

Consolidation processes in decision making: Post-decision changes in attractiveness of alternatives *

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The Differentiation and Consolidation Theory of decision making models decision making as performed through a set of differentiation processes, leading to a decision and followed by post-decision consolidation processes. The last of these play a role in subsequent decisions. This paper illustrates one of several consolidation processes, namely that of reevaluation in the post-decision phase. Subjects were asked to make a non-consequential decision between two objects central to their own interests and characterized on different value attributes. After five minutes or one week the subjects were asked to describe the alternatives again. The results demonstrated reevaluation, and showed that the process needed a week to reach significance. The reevaluation process was highly selective in that it affected only aspects of the most important attributes. The reevaluation process increased differentiation in support of the chosen alternative on attributes on which it was already superior, and did not support the chosen alternative on attributes where it was inferior to the non-chosen alternative.

Introduction

Unlike most studies of decision making this work is primarily devoted to post decision processes. Both structural models of decision making such as the Subjective Expected Utility model, and process models deal only with the period in time which leads to and ends with a decision (cf. Svenson 1979; Abelson and Levi 1985). Some re-

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searchers extend their interest to the implementation stage (cf. Von Winterfeldt and Edwards 1986), but very few devote attention to processes beyond that point. Yet post-decision processes are fundamental to the evaluations of the quality of past decisions and as background knowledge for present and future decisions.

Post-decision changes in the overall attractiveness of decision alternatives were described in a pioneering study by Brehm (1956). The theoretical foundation was an early version of Festinger's Theory of Cognitive Dissonance (Festinger 1957), and not decision theory. Since then a small number of scholars have followed up that tradition (for a review see Svenson and Benthorn, 1990).

According to the Differentiation and Consolidation Theory of decision making (Svenson 1991), post-decision processes serve the purpose of consolidating the prior decision. Generally speaking, consolidation of a decision means that the differentiation or discrepancy between the chosen alternative and its competitor(s) is increased so that in retrospect it looms larger than when the decision was made.

A decision theoretic framework

Decision theory differentiates between decisions under uncertainty or risk and decisions under certainty (e.g., Raiffa 1968). Gambles and lotteries are the prototypes for risky decisions while decisions among, for example, pieces of furniture are decisions under certainty. This distinction reflects decision theory's emphasis on separate treatments of, on the one hand, the evaluation of a consequence of a decision, and, on the other hand, the probability of that consequence occurring. The present study is devoted to decisions under certainty, that is, to decision alternatives primarily associated with highly determined and predictable characteristics. First, however, a few words about the probability aspects and post-decision processes.

Most of the decision research literature deals with decisions under uncertainty, but very few of these studies have compared pre- and post-decision states. One exception is Fischhoff's (1975) pioneering study of the hindsight phenomenon. His and subsequent studies illustrate very nicely that in retrospect (after a decision or the outcome of an event has occurred), a decision maker's memory of the situation is biased concerning his own prior factual knowledge. In Fischhoff's study subjects were asked to judge the prior probabilities

of an event occurring and later, after it had or had not occurred, they made a second judgment of the prior probability. The results indicated memory biases exaggerating the prior probabilities of events that did occur and underestimating those that did not occur. According to Differentiation and Consolidation Theory, this represents factual restructuring (Svenson 1991). Recently, Hawkins and Hastie (1990) reviewed the research on the hindsight phenomenon and biased processing of past events in response to outcome information.

In the following (the certain) decision alternatives are denoted A_i ($i = 1, m$) and are defined in terms of aspects (a_{ij} , $i = 1, m$; $j = 1, n$) which are ordered on attributes 1 to n . In decisions under certainty this generic representation of the alternatives is sufficient, but the interpretation of attractiveness needs to be further elaborated (cf. Svenson 1979). To illustrate, imagine a decision between two apartments. Each apartment is characterized by aspects on attributes such as size and rent. For example, one apartment may be 90 m² and the other 110 m² which represents two aspects on the attribute of *objective size*. However, upon entering it is clear that the first flat (well planned, light and so forth) is perceived as bigger than the second one. Thus, on the attribute of *perceived size* the aspects representing the flats are reversed. However, when making decisions, it is the representation of the flats on the *attractiveness of size* attribute which matters. This last representation maps the decision alternatives through their aspects on attractiveness attributes, enabling the researcher to follow and describe decision processes on a more detailed level than in earlier studies. Note, that different attributes may be given different degrees of *importance or weight* in a decision process. The importance of one attribute may differ over time during a decision process and after a decision.

The purpose of the present study is to find evidence for post-decision consolidation processes and to describe the effects of these processes.

Experiment 1

The experiment was conducted in a school and each subject was asked to make a decision between two alternatives, each characterized on four attributes of attractiveness.

Method

Decision alternatives

In all, there were four pairs of decision alternatives. Both alternatives in a pair were of the same kind, either (a) personal stereos, (b) friends, (c) computer games, or (d) horses. The alternatives were described on graphical scales ranging from 'very poor' to 'very good' for each of 4 attributes per alternative. For the stereos the attributes were (1) price, (2) design, (3) sound quality, and (4) overall (electronic and mechanical) quality of a set. The friends were characterized on (1) kindness, (2) trustworthiness, (3) popularity, and (4) generosity. The computer games were characterized on (1) sound quality, (2) thrill of game, (3) quality of picture, and (4) what you could learn from the game. Finally, horses were characterized by (1) enjoyable, (2) beauty, (3) kindness, and (4) how 'spirited' the horse was. These attributes were selected as a result of pre-experimental interviews with subjects of the same age who were not participating in the present study.

The alternatives were presented pairwise on regular sheets of paper and given names (e.g., Jabber and Scamper for the stereos). The left-hand part of the sheet presented one alternative with four horizontal lines arranged in a vertical array, representing the attributes (e.g., price, design, sound quality, and overall quality). The scales were marked 'very poor' to the left and 'very good' to the right of the line. A short vertical crossing line marked the attractiveness level on each of the four attributes. Table 1 presents the values in millimetres from the left 'very poor' end point (the scales were all 69 mm long).

Subjects

A total of 96 subjects, 11 or 12 years old, participated in the experiment. They were recruited from four classes of a school in Helsingborg in the south of Sweden.

Procedure

The subjects were divided into treatment groups of 49 and 47 subjects. In the first treatment the time interval between making a decision and the memory reproduction of the decision alternatives was 5 min and in the second group 1 week.

Each subject was given only one of the 4 different choice pairs. In all, 22, 30, 23, and 21 subjects were given the problems with personal stereos, friends, computer games, and horses, respectively.

Table 1

Characterization of decision alternatives. The numbers represent distance (in mm) from end-point 'very poor' on 69 mm long scales to 'very good' (experiment 1).

Choice pair	Attribute			
	1	2	3	4
Personal stereos				
Left alt.	44	16	65	54
Right alt.	33	55	40	35
Friends				
Left alt.	44	58	25	21
Right alt.	61	13	45	42
Games				
Left alt.	53	24	46	29
Right alt.	23	64	55	48
Horses				
Left alt.	13	50	20	50
Right alt.	49	14	49	37

At the beginning of the experiment there was an instruction telling the subjects that they were each supposed to make one single decision between a pair of alternatives described in terms of different characteristics. The subjects were also instructed to rate (on linear scales) how important each characteristic (attribute) was for their decision. To make everything absolutely clear, the experimenter presented a decision problem illustrating the experimental procedure. Two apples were presented in the same manner as the subjects' subsequent decision problem would be presented. After this, the experiment started.

In order to make sure that the subjects really attended to the information available for their decision, they were asked directly after their decision to reproduce the problem with the original in front of them. To do so, each subject was given a response sheet designed exactly as the presentation of the alternatives except that the crossing lines on the scales were missing (indicating how good or bad the alternatives were). This procedure made the subjects more familiar with the response sheet to be used later in the experiment. It also facilitated memory storage of the information. Comparisons of these

reproductions with the original showed no systematic differences and therefore this task will not be discussed further.

Later, in the second session, the subjects were told 'Five minutes ago [a week ago] you made a decision. I am sure you remember that. You were each given a sheet of paper like this [shown to the subjects through an overhead projector]. There was a marking for each characteristic for both alternatives, which is not shown here. Now, I want you to remember your own decisions and fill out the forms and indicate how good or bad the alternatives were on the different characteristics. As before, we want you to answer the questions on the next sheet of paper as well.' On that response form, the subjects were asked to judge the importance of the attributes on linear scales of the same length as the other response scales. No monetary incentives were provided, but the decisions in themselves were found quite motivating by the subjects, who were very interested in their tasks.

Results

Each group (5 min and 1 week) was treated separately and the 4 different decision problems were all used when means were later computed for each group. All subjects remembered their own choice correctly. Attribute differences between the decision alternatives will be presented first, and a more detailed analysis of how the representation of individual alternatives changed during the post decision period will then follow.

Attribute differences

Each alternative ($i = 1, 2$) was characterized in terms of each of the four attributes ($j = 1, 4$) on the linear scales. Thus, the aspects, a_{ij} , were described by the marks on the horizontal scales (69 mm long) from very poor to very good. The aspects given to the subjects are denoted by $a(0)_{ij}$ and those recalled by $a(1)_{ij}$, where 0 represents the original decision session and 1 the recall session. Aspects of the chosen alternative are denoted $a_c(0)_{ij}$ and $a_c(1)_{ij}$ and of the non-chosen alternative $a_{nc}(0)_{ij}$ and $a_{nc}(1)_{ij}$.

For each alternative and attribute the differences $a_c(0)_{ij} - a_{nc}(0)_{ij}$ and $a_c(1)_{ij} - a_{nc}(1)_{ij}$ were computed. The first of these differences reflect attractiveness differences in favor of the chosen alternative as presented at the time of the decision. If this difference is positive it

supports and if it is negative it is against the chosen alternative (cf. table 1). The second difference denotes the same variable but in the post-decision condition, when the decision was reproduced from memory.

In this way it is possible to describe changes in the attractiveness patterns between the time of decision and the post-decision condition. First, the classification of the importance of the attributes were used to find the two most important and the two least important attributes for each subject in his or her specific decision problem. Importance was judged both at the decision and in the post-decision conditions and both judgments were averaged to get the overall rank order classification of the importance of an attribute for that subject. Degree of importance was rated on 47 mm long horizontal scales ranging from 'not at all important' to 'very important'.

For each subject the mean of $a_c(0)_{ij} - a_{nc}(0)_{ij}$ was computed across the two more important attributes and across the two less important attributes. This was also done for the post-decision condition, $a_c(1)_{ij} - a_{nc}(1)_{ij}$. If the second difference is greater than the former, this represents consolidation of the decision through an attractiveness reevaluation processes.

Five minutes after the decision, post-decision consolidation processes now produced only a small and non-significant effect. However, one week after the decision there was a significant change in attractiveness differences favoring the chosen alternative, but only for the two most important alternatives ($t = 7.81$, paired observations, $df = 46$, $p < 0.002$); the two least important attributes did not change significantly. The significant effects of one week on the two most important attributes are depicted in figure 1.

The figure shows that the whole of the significant effects of post-decision processes could be explained by decreases of the attractiveness of the non-chosen alternative on the two most important attributes.

The systematic reevaluation shown in figure 1 did not apply to non-supportive attributes. Typically, non-supportive aspects belonged to the two least important attributes. Aspects on attributes for which the chosen alternative was inferior to the non-chosen alternative were analyzed separately for both groups in the 1-week condition. No significant reevaluation was found in either group. Thus, consolidation through reevaluation involved depreciation of the non-chosen alterna-

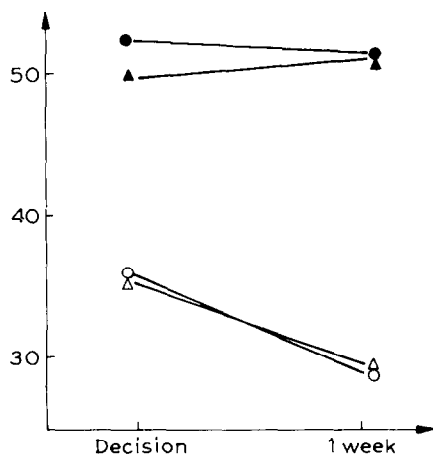


Fig. 1. Mean attractiveness ratings of chosen (filled symbols) and non-chosen (open symbols) alternatives on most attractive (circles) and second most attractive (triangles) attributes. Data for time of decision and one week after the decision.

tive only on those attributes where it was already inferior at the time of decision.

In order to further elucidate this finding, a second experiment was designed in which one alternative dominated the other in each pair. According to Differentiation and Consolidation Theory and the findings of experiment 1, there should be post-decision changes in attractiveness, while according to Dominance Structuring Theory (Montgomery 1983) the goal of dominance is already fulfilled in this case and therefore no further structuring would be needed. Note, however that Dominance Structuring Theory was developed primarily for pre-decision processes.

Experiment 2

As in experiment 1, subjects were first asked to make a decision among one pair of decision alternatives. After a week they were asked to describe their previous decision and the alternatives on different attractiveness attributes. The experiment was conducted in a school and each subject was asked to make a decision between two alternatives characterized on four attributes of attractiveness each.

Table 2

Characterization of decision alternatives. The numbers represent distance (in mm) from end-point 'very poor' on 69-mm long scales to 'very good' (experiment 2).

Choice pair	Attribute			
	1	2	3	4
Personal stereos				
Left alt.	34	16	41	36
Right alt.	45	56	66	55
friends				
Left alt.	62	58	47	44
Right alt.	47	13	24	20
Games				
Left alt.	54	65	56	49
Right alt.	23	24	46	28
Horses				
Left alt.	18	20	21	37
Right alt.	50	52	49	51

Method

Decision alternatives

The decision alternatives corresponded to those in experiment 1. The only changes concerned the attractiveness values, which were changed so that one alternative in each pair dominated the other alternative. The descriptions of the alternatives are given in table 2.

Subjects

A total of 51 subjects, 11 or 12 years old, participated in the experiment. They were recruited from two classes of a school in Helsingborg in the south of Sweden. None of them had participated in experiment 1.

Procedure

For all subjects the time interval between making a decision and the memory reproduction of the decision alternatives was 1 week. Each subject was given only one of the 4 different choice pairs. This was done randomly. In all, 11, 15, 12, and 13 subjects were given the problems with stereos, friends, computer games, and horses, respectively. The instruction and procedure were identical to those of experiment 1.

Results

For each subject the attributes were rank ordered according to the importance ratings. The subsequent data analysis will follow this classification. The rank orders were obtained from the average judged importance across the two ratings from each subject.

In all there were 204 rankings at the time of decision, followed by another 204 rankings when the decision was memorized. There were 15 pairs for which either the first or the second estimate was not marked properly. For the remaining 189 pairs of ratings, 112 were identical and 50 differed by one rank only. Ties were randomly assigned across ranks. Thus, 27 or about 13% of the rank order pairs differed by two or three ranks over the two ratings. This was considered too small a variation for analyses of systematic change over time. A total of 49 of the 51 subjects chose the dominant alternative. One subject changed from dominant to non-dominant 1 week later, and one subject chose the non-dominant alternative because she liked the name of that alternative better.

Table 3 presents the mean attractiveness ratings across subjects for attributes of different importance and for the chosen and non-chosen alternatives at different times. First, it is clear that the means of the chosen alternative tend to decrease one week after the decision. Second, the non-chosen alternative decreased significantly only on the

Table 3

Mean attractiveness at time of decision and one week after decision for chosen and non-chosen alternatives. Numbers in parentheses represent standard deviations.

Attribute	Decision			One week after decision		
	Chosen	Non-ch.	Diff	Chosen	Non-ch.	Diff
Most important	54.2 (8.0)	32.9 (9.5)	21.3	52.4 (10.2)	25.1 ^a (12.3)	27.3
Second	55.2 (8.4)	30.5 (11.0)	24.7	51.2 ^a (11.6)	25.4 ^a (15.0)	25.8
Third	53.3 (6.5)	24.8 (10.3)	28.5	49.3 ^a (10.1)	25.7 (13.5)	23.6
Fourth	51.2 (7.0)	24.8 (10.2)	26.4	47.0 ^a (13.5)	26.5 (15.9)	20.5
Mean	53.5	28.2	25.3	50.0	25.5	24.5

^a Significant (*t*-tests paired observations, *df* = 50, α = 0.05) changes from decision to post-decision.

two most important attributes. Third, the results indicate an increase of the difference (Diff) between the chosen and non-chosen alternatives on the most important attributes (from 21.3 to 27.3 and from 24.7 to 25.8). On the two least important attributes the trend is the opposite; decreasing support for the chosen alternative. Of these changes all, except the one for the second most important attribute, were significant or in one case marginally significant ($p = 0.06$) ($t = 1.82$ $df = 49$; $t = 0.30$ $df = 47$; $t = -1.74$ $df = 48$; $t = -1.61$ $df = 48$, paired comparison $\alpha = 0.05$).

To sum up these findings, the difference (diff) columns in table 3 show that the differences, supporting the chosen alternative at the time of decision and one week later, tended to increase for the two most important attributes and to decrease for the two least important attributes.

The results in experiment 2 also demonstrate post-decision consolidation processes in the form of reevaluation. The consolidation processes were selective in that consolidation was performed through increasing the attractiveness difference, favoring the chosen alternative on the two most important attributes only, just as in experiment 1. The corresponding differences on the less important attributes tended to decrease. This experiment has demonstrated post-decision processes following decisions among pairs of alternatives in which one alternative dominates the other. This indicates that some other decision rule than dominance was applied. For example, the attractiveness difference rule (Svenson 1979) is compatible with the present results.

Concluding remarks

In summary, the present investigation has demonstrated post-decision consolidation through reevaluation of the attractiveness of decision alternatives. The consolidation implied support for the chosen alternative and, for the non-sequential decisions studied here, could only be demonstrated after a week had passed since the decision was taken. The consolidation process was highly selective in that it affected only aspects on the most important attributes and only for the non-chosen alternative. In addition, only aspects which were inferior on the non-chosen alternative at the time of decision were reevaluated

(depreciated); there was no tendency to do so for aspects belonging to the chosen alternative and attributes on which the chosen alternative was superior.

Bem has presented a self-perception theory related to attitude consistency (Bem 1972; Bem and McConnell 1970; Salancik and Conway 1975). In this theory, it is assumed that people are not aware of their current attitudes and values. Instead they infer those from their behavior. Applying this to the present study, decision makers would reconstruct the alternatives from remembering their own decisions. However, Bem states that the self-perception process takes place only when internal cues are weak or ambiguous. This has also been proposed in later research (Chaiken and Baldwin 1981).

The present results are not compatible with these findings. Assuming that the aspects on non-important attributes are weaker than those on the more important attributes, Bem's theory would predict a greater change of the former than the latter. The present study has indicated exactly the opposite. Restructuring seems to be more urgently needed for the most important attributes, leaving the less important attributes unchanged. It may perhaps be argued that Bem's theory predominantly applies to decisions which are more important than those studied in the present work. It may be that increasing importance of a decision would shift the present emphasis from the most important attributes to less important ones.

The Dominance Structuring Theory of Montgomery (1983) was developed primarily for pre-decision processes. The present study shows that it cannot be generalized to the post-decision phase. Instead the results seem to support Differentiation and Consolidation Theory.

Differentiation and Consolidation Theory assumes that there are a number of different consolidation processes (cf. Svenson 1991), among which are facts consolidation and reevaluation. Facts or factual consolidation refers to changes in, for example, physical characteristics, relations or probabilities. It was exemplified by Fischhoff's (1975) study mentioned above. Consolidation through reevaluation of aspects characterizing the alternatives was demonstrated in the present study. However, note that because the subjects had to memorize their decisions, there is a risk that the results represent a joint effect of both reevaluation and facts consolidation. Both the perception of the marks on the lines and the attractiveness they represented could have been responsible for the effects reported here. One way of separating

these effects is to use decision alternatives which are physically present both at the time of decision and after a shorter or longer consolidation phase. This was done by Svenson and Malmsten (1992), who also found evidence for consolidation processes affecting representations on the most important attributes.

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