

# The Effects of Prior Use on Preference

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## Abstract

There is little research examining the effects of decision processes on the individual, and the work that does exist has emphasized very high-level processes, associated with complex decisions made over extended periods of time, with substantial levels of engagement. We present two studies demonstrating very basic effects, in which use of a dimension in a decision leads to its increased salience, and subsequent greater weighting in later decisions. Effects were based on both recency of use and total amount of prior use.

## Introduction

A large body of research has focused on the factors that influence people's decisions. (For a recent review, see Markman & Medin, 2002). However, relatively little attention has been given to the effects that the act of making a decision may have upon the individual. Of course, there are the obvious tangible effects of the actions people undertake as a result of their choices. However, it is also reasonable to suggest that there could be an impact on the mental representations that are used in decision processes.

In the present studies, we are investigating very specific, low-level effects, determining whether the particular dimensions that are used in making a decision will become generally more salient, and thus play a larger role in subsequent choices. We presented participants with alternative models of portable video players, in which certain dimensions (such as hard drive capacity or battery life) were diagnostic and thus useful for determining relative preference. We then examined the extent to which dimensions that were used in a decision would become more important on later choices between different models.

## Comparison and Choice

One reason to expect choice processes to affect mental representations is the fact that decisions generally require comparison between alternatives, and there is evidence that comparison itself may lead to representational change. Some of the most compelling evidence in this regard comes from demonstrations that comparison may facilitate knowledge transfer. For example, people were found to be more successful at solving difficult problems or applying optimal strategies after having previously made comparisons between analogous examples, and this advantage was far superior to that of situations in which the prior analogues were simply encoded separately (Gick &

Holyoak, 1983; Loewenstein, Thompson & Gentner, 1999). This suggests that the act of comparison may serve to highlight meaningful structural commonalities between the examples, making those structures more available for application to new situations. Similar results have been found in developmental research, where comparison has been shown to facilitate the acquisition and application of difficult abstract concepts (e.g., Gentner & Medina, 1998).

These findings can be interpreted within the framework of structure mapping theory (Gentner, 1983), which proposes that comparisons involve the alignment of representational structures (e.g., Markman & Gentner, 1993). These structural alignments lead to a special role for "alignable differences," or differences that are related to structural commonalities. For instance, the fact that cars have four wheels while motorcycles have two is an alignable difference, since it involves different values on the shared dimension of "number of wheels." On the other hand, the fact that motorcycles have a kickstand is a unique feature for which a car has no corresponding attribute, making it a "nonalignable difference." Prior research has repeatedly shown a privileged role for alignable differences, in areas such as perceived similarity (Markman & Gentner, 1996), recall (Markman & Gentner, 1997), and preference (e.g., Roehm & Sternthal, 2001). With respect to the current studies, these findings suggest that comparison of alternatives that vary along particular dimensions should serve to highlight those dimensions. Our primary question is whether this sort of differential emphasis could lead to generally increased salience, causing increased dimension weighting on subsequent choices.

Some work exists examining the relationship between structural alignment and decision processes. In the domain of consumer research, Zhang and Markman (1998) showed that after initially learning facts about a particular brand of product, future alternative products were evaluated largely in terms of their alignable differences with this "first entrant." Values on dimensions that were shared with this initial product were better remembered, and played a larger role in preference judgments. In another set of studies, Markman and Medin (1995) found that justifications for preferences were more likely to include alignable than nonalignable differences. (For a review of interesting parallels between similarity and choice processes, see Medin, Goldstone & Markman, 1995).

Another way in which comparison and decisions seem to be linked is in the shared influence of the context created by

the other alternatives under consideration. It has long been known that choice is influenced by relational properties of the alternatives, such as their similarity (e.g., Tversky & Russo, 1969), or their relationship with reference points (e.g., Coombs, 1958). One prominent line of research has demonstrated robust contextual effects in trinary choice (e.g., Huber, Payne, & Puto, 1983). For example, the introduction of a third alternative to a binary choice set may lead to “compromise effects,” wherein one of the initial alternatives becomes more attractive as result of its new position as an “intermediate” option between the other two (Simonson, 1989). Similarity judgments have likewise been shown to vary with the other items in a set (Golstone, Medin, & Halberstadt, 1997). Dhar and Glazer (1996) presented evidence that these two kinds of context effects are, at least sometimes, the result of shared underlying cognitive processes, showing that measures of contextual effects on similarity could be quite predictive of subsequent effects on choice. Dhar, Nowlis and Sherman (1999) explicitly examined the effects of comparison on later choice. In their studies, both the kind of comparison (similarity vs. dissimilarity ratings) and the direction of comparison (which alternative served as the referent) were manipulated. They found that these factors interacted to influence later preferences between the alternatives, in a manner consistent with differential feature weightings predicted by a feature-matching model of similarity.

In all of these cases, comparison processes are exerting an influence on choice, consistent with the focus of our studies. In each of the findings described thus far, however, the effects have been limited to the objects of comparison themselves, not to more general representations. That is, comparisons between Items A and B are clearly affecting decisions that involve those specific items, but there is no evidence suggesting that this comparison would have any influence on subsequent choices between new alternatives.

### **Evaluability**

Evaluability refers to the ease with which a value or attribute can be evaluated independently. For example, Hsee (1998) asked participants how much they would be willing to pay for two different products: 7 ounces of ice cream in a 5 ounce cup, or 8 ounces of ice cream in a 10 ounce cup. When the alternatives were presented together, individuals were (not surprisingly) willing to pay more for the second option, which provided more of the actual product of interest. However, when participants saw only one of the alternatives independently (between-subjects), they were willing to pay considerably more for the 7 ounce product that overflowed its container (\$2.26) than for the 8 ounce product whose container was under-filled (\$1.66). Hsee took this as evidence of people’s reliance on highly evaluable information (over- v. under-filling), to the detriment of information that could not easily be evaluated independently (cost/ounce of ice cream). Similar effects have been shown in a variety of domains (e.g., Hsee, 1996), and with varying levels of evaluability (Hsee, et al, 1999).

The construct of evaluability highlights the importance of reference information for evaluation and choice. Evaluations are made with respect to reference points, in the

form of comparisons to alternative options, comparisons to mental representations, or both. There are at least two ways in which prior decisions might alter these mental representations that serve as references. First, through repeated exposure and attention to relevant dimensions and features, an individual may gradually gain knowledge about distributions of values. Hence, one could accrue long-term knowledge that would allow formerly non-evaluable information to become evaluable, such as learning the per unit price for ice cream. (Some evidence for this kind of knowledge change is given by Moore, 1999). Additionally, human representation is known to be remarkably flexible, and the actual reference knowledge that is used in any situation will depend a great deal on what particular information is active at that moment. We could therefore also expect prior decisions to exert a more local effect on representations by differentially activating certain features and dimensions through use. These local effects might themselves eventually lead to long-term representational change.

Our interest in the current studies is in these (initially) more local effects. In the absence of specific long-term knowledge about the relative importance of different dimensions, individuals should be more likely to rely on representations that are based on current activation and salience. Recent use of a particular dimension should lead to a local increase in its accessibility, which in turn should give it a more important role in the mental representations that serve as reference points.

### **Coherence and decision making**

Some researchers have examined representational change in decision processes in terms of the need to maintain a coherent set of beliefs (e.g., Phillips, 2002). For example, Simon and his colleagues have examined the influence of constraint satisfaction processes in coherence and belief change, and have specifically looked at these processes in the domain of complex decisions. In one study (Simon, Krawczyk & Holyoak, 2004), participants were asked to decide between two alternative job offers. These jobs were described on four dimensions (such as salary), with each being superior on two of the dimensions and inferior on the other two. An additional factor—“good location” vs. “bad location”—was varied in order to experimentally manipulate overall preference between the two options. Simon proposed that in order to maintain an internally consistent set of beliefs, individuals would alter their evaluations of the relevant dimensions, inflating the importance of the dimensions that favored the alternative that would eventually be chosen, while deflating those that favored its competitor. This was indeed the pattern that was found; participants changed their ratings of each dimension’s importance and desirability to make them more consistent with the decisions that they ultimately made.

These results provide compelling evidence for the larger issue of examining the impact of decision processes on mental representations. The goals of previous studies were considerably different from those of the current experiments, however. While Simon and his colleagues have explored intriguing issues regarding how systems of

beliefs interact at a fairly high level, we are investigating much more fundamental, low-level processes—at the level of activation and salience—which may act on dimensions independently. Consistent with this difference, the tasks used in their experiments have generally involved a single, very deliberate and ostensibly important decision, made over an extended period of time, requiring difficult tradeoffs across many attributes, and demanding a high level of participant involvement. The current studies examine much more automatic and local kinds of effects springing from simple dimension use.

## Experiments

### Experiment 1

The first experiment was designed to examine whether dimensions that had been used in making recent decisions would receive more weight in future choices. An obvious difficulty in looking at the effects of one decision on another is the lack of experimental control; decisions are inherently driven by processes and representations that are internal to the individual, and preferences can not be dictated by the experimenter. To circumvent this problem, our study utilized choice pairs in which one alternative was clearly objectively superior to the other. Many of the decisions that participants made in this study involved alternatives that were identical on all but one dimension, making that dimension the sole criterion for comparison. Since one of the two alternatives would necessarily be superior on that dimension, the outcome of those decisions was essentially predetermined. This meant that on those trials we were able to control which dimensions participants were using to make their decisions, giving us an experimentally-controlled method for examining whether those recently-used dimensions would be considered more important in subsequent choices. Of course, it is quite possible that in circumstances where the outcome of a decision is essentially out of the individual's control, the person will discount its meaningfulness. However, if we do observe subsequent effects from even these predetermined kinds of choices, it would provide strong evidence for the claim that prior decisions can influence later ones at a fundamental level.

We attempted to use a domain that was novel enough that participants' preferences would be somewhat malleable, but understandable enough that they should be able to easily structure the new information. We decided on portable digital video players, which we assumed would be readily construed in terms of existing schemas about portable audio devices, but without as many preconceptions about what would constitute a good or bad value on any dimension.

Each device was described in terms of nine characteristics: four of these were discrete features, which were described as being either present or absent (e.g., a built-in voice recorder), and five were variable dimensions, for which each model had some value (e.g., battery life, hard drive capacity). There were three possible values (low, medium, and high) for each of these variable dimensions; for instance, the battery life for any device could be given as 2, 4, or 6 hours.

Descriptions of models were presented to participants two at a time on a computer screen, on the left and right sides, under the column headings "Model A" and "Model B". Values of particular dimensions were always aligned horizontally (i.e., one model's battery life was always adjacent to the other model's battery life), but the order of these features and dimensions was randomly assigned for each participant, in order to facilitate comparison. A horizontal bar was displayed beneath the descriptions, with its endpoints labeled "Strong preference for Model A" and "Strong preference for Model B", and its midpoint labeled "No preference". Participants were asked to click anywhere on this scale to indicate their strength of preference. This continuous scale gave us a more sensitive measure of participants' preferences and representations than a binary forced-choice response would provide.

Decisions were organized into short "test series". These consisted of a set of alternative pairs that each differed on only one variable dimension ("1-dimension" pairs), followed by a final pair which varied on two dimensions ("2-dimension" pairs). For all of these 2-dimension pairs, each of the two alternatives was favored by one of the varying dimensions and disfavored by the other; for example, one model might be superior on battery life, while the other was superior on hard drive capacity. Preferences on these trials should largely be determined by the relative weight that participants give to the two relevant dimensions. In all cases where a dimension varied between the two alternatives, the difference in the two values was one "step"—either a high vs. a medium value, or a medium vs. a low value.

The purpose of these organized series was to allow us to examine the influence of the 1-dimension pairs, whose use and decision outcome we could effectively control, on the preferences exhibited on the 2-dimension pairs, which should be a reflection of the individual's own representations—at least at that moment. In this first experiment, we examined this influence at a very local level by seeing whether dimensions that had been used in making more recent decisions would be given greater weight than those used in earlier choices.

Four different types of series were used in this study. To understand their general structure, consider the "1 v. 3-back" series. The five variable dimensions may be arbitrarily designated as Dimensions A–E. If the final, 2-dimension choice in this series involved alternatives that varied on Dimensions A and B, then the choice immediately before this ("1-back") would be a 1-dimension decision varying only on Dimension A, and the choice three items before ("3-back") would be a 1-dimension decision varying only on Dimension B. The prediction in this case would be that the more recently used dimension (A) would on average be given more weight in the 2-dimension test decision, leading to higher preferences for the model favored on that dimension. The choice that was two items prior to the test decision would be a filler 1-dimension item (varying on Dimension C, D, or E) which should not be relevant to the current test decision, since both alternatives shared the same value on this dimension. Similarly, each series would begin with a filler 1-dimension item. The assignment of actual

dimensions to these five roles was done randomly at the beginning of each series. Other series were similarly structured, including the “1 v. 2-back” and “2 v. 3-back”. Finally, the “1-back” series examined preferences in cases where one of the varying dimensions had been used on the previous item, while the other had not been used at all during that series.

The order of the four series types was randomized for each participant at the beginning of the study. Dimensions were randomly assigned to roles at the beginning of each series, and the side of the screen on which each alternative was presented was randomized for each item. Boundaries between series were not indicated to participants; rather, the items were presented as a continuous series of judgments. Participants made a series of decisions for four minutes, beginning after the instructions with the presentation of the first pair of alternatives. At the end of the four minutes, the participants completed the trials remaining in the current series, and the experiment ended. Twenty undergraduate students participated in the study for partial course credit.

The overall prediction of the first study is that participants’ preferences on the 2-dimension choices should be more influenced by the dimension that had most recently been used in a previous decision. On average, this should lead to a general preference for the alternative favored on that dimension.

## Results and Discussion

Participants completed an average of 7.4 series in the course of the experiment (median and mode = 7). The data of interest are the preference ratings for the 2-dimension decisions at the end of each series. Each of these responses was coded as a continuous value between 0 and 1, with 1 being the end of the scale strongly preferring the alternative favored by the more recently used dimension, and 0 being the end strongly preferring the competitor. These values were then averaged for each participant. Values of .5 would demonstrate no influence of dimension recency of choice.

The average preference rating was .62 (significantly greater than chance [ $t(19) = 4.9, p < .01$ ]), suggesting that participants were giving greater weight to dimensions that had more recently been used in another decision. All four series types led to average preferences that were greater than .5, and there was no statistical difference between the types.

In some ways, this is a very surprising result. The outcome of each of the 1-dimension decisions was predetermined, with one alternative being objectively superior to the other. In spite of the fact that these decisions involve little task engagement, and should not require individuals to examine their “real preferences” at all, they had a significant impact on which factors were considered important in the subsequent 2-dimension choices, which *did* draw on participants’ perceptions of their beliefs.

The effects observed in this study are admittedly very local, however. Clearly, both of the dimensions that were varied on the test items had been used quite recently—one was just slightly more recent than the other. It would be useful to demonstrate more long-term, compounding effects that could accrue over repeated uses. Some post-hoc analyses were performed that are suggestive of such effects.

First, for each critical trial, we calculated the total number of previous times that each of the two relevant dimensions had been used up until that point. We created a “repetition index” by taking the difference between the total repetitions for the recency-preferred and non-preferred dimensions. This index was marginally correlated with participant’s preference ratings, suggesting that total prior use may also influence later dimension weighting. Additionally, after the study, we gathered importance ratings from participants on each of the dimensions used in the task, for stimuli norming purposes for future research. Post hoc analysis revealed a positive (though non-significant) correlation between the total number of times a dimension had been used and a participant’s later importance rating for that dimension.

These two results encourage further investigation into the longer-term effects of prior decisions. Experiment 2 was designed to systematically control the total number of times each dimension had been previously used at each decision point, allowing a more controlled examination of these repetition effects.

## Experiment 2

The first experiment demonstrated that the recency of a dimension’s use influenced its weighting in later decisions. Experiment 2 was designed to examine whether the total number of times that a dimension has previously been used could have similar effects, which would suggest more long-term representational change. The design of this study was very similar to that of Experiment 1, but in order to strictly control the number of prior uses of each dimension, a single abstract structure of decisions was used for all participants.

We created a series of 36 preference decisions similar to those used in the first experiment, including ten 2-dimension test pairs. Each of these test pairs could be described by its “repetition index”, which was simply the total number of times the recency preferred dimension had been previously used, minus the total prior uses for the other dimension (the recency favored dimension was intended as an arbitrary reference point; the effects are identical if the order of subtraction is reversed). For example, if the dimension of “hard drive capacity” had been previously used eight times, and “battery life” had been used six, then a comparison that pitted those dimensions against each other would have repetition index of two (or negative two). The set of decisions was organized such that the test pairs included two each of the following repetition indices: 4, 2, 0, -2, and -4. This structure allowed us to more systematically examine the prediction that an increase in the total prior use of a dimension should lead to an increase in its weighting, and a corresponding increase in the preference for the alternative favored by that dimension.

Actual assignment of dimensions to the five roles was done randomly for each participant at the start of the study. The task and presentation were identical to Experiment 1; participants responded on a continuous scale, indicating their relative preference for the two alternatives.

Approximately 10 to 15 minutes after completing the task (during which time a filler task was performed), participants gave importance ratings for each dimension used in the study. They were prompted with “How important is this

feature when selecting a portable video player?”, and responded by clicking at any point on a horizontal bar with endpoints labeled “Not at all important” and “Very important”. These data allowed us to explore the possibility that prior use in the study was contributing to longer-term representational change, affecting participants’ explicit beliefs about a dimension’s importance.

In sum, the main prediction of Experiment 2 is that a greater number of prior uses of a dimension should lead to its greater subsequent weighting, both in comparative decisions and in independent ratings of importance.

## Results and discussion

Preference ratings for the 2-dimension test items were coded as in Experiment 1, as a continuous value between 0 and 1. A value of 1 once again reflected the end of the scale referring to the recency-preferred item, but in this case this was an arbitrary reference point which simply provided a way to compare preference to prior use (an alternative method in which one alternative in each pair is randomly assigned as the reference point leads to similar statistical results). Correlations were calculated between test ratings and repetition indices for each participant, providing a measure of the extent to which an individual’s preferences were influenced by an advantage in the number of prior uses of a dimension. In order to use these within-participant correlations in further analyses, we used Fisher’s *Z* transformation (Snedecor & Cochran, 1980), which corrects for the inherent positive skew in correlation distributions.

There are several ways to deal with within-participant correlations, but no universally standard approach. A pooled correlation of all of the test preference ratings with their corresponding repetition indices is clearly not appropriate, since the presence of several data points per participant would allow far too many degrees of freedom. One simple and statistically conservative technique is simply to determine whether the set of within-participant correlations is significantly greater than zero. A one-sample *t*-test confirmed that this was the case (mean Fisher-transformed correlation = .20,  $t(31) = 2.98$ ,  $p < .01$ ). A more sensitive analysis is to construct a regression model in which the repetition index, a “dummy” variable for each participant, and the interaction between these two are simultaneously used to predict preference ratings. An *F*-test of the effects of the repetition index—using the subject  $\times$  repetition interaction as the error term—allows us to take advantage of all available data while correcting for dependencies and degrees of freedom. This analysis again reveals a significant effect of the repetition index,  $F(1, 31) = 8.14$ ,  $p < .01$ . One way to understand the overall trend across all participants is to calculate averages for each level of the repetition index across all participants (averaging all participants’ ratings for index level 4, all ratings for index level 2, etc.). The correlation of these five averages with the repetition index is .79.

Across participants, preference ratings were significantly correlated with the repetition index, indicating that these judgments were being influenced by the total number of times that a dimension had been used in previous decisions. As in Experiment 1, this pattern held in spite of the fact that

the prior decisions in question had predetermined outcomes, consisting simply of selecting the alternative with the superior value on one varying dimension. This finding suggests that the act of making a decision—even a very simple and cognitively non-engaging one—may have consequences for decisions that are made much later, and that these influences may accrue over repeated use.

The predictions concerning importance ratings were not borne out, however. In that analysis, each participant’s importance ratings were transformed into deviation scores (participant’s rating minus average rating, for each dimension), in order to control for the natural variation in perceived importance between different dimensions. Within-participant correlations were then calculated between these deviation scores and the total number of times that each dimension had been used in the preference task. This set of correlations (after Fisher’s *Z* transform) did not significantly differ from zero.

One possible reason for this null result is the independent nature of the importance rating task. Unlike the preference ratings, in which each alternative could serve as a referent for the other, the importance of a dimension in isolation is likely to be a fairly non-evaluable judgment. It is therefore possible that the measure was simply not sensitive enough to detect any representational change. Of course, it is also possible that these effects of prior use are relatively short-lived, and though they are able to accrue throughout several minutes of continuous choices, they do not extend past the boundaries of the current choice context. Further research will be needed to distinguish these two possibilities, likely in the form of more evaluable long-term measures.

## Summary and Conclusions

These studies demonstrate that decision processes can affect an individual’s representations at a very basic level, and influence how that information is later used. Use of a dimension in making simple—in fact, predetermined—choices led to an increased reliance on that dimension in future decisions. These effects were shown locally, with more recently used dimensions showing increased weighting, as well as over longer periods, with the effects of use accruing throughout the course of the study. (It should be noted that in both studies, the range of attribute values experienced on previous trials may have had some influence on preference (see Mellers & Cooke, 1994, Parducci, 1965). However, since participants were exposed to only three levels of each attribute, we cannot test for this influence in these data.)

This research takes modest initial steps toward a very broad goal of understanding the ways in which decision processes lead to representational change, and how these changes may in turn impact later judgments. The studies draw upon and overlap with the wealth of existing decision making literature in many obvious ways, but there are some substantive differences to note as well. Perhaps the most obvious of these is the level at which these effects appear to operate. Prior studies examining changes over the course of the decision process have been quite cognitively demanding, requiring a considerable amount of engagement from participants and involving a decision process that spans a

significant period of time. Our tasks, on the other hand, required very little involvement from participants, and involved a series of quick decisions which lent themselves to “gut level” responses. This is an important dimension of contrast, given that prior research in this area has repeatedly found task involvement to be a significant intervening variable (e.g., Dhar, Nowlis, & Sherman, 2000; Roehm & Sternthal, 2002; Zhang and Markman, 2001). As a rule, the magnitude of the relevant effects in these studies has decreased with lower task involvement. Since our tasks were inherently low-involvement, they seem to constitute especially conservative tests of the effects under study.

This difference also suggests something about the processes involved—the effects reported here are likely the result of fairly low-level processes, processes that are perhaps even opaque to participants. This basic level of operation suggests that these effects are likely to occur spontaneously, in the course of both mundane and significant decisions, and to be fairly persistent.

Two important goals for the future, then, are to continue to explore these fundamental sorts of processes, but also to try to bridge these investigations with the work demonstrating the cognitive impact of decisions at a more explicit and deliberate level. It seems likely that a “bootstrapping” scenario—in which one basic choice builds upon another—is not at all uncommon, and that these sorts of situations may often ultimately lead to more established and profound sets of preferences. Common wisdom holds that a person is the sum of his or her prior decisions, and to the extent that the act of making a choice may alter an individual’s representations and influence the course of future choices, this may indeed be the case.

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