	+1.40*	+0.60	+0.20	-0.60	-0.80
Satisfaction from the decision-making process	Experiment 1	+1.37***	+1.23***	+0.97**	-0.14	-0.40	-0.26
	Experiment 2	+0.37	+1.40**	+0.60	+1.03*	+0.23	-0.80
	Experiment 4	+1.03*	+1.63***	+1.73***	+0.60	+0.73	+0.13
Difficulty level	Experiment 1	+1.27**	+1.27**	+1.47**	0	+0.20	+0.20
	Experiment 2	+1.70**	+0.27	+1.88***	-1.43**	+0.17	+1.6**
	Experiment 4	+0.10	+0.80	+0.64	+0.70	+0.54	-0.16

*** significant at 1 percent level

** significant at 5 percent level

*significant at 10 percent level

Appendix B

Gender effects for four dependent variables

Measure	Gender dummy		Interaction: options * gender	
	Experiment 1	Experiment 2	Experiment 1	Experiment 2
Satisfaction from the gift box	F(1, 115) = 4.07 p = .046	F(1, 115) = 7.16 p = .009	F(3, 112) = 0.49 p = .693	F(3, 112) = 1.55 p = .206
Satisfaction from the decision-making process	F(1, 115) = 2.37 p = .013	F(1, 115) = 7.87 p = .006	F(3, 112) = 2.27 p = .084	F(3, 112) = 0.14 p = .935
Difficulty level	F(1, 115) = 0.08 p = .775	F(1, 115) = 0.49 p = .487	F(3, 112) = 0.02 p = .997	F(3, 112) = 0.37 p = .774
Perception of the right number of options	F(1, 115) = 0.17 p = .683	F(1, 115) = 1.08 p = .302	F(3, 112) = 2.01 p = .117	F(3, 112) = 1.26 p = .290

Appendix C

Complexity effects for four dependent variables

Measure	Complexity dummy		Interaction: options*complexity	
	Experiment 1	Experiment 2	Experiment 1	Experiment 2
Satisfaction from the gift box	F(1, 115) = 9.81 p = .002	F(1, 115) = 5.72 p = .018	F(3, 112) = 1.14 p = .337	F(3, 112) = 2.72 p = .048
Satisfaction from the decision-making process	F(1, 115) = 3.34 p = .070	F(1, 115) = 0.07 p = .791	F(3, 112) = 0.18 p = .908	F(3, 112) = 0.26 p = .853
Difficulty level	F(1, 115) = 1.23 p = 0.270	F(1, 115) = 0.02 p = 0.878	F(3, 112) = 0.09 p = .966	F(3, 112) = 1.29 p = .282
Perception of the right number of options	F(1, 115) = 0.79 p = .377	F(1, 115) = 1.03 p = .312	F(3, 112) = 0.17 p = .915	F(3, 112) = 1.37 p = .256