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Early Positive Information Impacts Final Evaluations: No Deliberation-Without-Attention Effect and a Test of a Dynamic Judgment Model

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ABSTRACT

Evaluation judgments were affected by information order and not by subsequent unconscious versus conscious deliberation. In three experiments, we examined the influence of early positive information on final evaluations of four objects. Based on a task analysis, we predicted primacy effects in judgments in a sequential data acquisition task. Thinking periods following presentation were used to manipulate conscious or unconscious processing. In all three studies, we found no effects of thinking manipulations but instead found reliable order effects. We developed and tested an online judgment model on the basis of the belief updating model of Hogarth and Einhorn. The model accounted for large proportion of the individual level variability, and model comparison tests supported the presence of a primacy effect. Copyright © 2013 John Wiley & Sons, Ltd.

KEY WORDS model of online judgments; unconscious thinking; order effects; deliberation-without-attention; dominance

INTRODUCTION

The potential benefit of unconscious thinking in decision making has drawn considerable attention in the literature and the media (NPR, 2006). It has been proposed that an unconscious processing mechanism optimally weights and combines information during a brief period of distraction after input data are initially acquired, which improves the accuracy of resulting complex judgments. This phenomenon is known as the deliberation-without-attention effect and is derived from unconscious thought theory (UTT; Bos, Dijksterhuis, & van Baaren, 2008; Dijksterhuis, 2004; Dijksterhuis, Bos, Nordgren, & van Baaren, 2006; Dijksterhuis, Bos, Van, & Van Baaren, 2009; Dijksterhuis & Nordgren, 2006; Zhong, Dijksterhuis, & Galinsky, 2008). Although several investigations have failed to replicate the beneficial effects of distraction on complex decisions (Acker, 2008; Calvillo & Penaloza, 2009; Huizenga et al., 2012; Newell & Shanks, in press; Newell, Wong, Cheung, & Rakow, 2009; Nieuwenstein & van Rijn, 2012; Payne et al., 2008; Rey, Goldstein, & Perruchet, 2009; Thorsteinson & Withrow, 2009), others find support for it (Strick et al., 2011). We do not attempt to settle the controversy of the potential benefits of unconscious thinking here; instead, we seek to better understand the evaluation process within the context of the judgment task typically used in UTT research.

We focus on the notion of online judgments advanced by Hastie and Park (1986) in order to understand the judgment process occurring as information is encountered sequentially over time. We explore a key factor that affects this process—the order in which the data are encountered. In addition, we develop and evaluate a quantitative model of the evaluation process that relies on linear aggregation over time; thus, the model is dynamic. In combination, our findings lead us to conclude that online processing has a greater impact on final evaluations than post-acquisition thinking periods in the typical task encountered by participants in UTT studies. Indeed, our results are at odds with the notion that unconscious thinking can process the information optimally because order of information should not matter.

The literature on evaluation judgments encompasses different areas within psychology that converge around the idea that people form judgments via linear aggregation. From the behavioral decision making perspective, each object may be evaluated by focusing on aspects (attributes) that define it. These aspects provide utility, which are then summed via a weighted linear aggregation to produce an overall evaluation. This multi-attribute utility approach (Edwards, 1954) follows a maximization rule to ensure optimal decision making within tenets of rationality; the process is internally consistent and normative. The process is also deterministic and static. From a judgment analysis perspective (Hammond, 1955; Hammond & Stewart, 2001), evaluations may be similarly construed through a process of linear aggregation of cues that signal dimensional value and that are aggregated to result in an overall evaluation. The model is statistical, thus allowing for variation and inconsistency in judgments; the process is typically not modeled with time dependencies, and thus it is also static. In the social psychology literature, a large body of research has focused on person-perception and attitude formation (Ajzen & Fishbein, 2008; Fishbein, 1963; Fishbein & Ajzen, 1975) with theories that allude to linear aggregation, but in many instances, the mathematical underpinnings of these theories are less well defined. UTT is such an example; the theory takes the basic language of linear aggregation and

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optimization, but it does not advance a mathematical representation that can be examined. We thus attempt to advance a mathematical representation, albeit a simplified one, in order to explore the factors that are most important in determining final evaluations in the typical UTT task. We begin with the simple linear aggregation model and incorporate the time-dependent aspect of the task faced by participants in such a task. The model focuses on the updating of information process and a key factor, order of positive information that can alter the relative position of objects in a preference ranking.

Newell et al. (2009) proposed that participants were inclined to form their impression during the period of information acquisition if they were informed before the information presentation that they would eventually choose a best option. Lassiter, Lindberg, González-Vallejo, Bellezza, and Phillips (2009) made a similar point. Cleeremans, Waroquier, David, and Klein (2009) further reported that a majority of participants adopted the online impression formation approach as revealed by self-reports. Despite that Strick, Dijksterhuis, and van Baaren[1] (2010, Exp. 1) argued that the benefit of unconscious thinking pertained to off-line rather than online processing, 60% of their participants were categorized as online decision makers. Thus, the purpose of our work was to provide a more specific model of the insights given by these prior researchers.

Before detailing the specifics of the model, we introduce the basic paradigm from a typical UTT study to place the model description in context. In a typical UTT experiment (Dijksterhuis et al., 2006), participants are asked to select the best car among four alternatives, one of which has 75% positive attributes, another two have 50% positive dimensions, and the fourth one has only 25% positive attributes. Information about the cars, that is, the attribute values that describe the cars, are randomly presented one at the time for a short period. After we presented stimuli, results from UTT studies indicated that participants who were distracted from thinking about the cars provided higher evaluations for the option with the most positive attributes compared with individuals who were asked to think carefully about the options before the decision.

The working assumption of the updating of information model that we present is that impressions of objects are updated over time after participants receive each piece of evaluative descriptions. More specifically, we assume a model of linear aggregation of values consisting of a prior linearly formed impression and new/current attribute information. This model is based on the belief updating model of Hogarth and Einhorn (1992) applied to evaluations. We defer the more technical presentation of the model to Experiment 3 where we test it quantitatively but advance that the data acquisition stage is critical to understanding the resulting judgments and that final judgments are unaffected by whether participants are asked trial by trial for their evaluations or only at the end of the task.

The organization of the paper is as follows: Experiments 1 and 2 examine how the order of information presentation affects final evaluations and whether these evaluations are further influenced by post-acquisition manipulations intended to affect internal mental states. We label these thought conditions (i.e., whether participants are distracted after information acquisition or are asked to think carefully). Furthermore, Experiment 2 altered the options used by Dijksterhuis and colleagues in order to create a dominance structure and test dominance detection. Dominance is a basic principle of rationality assumed by most models of decision making: an alternative A dominates an alternative B if it is better on at least one dimension, and at least as good in all other aspects (French, 1986, p. 142). Little attention has been given to testing violations of this principle as it appears quite simple to understand and follow (but see violations of stochastic dominance in Busemeyer, 1985; Birnbaum & Navarrete, 1998; Birnbaum, Patton, & Lott, 1999; González-Vallejo, 2002). However, in the context of evaluating the benefits of unconscious processing as advanced by UTT, a basic test of whether the unconscious can produce better decisions is whether a dominant option is easily detected. Finally, the main goal of Experiment 3 was to develop a quantitative model of online evaluations in order to more clearly elucidate the role of early encountered positive information in a long string of data; model testing and model comparisons are presented.

EXPERIMENT 1

Order effects are ubiquitous in judgments, sometimes with information received early being more impactful than information received later (Nisbett & Ross, 1980; Pennington & Hastie, 1986). Other times, recent information exerts greater influence (Tubbs, Gaeth, Levin, & Van Osdol, 1993), and in some instances, both early and recent information have influenced judgments as discussed by Hogarth and Einhorn (1992) in their review of the literature (see also Collins & Shanks, 2002; Miller & Campbell, 1959). In particular, Hogarth and Einhorn classified tasks in terms of their length, complexity, and whether judgments were made after each piece of information was received or at the end of the sequence as is performed in a typical UTT experiment. Although Hogarth and Einhorn classified few studies as complex, long, and having end of sequence responses in their analysis, about half of them demonstrated an effect of early information (i.e. a primacy effect). Furthermore, across complexity, the primacy effect appeared more prominent in longer than shorter series (16 of 22 studies or 72.7%). In addition, in all tasks with the end of sequence evaluations, the primacy effect was demonstrated. Because it is clear that the typical UTT study contains a long series of attributes (48 in total with 12 for each of four objects), we hypothesized that information presented early would be more impactful than late information in the final evaluations. The main goal of this experiment was to test for an order effect on final evaluations by presenting participants with different sequences of attribute values. In addition, we test whether a distraction period after data acquisition can eliminate an order effect to yield consistent preferences as predicted by UTT.

[1]We note that in Strick et al. (2010), participants saw all the information not in random order across options, but the information was organized such that all aspects of one option were viewed before moving to another option. This is a very different information acquisition paradigm from the used by Dijksterhuis (2004) and Dijksterhuis et al. (2006).

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Methods

Participants

Eighty-eight undergraduate students enrolled in psychology courses participated for course credit.

Procedure and materials

Participants were told that they would be viewing information regarding four different cars and were told that they would eventually be asked to rate the four cars and pick their favorite one. Participants were presented with 48 attributes that described four cars (12 attributes per car) that were labeled with fictitious names. Hatsdun had eight positive and four negative attributes, Kaiwa and Dasuka had six positive and six negative attributes, and Nabusi had four positive and eight negative attributes. Each attribute was presented separately for 8 seconds following the typical procedure of UTT studies.

The order of the stimuli served as the between-participants manipulation (randomly assigned), with Order 1-early, Order 2-confusing, and Order 3-consistent having 31, 30, and 27 participants, respectively. APPENDIX A contains the order of the attribute values as they were shown in all conditions in the different experiments. In Order 1-early, all of the positive attributes of the Kaiwa (a middle car) and two of the positive attributes of the Nabusi (the most negative car) were presented in the very early phase of the experiment (i.e., within the first 15 trials). In Order 2-confusing, the most positive car Hatsdun and the middle cars Kaiwa and Dasuka tied in the frequency of positive attributes shown in the first part of the experiment; Nabusi was first mentioned in trial 20 with a positive attribute; thus, we labeled this order confusing from the perspective of the difficulty in separating the cars in terms of their overall number of positive attributes early on in the sequence. Finally, in Order 3-consistent, the rank order of the four cars in terms of their number of positive attributes shown was evident already by trial 15 with Hatsdun having four positive attributes, the two middle cars having two to three, and the Nabusi having none.

After the presentation of the attributes, all participants were given a 4-minute anagram task to distract them from thinking about the previously presented information. This is the typical unconscious manipulation used in UTT studies. Participants were then asked to choose the best car and to provide impression ratings of each car using the scale −10 (*very negative*) to +10 (*very positive*). Whether a participant provided a choice or a rating first was randomized.

Results

Within each participant, the choice of the preferred car was considered consistent if the individual selected the car receiving the highest value rating. Eighty-two out of 88 (93.2%) of the participants made a consistent choice. Table 1 displays the mean impression rating of each car and the frequency of choosing that car as the best one in each order condition. The frequency of choosing the best car was marginally dependent on the order, $\chi^2(6) = 10.95$, $p = .09$. Looking at Table 1, the frequency of choosing the Hatsdun (the most positive car) as the best car was higher than the frequencies of choosing the other cars only in Order 3-consistent; its mean evaluation rating was also highest in this order.

Table 1. Mean impression rating for each car and frequency of choosing that car in each order in Experiment 1

Car	Number of positive attributes	Order		
		1-early	2-confusing	3-consistent
Hatsdun	8	2.00	1.47	2.96
		(4.65)	(4.49)	(4.05)
		9	7	15
Kaiwa	6	2.19	2.47	1.85
		(3.40)	(3.43)	(3.84)
		10	12	5
Dasuka	6	.77	1.73	2.07
		(3.71)	(4.57)	(4.39)
		6	8	6
Nabusi	4	2.00	−.27	−1.19
		(3.10)	(3.78)	(4.05)
		6	3	1

Note: Standard deviations are in parentheses. Rating scale is −10 (*very negative*) to +10 (*very positive*).

A repeated-measures ANOVA was performed on impression rating, with order as the between-subjects factor and car as the within-subjects factor. The interaction between the order and car factors was significant, $F(6, 255) = 2.33$, $p = .037$, *partial* $\eta^2 = .052$. The main effect of car was also significant, $F(3, 85) = 4.99$, $p = .003$, *partial* $\eta^2 = .056$; the main effect of order was not, $F(2, 85) = .309$, $p = .735$, *partial* $\eta^2 = .007$.

To further explore the interaction following our hypothesis, we tested contrasts to elucidate how the order influenced impressions. Hatsdun's rating was higher than the average of the other cars only in Order 3-consistent, $F(1, 85) = 5.27$, $p = .027$, *partial* $\eta^2 = .056$, but not in Order 1-early, $F(1, 85) = .164$, $p = .686$, *partial* $\eta^2 = .002$, where only the Kaiwa and Nabusi were promoted, or in Order 2-confusing, $F(1, 85) = .032$, $p = .857$, *partial* $\eta^2 < .001$.

For Nabusi, the least positive car, its ratings were lower than the averages of the other three cars in Order 2-confusing and Order 3-consistent, as expected ($F(1, 85) = 9.05$, $p = .003$, *partial* $\eta^2 = .096$; in Order 2-confusing, and $F(1, 85) = 21.24$, $p < .001$, *partial* $\eta^2 = .20$, in Order 3-consistent). However, in Order 1-early, the mean rating of Nabusi was comparable with the mean ratings of the other more positive cars; that is, there was no difference between the mean rating of the Nabusi and the average rating of the other three cars in this order, $F(1, 85) = .238$, $p = .627$, *partial* $\eta^2 = .003$. Furthermore, the rating of Nabusi in Order 1-early was higher than its average rating across Orders 2-confusing and 3-consistent, $F(1, 85) = 11.82$, $p = .001$, *partial* $\eta^2 = .122$. Thus, Order 1-early had the effect of making Nabusi more preferable when half of its positive attributes were presented early.

Comparing the ratings of the middle cars in Order 1-early, Kaiwa and Dasuka, we found a marginally significant difference in the predicted direction ($t(30) = 1.51$, $p = .07$ one-tailed test, Cohen's $d = .272$). That is, even though Kaiwa and Dasuka had the same number of positive attributes, Kaiwa's positive values appeared earlier in the sequence

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leading to a slightly more positive impression of this car (mean = 2.19) compared with its similar counterpart, the Dasuka (mean = .77). There was no difference between the two cars when information was mixed in the first phase of the trials (i.e., in Order 2-confusing), $t(30) = -.669$, $p = .25$ one-tailed test, Cohen's $d = .122$, or in Order 3-consistent, $t(30) = .179$, $p = .45$, one-tailed test, Cohen's $d = .034$.

Discussion Experiment 1

This first experiment demonstrated that in a task in which participants encounter several options described by many attributes in a sequential string of data, information presented early impacted final judgments to a greater extent than later information. In particular, when positive attributes were presented early, the mean rating of the car with the fewest positive attributes was comparable with the ratings of the other cars with more positive attributes. In contrast, the car with the most positive attributes was not always rated as the top car; its mean evaluation was clearly more positive only in the order condition where the attribute presentation made its relative position evident from the start of the sequence (i.e., Order 3-consistent). Finally, a prediction from UTT that unconscious thought can organize and weigh information efficiently, and thus evaluations should not be affected by order of information acquisition, was not supported. This conclusion echoes that reached by Newell et al. (2009).

We note that this study found a primacy effect that contrasts with what was found by Experiment 4 of Newell et al. (2009). We believe that the difference may be due to the length of the information sequence. As reviewed, Hogarth and Einhorn's (1992) summary found primacy effects for complex and long sequences; the study of Newell et al. had only two options and a total of 20 pieces of information, which may be deemed short relative to the 48-long sequence in this study. Because order effects in different paradigms have demonstrated both primacy and recency effects as earlier reviewed, it is not always straightforward to compare and contrast the effects between studies when other factors are not kept constant. Future studies are needed to better understand the conditions that may lead to either type of order effect within the sequential information acquisition task employed in UTT studies.

To better address the possible influence that different modes of thought may have after information acquisition, we conducted Experiment 2 where we manipulated mode of thought as a between-participants independent variable. The experiment serves to provide further evidence for an effect of early encountered information on final evaluations.

EXPERIMENT 2

Experiment 2's goals were to replicate the observed order effect on impressions and also test the effect of post-acquisition thinking periods. Three conditions labeled conscious, unconscious, and immediate were used following standard instructions from UTT studies (Methods section). From a UTT perspective, the distracted group should be better able to distinguish the cars from best to worst in their final evaluations. Given the results of Experiment 1, on the other hand, we expected that the order of information during acquisition would be more influential on final impressions. Furthermore, in order to eliminate the possibility that the ranking of the cars defined by the proportion of positive attributes may not be for some participants the actual ranking in terms of utility (for example, the car with most positive attributes may not be the best if it contains a negative attribute that is crucial to a participant), we altered the stimuli in this experiment so that a simple dominance structure existed.

Methods

Participants

One hundred and twenty-five university students enrolled in psychology courses participated for course credit.

Procedure and materials

Three key changes were made to the stimuli in this study. First, the names of the cars were changed to single letters (N, K, J, and H). N (best) had eight positive attributes, K and J (middle) had six positive attributes, and H (worst) had four positive attributes. Second, the structure of the attributes was such that car N had all of the positive characteristics the other cars had, so it was the dominant option; the middle cars (K and J) were identical and had all the positive attributes that H had. H was the worst (dominated) option.

The order manipulation in this study was a within-participants factor. Specifically, K (middle) had all of its positive characteristics presented before the middle of the sequence, whereas J (middle) had all of its positive characteristics presented last. This presentation was intended to make them be as different as possible in the first phase of the trials. More positive attributes of the N (top) car compared with the H (bottom) car were presented early in the sequence. By trial 24, the N was described by six positive characteristics, whereas the H car had only two positive characteristics by this trial. (See APPENDIX A for the order of information.)

After attribute information was presented, participants were randomly assigned to one of three thought conditions: unconscious, conscious, and immediate. The unconscious manipulation was identical to the one used in the previous study, that is, participants were distracted for 4 minutes. Participants in the conscious group were asked to think carefully about the cars for 4 minutes. Participants in the immediate condition made their judgments immediately after the stimuli presentation. Participants gave impressions of each car using a slider bar, with end points at −100 and +100 indicating extremely negative and extremely positive impressions, respectively. Participants were also asked to indicate which car they believed was the best car.

Results

The number of participants who showed consistent preferences between their ratings and choices was 116 out of 125

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participants (92.8%). Table 2 displays the mean impression ratings of each car and the frequency of choosing that car as the best one in the three thought conditions. The frequency of choosing the best car was independent of the thought condition, $\chi^2(6) = 3.08$, $p = .20$.

A repeated-measures ANOVA was performed on impression rating, with thought condition as the between-subjects factor and car as the within-subjects factor. There was a significant main effect of car, $F(3, 366) = 25.30$, $p < .001$, *partial* $\eta^2 = .172$. There was no main effect of thought condition, $F(2, 122) = .355$, $p = .702$, *partial* $\eta^2 = .006$, or interaction between car and thought condition, $F(6, 366) = 1.099$, $p = .362$, *partial* $\eta^2 = .018$. The non-significant result of thought condition on impression rating was consistent with the negative result of thought condition on choice. To confirm this, for each car, contrasts made up of mean impression ratings from pairs of thought conditions were tested. No significant differences were found (all Fs < 2.2, *partial* $\eta^2 < .018$).

A key hypothesis in this study from the perspective of an order effect is whether the two identical cars differed in their mean ratings as a function of the attribute presentation order. As we can see in Table 2, the middle K car whose positive attributes appeared earlier in the sequence received higher mean ratings than its twin, the J car, in each thought condition. Across thought condition, K was rated significantly more positive than J, $F(1, 122) = 26.09$, $p < .001$, *partial* $\eta^2 = .176$. Such a pattern revealed that participants were more sensitive to the earlier information as was the case in the first experiment.[2]

As stated previously, the attributes of the cars N and H were presented so that the difference in their positive characteristics was evident early on. Consistently across thought conditions, car N was significantly better than the mean of the other three cars, $F(1, 122) = 21.97$, $p < .001$, *partial* $\eta^2 = .153$, and car H was significantly worse than the average of the other three cars, $F(1, 122) = 42.24$, $p < .001$, *partial* $\eta^2 = .257$. Thus, we found that the cars with most and fewest positive attributes were differentiated in the mean ratings as a function of their relative positions on the basis of their positive characteristics early on. Furthermore, this effect was consistent across thought conditions, so no special benefit of thinking after the information was acquired. We find it more interesting that the best car N received very similar ratings to the next, and dominated, car K, which was presented positively very early on (thus, it was promoted). Comparing these two cars, we found no significant differences in the ratings within each of the thinking conditions and no difference across conditions, $F(1, 122) = .019$, $p = .89$, *partial* $\eta^2 < .001$. Thus, the thinking periods, and in particular the unconscious thinking period, did not enhance the value of the dominant option as would be expected from UTT.

Table 2. Mean impression rating for each car and the frequency of choosing that car in each thought condition in Experiment 2

		Thought condition		
	Car type	Immediate	Conscious	Unconscious
N	Dominant	23.75 (38.48) 21	10.62 (43.10) 16	24.30 (43.94) 16
K	Middle early	15.02 (38.90) 15	23.93 (35.49) 20	21.61 (39.79) 19
J	Middle late	3.98 (40.49) 4	−8.67 (45.93) 4	−8.39 (40.95) 5
H	Dominated	−12.95 (42.90) 1	−14.16 (42.93) 2	−12.41 (41.81) 2

Note: Standard deviations are given in parentheses. Rating scale is −100 (*very negative*) to +100 (*very positive*).

Discussion Experiment 2

Results demonstrated an order effect, replicating the basic finding of Experiment 1. In addition, we found that two identical alternatives were evaluated differently depending on how their aspects were encountered at acquisition time. As detailed earlier, we presented the positive attributes of the middle K car before its negative attributes, whereas we presented the positive attributes of the middle J car after its negative attributes. It was found that car K was rated more positive than car J, lending further support for a primacy effect.

In addition, the results demonstrated that the evaluation of the dominant option, car N, depended on how information was encountered. Although the dominant option was never judged below the worst option, it was rivaled by a closely dominated alternative, car K. Although demonstrations of dominance violations are rare (but see violations in decisions about gambles; Kahneman & Tversky, 1984), they tend to occur when comparisons are not possible as when options must be judged individually. Mellers, Weiss, and Birnbaum (1992) found that participants did not abide by dominance when pricing individual gambles. Similar results were obtained by Mellers, Berretty, and Birnbaum (1995). Violations of dominance for decisions without risks (or uncertainty) are even more singular (but see results described by Li, 2001). However, this is an important finding because (i) no post-acquisition thinking period enhanced dominance detection and (ii) the order in which information was encountered affected it. This has important prescriptive implications for everyday decision making because comparing options side by side is not always feasible, and thus choices made without memory aids may result in many more suboptimal decisions than we would be willing to accept.

EXPERIMENT 3

Experiment 3 has two main goals. First, we manipulated the order of information to further test the impact that early positive information has on the evaluations. Second, we develop and test a quantitative model of the online updating mechanism assumed to be occurring. This model is based on the work by Hogarth and Einhorn (1992), and it assumes that

[2]It could be argued that this pattern may be due to the latter negative information that caused J to be rated more negative than K. If so, the result would be a recency rather than a primacy effect. We tested this in Experiment 3.

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impressions are a linear combination of prior impressions and new information. More precisely, the impression (evaluation) of an object at time t is given by

$$I_t = (1 - b)I_{t-1} + bX_t, \quad (1)$$

with I_t is impression after exposure to the tth piece of information, X_t is tth piece of information, and b is weight given to new information relative to the weight given to the previously held impression.

The parameter b ($0 \leq b \leq 1$) is constant across experimental trials and indexes greater or lesser sensitivity to new information, with $b > .5$ indexing greater sensitivity to the new information relative to the existing impressions, and $b < .5$ indicating the reversed pattern. As assumed by Hogarth and Einhorn, attribute information X_t is coded in a binary scale, and we used a 0 for the lowest utility and 1 for the maximum. Furthermore, even though the task requires participants to give an end of sequence evaluation, we assume that the process is based on a presentation-by-presentation computation that is carried out until the end of the trials. That is, we assume that participants update their impression each time they see a piece of information for a given object. This type of process was described by Hogarth and Einhorn as making minimal demands in memory; thus, given the long stream of attributes for different options, it seems a reasonable strategy. Finally, we note that the model is a simplified version of the weighted linear aggregation model of multi-attribute utility (Edwards, 1954) because we set the importance attribute weights to unity. Furthermore, the model is idealized because it does not contain an error term to represent variability in judgment due to noise from working memory demands, distraction, and so on, as a judgment analysis model would. Thus, the model is to serve as an initial descriptive approximation of the online judgment process. Experiment 3 provides a statistical evaluation of this model and also examines the possible effects of thought conditions on final evaluations.

Methods

Participants
One hundred and sixty university students participated in the study for course credit.

Procedure and materials
This study uses the stimuli of Experiment 1 with Hatsdun having eight positive attributes, Kaiwa and Dasuka having six positive attributes, and Nabusi having four positive attributes. Experiment 3 used two orders. In Order 1-early, all of the positive attributes of the middle car Kaiwa were presented before its negative attributes (by trial 15); the least positive car Nabusi was also introduced early on with half of its positive attributes and none of its negative ones. For Hatsdun and Dasuka, the attributes were arranged in a mixed fashion (APPENDIX A). Order 2-reversed contained the same stimuli but presented them in exactly the reversed order. That is, the first attribute presented in Order 1-early for each car was presented in the last trial in Order 2-reversed; the second attribute in Order 1-early was presented in the second to last trial in Order 2-reversed, and so forth.

Participants were randomly assigned to one of eight groups in a 2 (thought condition: conscious vs. unconscious) × 2 (Order: Order 1-early vs. Order 2-reversed) × 2 (online impression solicitation: yes vs. no) factorial design. The procedure of this experiment was identical to the previous experiments with the addition of the online impression solicitation condition. In this condition, after viewing each piece of information describing a car for 8 seconds, participants were asked for their evaluation of the car. That is, on each trial, a participant provided a rating for the car being presented resulting in 12 ratings per car. Ratings were provided using a slider bar from −100 (very negative) to +100 (very positive). After presentation of the information, participants were randomly assigned to the conscious or unconscious thought groups and provided final ratings and choices after the distraction/thinking periods as performed in Experiment 2. We note that participants in the online impression solicitation condition provided immediate ratings because their last rating for each car occurred prior to any further instructions.

Results

Of 160 participants (92.5%), 148 had a consistent choice-impression rating preference. A repeated-measures ANOVA was performed on impression ratings obtained after the thought manipulation with thought condition (unconscious and conscious), online impression solicitation (yes and no), order (Order 1-early and Order 2-reversed) as the between-subjects factors, and car (Hatsdun, Kaiwa, Dasuka, and Nabusi) as the within-subjects factor. The interaction between car and order was significant, $F(3, 456) = 4.38$, $p = .005$, *partial* $\eta^2 = .028$. The main effects of car and order were also significant (for car, $F(3, 456) = 16.58$, $p < .001$, *partial* $\eta^2 = .098$; for order, $F(1, 152) = 22.8$, $p < .001$, *partial* $\eta^2 = .130$). No significant effects were found for any other factors ($F < 2$, *partial* $\eta^2 < .01$). Table 3 displays the mean impression rating of each car and the frequency of choosing that car as the best one separately in each order. As seen in Table 3, the mean of the middle car having its positive attributes shown early (i.e., the Kaiwa) has the highest mean evaluation in the Order 1-early as expected. Similarly, the least positive car, Nabusi, appears more positive in Order 1-early than in Order 2-reversed as expected by the positioning of its positive attributes.

First, to further investigate possible effects of thought condition, we took the ratings given by the online participants on the last trial they rated a car as the immediate ratings and compared them with the ratings they provided after the conscious and unconscious manipulations. Table 4 displays the means of the immediate ratings and the mean of the post-acquisition instructions (final) ratings labeled as conscious/unconscious depending on the group assignment. The top two rows show the means within the conscious group before (immediate) and after the thinking manipulation. Similarly, the bottom two rows show the immediate and the after unconscious thinking mean ratings.

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Table 3. Mean impression rating of each car (arranged by frequency of positive attributes) and the frequency of choosing that car as the best one in each order in Experiment 3

	Order	
Car	1-early	2-reversed
Hatsdun	13.76 (40.22)	6.06 (50.74)
	13	26
Kaiwa	29.29 (38.28)	9.51 (38.78)
	55	40
Dasuka	4.31 (39.69)	.08 (40.55)
	5	13
Nabusi	4.68 (41.62)	−30.92 (50.96)
	6	2

Note: Standard deviations are given in parentheses. Rating scale is −100 (*very negative*) to +100 (*very positive*).

As is observed in Table 4, within each car in each order, there was no difference in mean impression between the immediate ratings and the ratings after each thinking/distraction period. Using one-tailed, pre-planned related *t*-test, and a liberal $\alpha = .05$, we found a single pair comparison between the immediate and unconscious post-acquisition means to be significantly different from each other (for Dasuka in or Order 1-early; $t(19) = 1.82$, $p < .05$ one-tailed), but this particular difference is not one expected by UTT. Indeed, the key comparisons, that is, a higher mean rating for the most positive car H after unconscious thinking and a lower mean rating for the least positive car N after unconscious thinking is not evident, and three of the four comparisons in Table 4 show the opposite mean pattern. We note that differences between immediate and conscious mean ratings were also not significantly different from each other (largest calculated $t(18) = .97$, $p = .17$, one-tailed). This shows strong evidence that instructions to think consciously or unconsciously were less influential to evaluations than online processing.

Collapsing across thought and online solicitation condition, we focused on the effects of order on the final evaluations. A key test entailed comparing the mean ratings of the Kaiwa and Nabusi, between Orders 1-early and Order 2-reversed. As shown in Table 3, their means are greater in Order 1-early than in Order 2-reversed, as predicted, and this difference is significant in each comparison: for Kaiwa, $F(1, 158) = 10.55$, $p = .001$, *partial* $\eta^2 = .063$; for Nabusi, $F(1, 158) = 23.36$, $p < .001$, *partial* $\eta^2 = .129$. That is, the early positive information influenced their evaluations when compared with the evaluations based on the reversed information order. Furthermore, when comparing the two middle cars Kaiwa and Dasuka, we observe that Kaiwa was rated more positive than Dasuka only in Order 1-early as expected (in Order 1-early, $F(1, 158) = 16.741$, $p < .001$, *partial* $\eta^2 = .089$; in Order 2-reversed, $F(1, 158) = 2.30$, $p = .134$, *partial* $\eta^2 = .03$).

In a similar vein, comparing the ratings of Nabusi (the mostly negative car) with those of the other cars, we found that Order 1-early boosted its evaluation as expected. As seen in Table 3, Nabusi's mean ratings were similar to those of the middle car Dasuka in Order 1-early, $F(1,158) = .003$, $p = .953$, *partial* $\eta^2 = 0$. On the other hand, Nabusi's mean

Table 4. Mean evaluations for each car in each order for the online group in Experiment 3

	Order 1-early ($n_{con} = 19$, $n_{uncon} = 20$)				Order 2-reversed ($n_{con} = 20$, $n_{uncon} = 21$)			
	H	K	D	N	H	K	D	N
Immediate conscious	13.74 (28.58)	20.00 (46.10)	15.05 (41.64)	8.79 (33.32)	9.38 (36.26)	18.29 (33.52)	−5.57 (35.82)	−25.14 (44.17)
Conscious	13.47 (36.42)	28.32 (41.42)	8.53 (38.78)	12.74 (42.53)	4.38 (55.63)	16.62 (38.77)	4.52 (46.83)	−28.43 (53.42)
Immediate unconscious	5.90 (37.45)	26.90 (34.06)	−3.95 (49.05)	2.55 (29.51)	12.95 (32.74)	13.10 (44.25)	−1.80 (35.89)	−29.63 (41.64)
Unconscious	5.30 (44.78)	26.25 (31.92)	9.15 (38.11)	5.30 (34.38)	13.35 (41.05)	9.10 (50.73)	−2.60 (34.02)	−26.65 (52.21)

Note: Standard deviations are given in parentheses. Rating scale is −100 (*very negative*) to +100 (*very positive*). The mean immediate ratings (immediate conscious and immediate unconscious) are the online group ratings in the last experimental trial of each car prior to the thinking manipulation.

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Table 5. Mean impact change score per attribute as a function of order in Experiment 3

Attribute	Order 1-early	Order 2-reversed
Mileage	14.7	22.5
Highway stability	27.6	16.8
Handling	20.3	17.5
Service	22.3	26.9
Sound system	24.2	21.3
Environment	25.9	22.2
New/old	22.8	15.3
Cup holder	25.2	17.7
Legroom	30.1	21.3
Sunroof	23.1	17.6
Trunk	26.2	15.5
Color availability	30.0	14.7

Higher values demonstrate greater impact.

rating in Order 2-reversed was significantly worse than the average rating of the other cars, $F(1,\ 158) = 47.0$, $p < .001$, *partial* $\eta^2 = .229$. Thus, we replicated the findings that participants were more sensitive to the positive information encountered earlier. This impact, in turn, had implications for how the most negative option was evaluated; in one context, it was clearly worse, but in the other context, it was not.

In terms of the most positive option, the Hatsdun, it did not receive the top mean average rating, and we attribute this to the manipulation of the other cars' information. That is, in Order 1-early, its mean rating was not significantly better than the others in part because of competition from cars that were "promoted" (e.g., the middle car Kaiwa), $F(1,\ 158) = .03$, $p = .864$, *partial* $\eta^2 = 0$. In combination, these findings demonstrate the malleability of evaluation ratings and order effects, which in the aggregate amounted to having a more positive product undermined.

In order to further test the impact of early information on impressions, we conducted an attribute level analysis. We computed the absolute change in rating after receiving each piece of positive or negative information, per attribute. For example, if someone gave a rating of 45 to a car in trial t, but then this car's rating was changed to 25 when he or she saw a negative value for a given attribute, a change of 20 occurred, depicting the influence that the attribute had on the previous impression. Table 5 displays the mean, across cars, of the absolute impression changes produced by each attribute, separate by condition.

As seen in Table 5, the mean impression change depends on the order condition. For example, mileage had a greater impact on the final evaluations when appearing in Order 2-reversed than when appearing in Order 1-early. The mileage attribute described the Nabusi, the Hatsdun, and the Dasuka in trials 1, 8, and 11 in Order 2-reversed, thus appearing relatively early in this condition. In contrast, mileage described these same cars a lot later (trials 38 onwards) in the other order. Thus, mileage had greater impact on the ratings the earlier it occurred in a sequence. To further elucidate the role of position of attribute values on the ratings, a Spearman rank-order correlation was computed between the average change score and the average position of each attribute (e.g. position = 1 if the attribute was presented in the first trial of a given car). In Order 1-early, $r(10) = -.858$, $p < .001$; in Order 2-reversed, $r(10) = -.639$, $p = .025$. Thus, the earlier the attribute was presented, the greater its impact on the rating, demonstrating a primacy effect.

Model fitting

Before model fitting, impression data were scaled by linearly translating the participants response, Y, into a [0, 1] utility scale using the transformation $t(Y) = (Y + 100)/200$; thus, negative impressions were translated to values between 0 and .50, whereas positive impressions were translated to values between .50 and 1. Similarly, in terms of attribute values, X_t in Equation (1), negative values were coded as 0, whereas positive attribute values were coded as 1.

The model in Equation (1) was fitted to each person's data, per car, by using a non-linear regression procedure in which each rating was the dependent variable and the attribute information along with the impression at time $t - 1$ were the independent variables. For the first trial, the prior impression was set equal to .5.

Table 6 displays the median R^2 and median b (across participants) for each car in each order. The model fitted individual participants with median $R^2 > .635$ and in 80.2% of the cases $R^2 > .5$. In 97.2% of the cases, the estimated parameter $b < .5$, indicating that participants were more sensitive to the information received earlier than to information received later in the sequence. This result is in agreement with the pattern observed in the model free tests.

Table 7. Median MSE for each model, for each car, and order (indicated by 1 or 2) in Experiment 3

	MSE with estimated b	MSE with $b = .2$	MSE with $b = .5$	MSE with $b = .75$
Hatsdun1	.0238	.0226	.0568	.0911
Kaiwa1	.0355	.0378	.0905	.1486
Dasuka1	.0210	.0228	.0425	.0845
Nabusi1	.0230	.0294	.0429	.0853
Hatsdun2	.0271	.0333	.0554	.1143
Kaiwa2	.0304	.0403	.1116	.1525
Dasuka2	.0226	.0261	.0608	.1356
Nabusi2	.0324	.0343	.0475	.0931

MSE, mean square errors.

Table 6. Median R^2 and median b for each car in each order in Experiment 3

	Order 1-early ($n = 39$)				Order 2-reversed ($n = 41$)			
	Hatsdun	Kaiwa	Dasuka	Nabusi	Hatsdun	Kaiwa	Dasuka	Nabusi
Median R^2	.640	.690	.643	.652	.635	.724	.695	.711
Median b	.280	.096	.226	.252	.228	.117	.176	.175

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Model comparisons

In order to better judge the ability of the model to describe the overall data patterns, we tested three other models. In one model, we assumed a $b = .75$, which represents stronger reliance on later information or recency. We set $b = .5$ to represent a neutral weighting case; and finally, we set $b = .20$ to describe a general primacy effect model. Using the fixed values of b, we obtained predicted scores for each participant for each car in each order. We then computed the prediction errors as the square of the difference between an observed rating and a predicted rating. The average of these errors—mean square errors (MSE)—was calculated per participant. Table 7 presents the median values of the MSE organized by car and order for each of the models tested.

As seen in Table 7, the errors in prediction increase as b increases in every car and order, indicating that a primacy effect is more representative of the rating process. Furthermore, the MSE of the estimated b model and that of the fixed $b = .2$ model are very close despite that the estimated model has many more parameters. We used a Wilcoxon signed rank test with Bonferroni α correction ($\alpha = .001$) to compare the MSE of the four models tested per car and order. We note that the estimated model is of course expected to do better than the fixed b models, and this was the case when comparing the estimated model with the $b = .5$ and $b = .75$ models (all z scores greater than abs(4.53)). The pair-wise comparisons of the three fixed models were also all significantly different from each other, demonstrating worse prediction as b increased as expected by a primacy effect. However, comparing the fixed $b = .2$ model with the estimated model, we found little difference. Indeed, the models were significantly different only in two comparisons (for Kaiwa and Dasuka cars in Order 2-reversed). In other words, using three fixed b models, only the recency and the equal weight models resulted in significantly worse fit than a fixed primacy and the estimated models. A fixed primacy model was generally as good as the estimated model in describing the variability in the ratings.

Discussion Experiment 3

The main goal of this study was to formally test a model of online attitude processing and elucidate the role that early information had on such impressions. Consistent with the previous studies' findings, order of presentation of information was very important in determining final evaluations beyond the frequency of positive versus negative attributes defining the options. Furthermore, the order of cars as defined by the total number of positive attributes was not always reflected in the orders of the mean evaluation ratings as observed in Table 3. This study also demonstrated that the post-information acquisition thought manipulations did not have systematic effects on the final evaluations as observed in Table 4. In particular, the unconscious manipulation did not yield the highest mean rating for the most positive car Hatsdun and lowest mean rating for the most negative car Nabusi in all conditions as it would be expected by UTT. Indeed, the opposite pattern was observed in some instances. Furthermore, the means of the immediate ratings were not different from those obtained after the thought manipulation.

In terms of the model, we followed Hogarth and Einhorn (1992) and defined a simple trial-by-trial updating mechanism that linearly combines the impression of an option up to time $t - 1$ with the new data at hand. Because the model is a weighted linear combination of prior and new information, its parameter b measures the relative contribution of earlier information to the final impressions. As observed, the model described the variability of the ratings well, and the parameter b indicated primacy rather than recency effect. More importantly, a reduced model in which the parameter b was fixed at a value that would represent a primacy effect was as good as the estimated model in predicting the evaluations. Other models representing equal weighting or recency effects resulted in significantly worse fit.

GENERAL DISCUSSION

The present research had three major findings. First, we demonstrated that the order in which information about options is presented in a typical UTT task influences the final evaluations to a greater extent than a post-acquisition thinking period does. Not only did we affect people's ratings of top, middle, and worst cars, but we also found that generally, early appearing positive information had a greater impact on final impressions to the point that a truly dominant option, as shown in Experiment 2, was not self-evident. From the perspective of UTT, clearly if unconscious thinking is able to optimally weight and combine information, it should be able to more simply follow one of the most basic principles of rationality, that of dominance. Our study found no support for this hypothesis.

Order effects have been obtained in many domains (Anderson & Hubert, 1963 as cited in Hastie & Park, 1986; Nisbett & Ross, 1980; Pennington & Hastie, 1986), but our results are novel with regard to the paradigm we employed and with regard to the possible influence of unconscious or conscious thinking on final judgments beyond the order effects. When exploring the difference between memory-based (when the participant's goal is to memorize what will be encountered) and online impression formation, Hastie and Park (1986) proposed that online judgments were more spontaneous and less effortful than memory judgments. The spontaneous aspect of an online judgment as well as the difficulty of retaining a large amount of information in working memory can in part explain people's greater sensitivity to earlier over later information. Another way of stating this is that earlier characteristics can serve as anchors in online judgments, as was discussed by Hastie and Park (1986), and this is a key aspect of Equation (1) in which the past evaluation is kept as an anchor in the subsequent trial; when the parameter b is small, the adjustment process that incorporates new data is insufficient, in contrast, a value of b close to 1 makes the model very sensitive to new information. Order effects have been found in applied domains. For example, Scarpi (2004) found that in a natural setting, products positioned at a store's entrance were more likely to be purchased than similar ones positioned inside the shop. Xu and Kim (2008) showed that after controlling for other factors such as age,

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gender, internet experience, and factors pertaining to vendors such as rating, price, and brand awareness, consumers were more likely to purchase products that were positioned near the top when displayed on a computer screen by search engines. Our study contributes to this literature by demonstrating that not only the order of products can alter evaluations but also the order in which information that pertains to the products or describe the products (i.e., their attribute values) can also alter the evaluations.

Second, we failed to replicate the deliberation-without-attention effect and showed that the post-acquisition thinking manipulations had little impact on final evaluations. In particular, assuming that unconscious thinking can make decisions optimally, this process was not able to overcome the effects of information order. This was also true for those asked to think carefully, presumably because memory of specific information could not be accurately retrieved at that point to alter the evaluations made online. Future studies must look more closely at the way in which instructions may enhance the accuracy of retrieving stored information that is needed to even detect a dominant order as was necessary to do in Experiment 2. One aspect is how information is organized. The online paradigm employed here does not allow participants to make comparisons among alternatives very easily, nor does it present the information organized per alternative, which could facilitate such comparisons. With the advent of web-based online shopping, issues of data organization are even more prevalent. Research on when and how individuals will adhere to basic principles of rationality in these environments, along with mathematical models of the judgment and choice processes, is much needed.

A null effect, such as the ones we observed for thinking manipulations, can always be due to lack of statistical power. However, we note that with constant sample sizes per study, key predicted mean patterns were statistically significant, whereas others were not, implying that the lack of effect was due to small mean differences, rather than to issues of sample size or alpha levels. In addition, when possible, we tested the UTT hypothesis using the most powerful tests, but as shown in Table 4 for example, oftentimes the patterns of means were in the opposite direction of what would be expected by that theory. Furthermore, recent research has shown similar failures to replicate the UTT effect (Nieuwenstein & van Rijn, 2012); because science advances when interesting results are re-examined for robustness, our results contribute to this knowledge by showing evidence of a much more feeble deliberation-without-attention phenomenon. The extent to which our decisions depend on unconscious processes has fascinated psychology at least since Freud's psychoanalytic theory, which promoted an unconscious that could produce intellectual coherence and manipulate emotions (as cited by Erdelyi, 1992). More modern approaches, however, began to revise this view eventually settling on a less sophisticated cognitive homunculus (Greenwald, 1992). Many models conceive the cognitive system as a mixture of processes that work in parallel, some of which reach verbalization/awareness states, whereas others do not (Phaf & Wolters, 1997). UTT is more closely philosophically related to the Freudian perspective by proposing that distraction allows the unconscious to make superior evaluations (Bos et al., 2008; Dijksterhuis, 2004; Dijksterhuis & Nordgren, 2006; Dijksterhuis et al., 2006, 2009; Zhong et al., 2008). Our null results along with conclusions from other authors (Newell & Shanks, in press) are casting doubts on such benefits.

The third contribution of our work is the testing of a mathematical model of the online acquisition process. There is evidence from different research paradigms that people update attitudes towards objects in an online manner (Hastie & Park, 1986; Lodge, Steenbergen, & Brau, 1995; Tormala & Petty, 2001), particularly when the goal is to form an impression as in the present tasks (Briley, Shrum, & Wyer, 2007; Hamilton & Sherman, 1996; Lassiter et al., 2009; McConnell, Sherman, & Hamilton, 1994; McGraw & Dolan, 2007). In terms of modeling attitudes, a linear aggregation process, consistent with traditional expected utility theory considerations (Savage, 1954/1972; Edwards, 1954), was introduced in this domain by Fishbein (1963) and Fishbein and Ajzen (1975) and more recently re-evaluated by these authors (Ajzen & Fishbein, 2008). In this perspective, the overall evaluation of an object results from the weighted linear combination of its attribute values. The extension of this basic idea to online judgments involves the inclusion of the time variable as represented in Equation (1), thus making the model dynamic. In a multiple options paradigm, the participant is assumed to keep track of each of option with the corresponding impressions and attitudes updated sequentially as each new piece of additional data is presented. The model is clearly an idealization from the perspective of keeping track of all of the objects separately and from the perspective of focusing primarily on the positive information. The model is also a simplification, from the perspective of assuming equal importance weights of attributes (set to unity here), but can be easily generalized to include differential importance weights. The model also involves a simplification from the perspective of ignoring errors due to fatigue, memory lapses, difficulties in adding, and so on. Thus, the model is dynamic but deterministic. Generalizations in line with lens model approaches (Hammond & Stewart, 2001) are needed. Nevertheless, in spite of being an idealized model of the process of accumulating value for different objects, we found that the model was appropriate. From a model fit perspective, we found that the proportion of variance accounted for at the level of each participant was good in a relative sense. That is, using a fixed parameter model to represent the updating process of a primacy effect, we found that the estimated model and the fixed model perform equally well. In contrast, fixed models representing equal weighing or a recency effect performed significantly worse. From a qualitative perspective, the weighting parameter b captured the greater reliance on prior (early) positive information as increasing b resulted in greater discrepancies between observed and predicted ratings.

Similar models of online judgments are found in other domains. A recent study on political information processing (Kim, 2012) made related assumptions about the attitude updating process with results that supported the basic mechanism instantiated in Equation (1). The model tested here also fits well within conceptions of value accounts (Betsch, Plessner, Schwieren, & Gutig, 2001) but without recourse to implicit processing. As in the value-account theory, we assume

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that value-charged data produce a binary reaction to the positive and negative stimuli that results in an evaluation; furthermore, these evaluations are updated via an additive process as new information is encountered. In contrast to the value-account theory, our model is mathematically defined, and thus, our predictions are more precise at the level of each person and each object being evaluated. To our knowledge, this is the first quantitatively defined approach to modeling the judgments of a typical UTT paradigm (but see related approaches by Hogarth & Einhorn, 1992; Tubbs et al., 1993; and a dynamic model of interpersonal interactions by Denrell, 2005). Furthermore, our model accounts for time dependency in terms of the weight information receives when it is encountered.

In sum, three experiments demonstrated consistently systematic order effects while showing no effects of thinking manipulations. Results showed that positive information encountered earlier exerted a stronger influence than later information; this effect was assessed with different orders and with different statistical methods across the studies. For example, Table 5 shows the quantification of the impact that a newly encountered attribute value would have on changing an evaluation, and the results show a strong dependency on the order. A quantitative model of the process was tested, and in combination, we showed that judgment variability was more a function of acquisition factors than post-acquisition thought manipulations.

APPENDIX A: EXPERIMENT 1: TRIAL NUMBER AND INFORMATION PRESENTED IN EACH ORDER CONDITION.

Order 1-early

Trial number	Attribute description
1	The Hatsdun is new
2	The Dasuka has poor legroom
3	The Kaiwa is available in many different colors
4	The Nabusi is relatively good for the environment
5	The Kaiwa has good highway stability
6	The Hatsdun has poor highway stability
7	The Kaiwa has plenty of legroom
8	The Nabusi is available in many different colors
9	The Dasuka has a small trunk
10	The Hatsdun has a poor sound system
11	The Kaiwa has a large trunk
12	The Kaiwa has good mileage
13	For the Kaiwa service is excellent
14	The Hatsdun has cup holders
15	The Hatsdun is poor for the environment
16	The Kaiwa has a poor sound system
17	The Hatsdun has good handling
18	The Kaiwa is old
19	The Hatsdun is available in many different colors
20	The Dasuka has good highway stability
21	The Kaiwa does not have cup holders
22	The Dasuka is new
23	The Hatsdun has a sunroof
24	The Dasuka has a sunroof
25	The Dasuka has a good sound system
26	The Hatsdun has poor legroom
27	The Kaiwa is poor for the environment
28	The Nabusi has a small trunk
29	The Kaiwa has poor handling
30	The Nabusi has poor handling
31	The Hatsdun has a large trunk
32	The Nabusi has poor highway stability
33	The Nabusi does has a sunroof
34	The Dasuka is available in very few colors
35	For the Nabusi service is poor
36	For the Hatsdun service is excellent
37	The Nabusi has plenty of legroom
38	The Dasuka has poor mileage
39	The Dasuka has cup holders
40	The Kaiwa does not have a sunroof
41	The Hatsdun has good mileage
42	The Dasuka has good handling
43	For the Dasuka service is poor
44	The Nabusi has a poor sound system

(*Continues*)

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Order 1-early (continued)

Trial number	Attribute description
45	The Nabusi is old
46	The Dasuka is poor for the environment
47	The Nabusi does not have cup holders
48	The Nabusi has poor mileage

Order 2-confusing

Trial number	Attribute description
1	The Kaiwa has a large trunk
2	For the Dasuka service is poor
3	The Kaiwa is poor for the environment
4	The Hatsdun has a sunroof
5	The Kaiwa has plenty of legroom
6	The Hatsdun has poor highway stability
7	The Dasuka has cup holders
8	The Hatsdun is available in many different colors
9	The Kaiwa does not have cup holders
10	The Hatsdun is poor for the environment
11	The Dasuka has a good sound system
12	The Dasuka is new
13	For the Kaiwa service is excellent
14	For the Hatsdun service is excellent
15	The Hatsdun has poor legroom
16	The Dasuka is available in very few colors
17	The Hatsdun has a large trunk
18	The Kaiwa has a poor sound system
19	The Dasuka has good handling
20	The Nabusi does has a sunroof
21	The Kaiwa is available in many different colors
22	The Kaiwa has good highway stability
23	The Hatsdun is new
24	The Dasuka has good highway stability
25	The Kaiwa has good mileage
26	The Hatsdun has a poor sound system
27	The Kaiwa has poor handling
28	The Nabusi has a small trunk
29	The Kaiwa does not have a sunroof
30	The Nabusi has a poor sound system
31	The Hatsdun has good mileage
32	The Nabusi has poor handling
33	The Nabusi is available in many different colors
34	The Dasuka has poor legroom
35	The Nabusi does not have cup holders
36	The Hatsdun has cup holders
37	The Nabusi has plenty of legroom
38	The Dasuka is poor for the environment
39	The Hatsdun has good handling
40	The Kaiwa is old
41	The Nabusi is relatively good for the environment
42	The Dasuka has a sunroof
43	The Dasuka has poor mileage
44	The Nabusi has poor mileage
45	For the Nabusi service is poor
46	The Dasuka has a small trunk
47	The Nabusi is old
48	The Nabusi has poor highway stability

Order 3-consistent

Trial number	Attribute description
1	The Hatsdun has a large trunk
2	The Dasuka has poor legroom

(*Continues*)

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Order 3-consistent (continued)

Trial number	Attribute description
3	The Kaiwa does not have a sunroof
4	The Hatsdun has good mileage
5	For the Kaiwa service is excellent
6	The Hatsdun is poor for the environment
7	The Dasuka has a good sound system
8	The Hatsdun is new
9	The Kaiwa is poor for the environment
10	The Hatsdun has poor highway stability
11	The Kaiwa is available in many different colors
12	The Dasuka has a sunroof
13	The Kaiwa has good mileage
14	The Hatsdun has cup holders
15	The Hatsdun has a poor sound system
16	The Dasuka has poor mileage
17	The Hatsdun is available in many different colors
18	The Kaiwa has poor handling
19	The Dasuka has good handling
20	The Nabusi has plenty of legroom
21	The Dasuka has cup holders
22	The Kaiwa has a large trunk
23	The Hatsdun has good handling
24	The Dasuka is new
25	The Kaiwa has plenty of legroom
26	The Hatsdun has poor legroom
27	The Kaiwa has a poor sound system
28	The Nabusi is old
29	The Kaiwa is old
30	For the Nabusi service is poor
31	For the Hatsdun service is excellent
32	The Nabusi has poor mileage
33	The Nabusi is available in many different colors
34	The Dasuka is available in very few colors
35	The Nabusi has poor highway stability
36	The Kaiwa has good highway stability
37	The Nabusi does has a sunroof
38	For the Dasuka service is poor
39	The Hatsdun has a sunroof
40	The Kaiwa does not have cup holders
41	The Nabusi is relatively good for the environment
42	The Dasuka has good highway stability
43	The Dasuka has a small trunk
44	The Nabusi has a small trunk
45	The Nabusi has poor handling
46	The Dasuka is poor for the environment
47	The Nabusi does not have cup holders
48	The Nabusi has a poor sound system

Experiment 2: Trial number and information presented.

Trial number	Attribute description
1	The N has good handling
2	The H has poor highway stability
3	The K has cup holders
4	The J has poor service
5	The J has poor highway stability
6	The K has good handling
7	The N has a good sound system
8	The H has cup holders
9	The N is relatively good for the environment
10	The H is relatively poor for the environment
11	The K has a good sound system
12	The J is relatively poor for the environment
13	The N has poor service
14	The J has a small trunk

(*Continues*)

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Experiment 2: (continued)

Trial number	Attribute description
15	The K has a sunroof
16	The H has a small trunk
17	The J has poor legroom
18	The J is not available in many colors
19	The K has good gas mileage
20	The N is not available in many colors
21	The N has a sunroof
22	The K is relatively new
23	The H has poor handling
24	The H has a sunroof
25	The N has cup holders
26	The K has a small trunk
27	The N has poor highway stability
28	The J has good handling
29	The H has poor legroom
30	The J has good gas mileage
31	The K has poor highway stability
32	The H has poor service
33	The J is relatively new
34	The H has a poor sound system
35	The N is relatively new
36	The K has poor service
37	The H is relatively new
38	The K is not available in many colors
39	The J has a sunroof
40	The N has good gas mileage
41	The J has a good sound system
42	The H is not available in many colors
43	The K has poor legroom
44	The K is relatively poor for the environment
45	The N has a large trunk
46	The J has cup holders
47	The H has good gas mileage
48	The N has poor legroom

Experiment 3: Trial number and information presented in each order condition.
Order 1-early

Trial number	Attribute description
1	The Kaiwa is available in many different colors
2	The Dasuka has poor legroom
3	The Hatsdun has cup holders
4	The Nabusi is relatively good for the environment
5	The Kaiwa has good highway stability.
6	The Hatsdun has poor highway stability.
7	The Kaiwa has plenty of legroom
8	The Nabusi is available in many different colors
9	The Dasuka has a small trunk
10	The Hatsdun has a poor sound system
11	The Kaiwa has a large trunk
12	The Kaiwa has good mileage
13	For the Kaiwa service is excellent
14	The Hatsdun is new
15	The Hatsdun is poor for the environment
16	The Kaiwa has a poor sound system
17	The Hatsdun has good handling
18	The Kaiwa is old
19	The Hatsdun is available in many different colors
20	The Dasuka has good highway stability.
21	The Kaiwa does not have cup holders
22	The Dasuka is new
23	The Hatsdun has a sunroof
24	The Dasuka has a sunroof
25	The Dasuka has a good sound system

(*Continues*)

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Experiment 3: (continued)

Trial number	Attribute description
26	The Hatsdun has poor legroom
27	The Kaiwa is poor for the environment
28	The Nabusi has a small trunk
29	The Kaiwa has poor handling
30	The Nabusi has poor handling
31	The Hatsdun has a large trunk
32	The Nabusi has poor highway stability.
33	The Nabusi does has a sunroof
34	The Dasuka is available in very few colors
35	For the Nabusi service is poor
36	For the Hatsdun service is excellent
37	The Nabusi has plenty of legroom
38	The Dasuka has poor mileage
39	The Dasuka has cup holders
40	The Kaiwa does not have a sunroof
41	The Hatsdun has good mileage
42	The Dasuka has good handling
43	For the Dasuka service is poor
44	The Nabusi has a poor sound system
45	The Nabusi is old
46	The Dasuka is poor for the environment
47	The Nabusi does not have cup holders
48	The Nabusi has poor mileage

Order 2-reversed

Trial number	Attribute description
1	The Nabusi has poor mileage
2	The Nabusi does not have cup holders
3	The Dasuka is poor for the environment
4	The Nabusi is old
5	The Nabusi has a poor sound system
6	For the Dasuka service is poor
7	The Dasuka has good handling
8	The Hatsdun has good mileage
9	The Kaiwa does not have a sunroof
10	The Dasuka has cup holders
11	The Dasuka has poor mileage
12	The Nabusi has plenty of legroom
13	For the Hatsdun service is excellent
14	For the Nabusi service is poor
15	The Dasuka is available in very few colors
16	The Nabusi does has a sunroof
17	The Nabusi has poor highway stability.
18	The Hatsdun has a large trunk
19	The Nabusi has poor handling
20	The Kaiwa has poor handling
21	The Nabusi has a small trunk
22	The Kaiwa is poor for the environment
23	The Hatsdun has poor legroom
24	The Dasuka has a good sound system
25	The Dasuka has a sunroof
26	The Hatsdun has a sunroof
27	The Dasuka is new
28	The Kaiwa does not have cup holders
29	The Dasuka has good highway stability.
30	The Hatsdun is available in many different colors
31	The Kaiwa is old
32	The Hatsdun has good handling
33	The Kaiwa has a poor sound system
34	The Hatsdun is poor for the environment
35	The Hatsdun is new
36	For the Kaiwa service is excellent

(*Continues*)

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Order 2-reversed (continued)

Trial number	Attribute description
37	The Kaiwa has good mileage
38	The Kaiwa has a large trunk
39	The Hatsdun has a poor sound system
40	The Dasuka has a small trunk
41	The Nabusi is available in many different colors
42	The Kaiwa has plenty of legroom
43	The Hatsdun has poor highway stability.
44	The Kaiwa has good highway stability.
45	The Nabusi is relatively good for the environment
46	The Hatsdun has cup holders
47	The Dasuka has poor legroom
48	The Kaiwa is available in many different colors

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