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Attention Bias in Integration of Outcomes of Concurrent Decisions

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Boe, O. Attention bias in integration of outcomes of concurrent decisions. Göteborg Psychological Reports, 2000, 30, No. 1. An experiment was conducted to investigate whether an attentional bias explains why decision makers sometimes fail to integrate outcomes of concurrent decisions. Forty-eight undergraduates recruited as participants were asked to make fictitious choices of stores located at different distances where they could purchase the same consumer products at different prices. In one condition the participants were asked to also make a choice between driving and walking to the stores, in another condition to choose between the stores when they had no other option than to walk or drive. Attitudes toward driving were independently assessed by means of a questionnaire. A finding supporting the attentional bias was that participants with a more positive attitude toward driving chose more frequently to drive to stores within walking distance than participants with a less positive attitude towards driving.

Key words: Decision making, concurrent decisions, integration

People frequently face decision tasks requiring that two or more decisions are made concurrently (Brehmer, 1992; Huber, 1990). Concurrent decisions are completely dependent if the decision maker evaluates and chooses among all combinations of the outcomes of each option entailed by each decision. Gärling et al. (1997) argued that a

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more plausible assumption is that such decisions are frequently independent or only partially dependent. In its simplest case integration refers to adding the utilities of the expected outcomes of one of two decisions to the utilities of the expected outcomes of the other decision. According to the principle of utility maximization, the outcomes of the two concurrent decisions are integrated when the utilities of the outcomes of an option available in the first decision increases the utilities of the outcomes of an option available in the second decision. If this is not the case, the outcomes of the two decisions are not integrated. Consider the following demonstration by Tversky and Kahneman (1981, p. 454) violating utility maximization:

Imagine that you face the following pair of concurrent decisions. First examine both decisions, then indicate the options you prefer.

Decision (i). Choose between:
A. a sure gain of $240
B. 25% chance to gain $1,000, and 75% chance to gain nothing

Decision (ii). Choose between:
C. a sure loss of $750
D. 75% chance to lose $1,000, and 25% chance to lose nothing

A majority of participants chose A and D. However, in choosing between the following two alternatives, they chose B' which maximizes expected utility:
A'. 25% chance to gain $240, and 75% chance to lose $760
B'. 25% chance to gain $240, and 75% chance to lose $750

Since alternative B' is B and C combined whereas A' is A and D combined, the two decisions did not maximize expected value.

Why did the concurrent decisions fail to maximize expected utility? It should first be noted that if the decisions are made independently, consistent with prospect theory (Kahneman & Tversky, 1979; Tversky & Fox, 1995; Tversky & Kahneman, 1992) each decision maximizes value. Because the value function is concave for gains and convex for losses, the value associated with a sure gain of $240 is greater than 24% of the value associated with a gain of $1,000. At the same time, the value associated with a loss of $750 is smaller than 75% of the value associated with a loss of $1,000. In addition, Tversky and Kahneman (1981) suggested that each decision
is framed in a "minimal account," that is, as being made independently of the other decision. Such a decision frame may frequently be employed because it "(i) simplifies evaluations and reduces cognitive strain, (ii) reflects the intuition that consequences should be causally linked to acts, and (iii) matches the properties of hedonic experience which is more sensitive to desirable and undesirable changes than to steady states" (p. 457).

Boe and Gärling (1998a, 1998b) investigated several of the possible factors that according to Tversky and Kahneman (1981) counteract integration. One factor is that the number of options and outcomes of each decision imposes cognitive strain. In line with this assumption it was demonstrated that outcomes are integrated when they are riskless but not when they are risky or uncertain. For instance, a choice of a consumer product is a riskless outcome that was integrated with another riskless outcome. In contrast, a choice of a lottery ticket with the consumer product as the prize is an uncertain outcome that was not integrated with another uncertain outcome. Risky or uncertain outcomes impose cognitive strain partly because the number of outcomes increases, partly because of the demand on the decision maker to imagine different possibilities. As observed by Tversky and Shafir (1992), people are often reluctant to think through the implications of each outcome in the presence of risk or uncertainty.

Boe and Gärling (1998a) also demonstrated that causally related outcomes were integrated whereas causally nonrelated outcomes were not. Thus, the added utility of choosing a means to an end influenced the choice when the end had been chosen or the reverse. For integration to occur, the outcomes of concurrent decisions may need to be causally linked (Tversky & Kahneman, 1981). In a similar vein, Bonini and Rumiani (1996) showed that the likelihood that participants made dependent decisions in the jacket and calculator problem increased when it was made salient that the outcomes were related. For instance, purchase choices became dependent when embedded in a shopping list.

In order to make concurrent decisions that maximize overall utility, a decision maker must attend to the additional benefits obtained from the combinations of outcomes. Any factor preventing or promoting this is likely to affect the integration of the outcomes. In
the demonstration by Tversky and Kahneman (1981) reported above, it is possible that the outcomes of each choice (obtaining a sure gain or avoiding a sure loss) are so attractive that the combinations of outcomes are never considered. Thus, it is perhaps not sufficient that the value of the combination is larger than the sum of the values of each outcome. For integration to occur, a decision maker has to attend to all possible outcomes. If he or she never enumerates and evaluates all the combinations because it would impose too much cognitive strain, it is possible that single outcomes are evaluated before combined outcomes are evaluated. Furthermore, if one of these outcomes is very attractive, the decision maker may never become aware of combinations of outcomes that are even more attractive. Even if cognitive strain is absent, it is plausible to assume that participants search and evaluate outcomes sequentially (Simon, 1982), perhaps starting with the single outcomes before the combined outcomes. Again, if participants encounter highly attractive single outcomes, then they may be satisfied with these and refrain from further search. We refer to this phenomenon as an attentional bias, assuming that the outcome of the bias is that participants choose single preferred outcomes rather than more preferred combined outcomes. In line with this hypothesis, Boe and Gärling (1998c) demonstrated that attractive combined outcomes were never chosen despite that they were riskless and causally related.

In the present experiment we further investigate the attentional bias in concurrent decisions. Participants were asked to make fictitious choices of stores located at different distances where they could purchase the same consumer products at different prices. They were asked to also make a choice between driving and walking to the stores. The most attractive store (where the price of the consumer product was lowest) was either within walking distance or not. We hypothesize that to a larger extent participants who express a positive attitude toward driving will ignore distance when they make concurrent decisions than will participants with a less positive attitude.
Method

Participants

Forty-eight undergraduates (24 men and 24 women) participated in return for the equivalent of USD 7.00. They were recruited from a pool of undergraduates who at the beginning of the semester volunteered to participate in experiments. Their mean age was 23.8 years (SD = 3.8, range 18 to 36). All of them had a driving license. On the basis of a measure of attitude toward driving consisting of ratings on three 7-point adjective scales (negative-positive, bad-good, and dull-fun) administered to participants, a median split was made. A group of 24 participants with positive attitudes was thus formed ($M=6.0$, $SD=1.0$) and contrasted to the remaining 24 participants with a less positive attitude ($M=3.4$, $SD=0.9$).

Materials

The materials consisted of fictitious choices of where to purchase the same consumer products at different prices. Table 1 shows that distance to the stores and price of the products were systematically varied so that in half of the choices the consumer products at the low price could be purchased in the store at the short distance, in the other half of the choices in the store at the long distance. The short distances were within and the longest distances longer than walking distance\(^1\).

\(^1\) As determined by asking another group of participants to make choices between walking and driving for different distances to the destination (Gärting, Boe, & Golledge, 2000).
Table 1
The Choice Problems in Which Distance to the Store and Price of the Product Varied.

<table>
<thead>
<tr>
<th>Product</th>
<th>Store 1</th>
<th>Store 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ring</td>
<td>4800 meters/SEK 675</td>
<td>2200 meters/SEK 725</td>
</tr>
<tr>
<td>Pants</td>
<td>4900 meters/SEK 575</td>
<td>2300 meters/SEK 625</td>
</tr>
<tr>
<td>Sunglasses</td>
<td>5000 meters/SEK 775</td>
<td>2400 meters/SEK 825</td>
</tr>
<tr>
<td>Jacket</td>
<td>5100 meters/SEK 875</td>
<td>2500 meters/SEK 925</td>
</tr>
<tr>
<td>Shoes</td>
<td>2200 meters/SEK 675</td>
<td>4800 meters/SEK 725</td>
</tr>
<tr>
<td>Wallet</td>
<td>2300 meters/SEK 575</td>
<td>4900 meters/SEK 625</td>
</tr>
<tr>
<td>Sweater</td>
<td>2400 meters/SEK 775</td>
<td>5000 meters/SEK 825</td>
</tr>
<tr>
<td>Camera</td>
<td>2500 meters/SEK 875</td>
<td>5100 meters/SEK 925</td>
</tr>
</tbody>
</table>

*The products were randomly assigned to stores and prices in different ways for different participants.

* A Swedish Crown (SEK) is approximately US$0.15.

**Design**

The design was mixed factorial with a between-subjects factor attitude towards driving and two within-subject factors type of decision problem (concurrent choices of store and travel mode vs. single choice of store for different travel modes) and short vs. long distance to the store with the low price.

**Procedure**

Participants served individually. They were seated in a sound-proof room facing a computer screen on which all information was presented. After having read general instructions for how to perform in the experiment, participants were told that their task was to choose between traveling to different stores where they could purchase the same consumer products at different prices. The instructions stressed that the consumer products were identical except for price. Participants were also asked to imagine that they planned to return directly back from the store.
Participants encountered one block of trials consisting of concurrent choices of store and travel mode (driving or walking), another block consisting of single choices of store. Half of the participants received the block with single choices before the block with concurrent choices, the other half of the participants in the reverse order.

The choice problems were presented at a self-paced rate. When the participants were prepared to respond, they pressed return. The choice problem then appeared on the screen. Single choices were presented alone on the screen. In the block with single choices, participants were in half the cases told that their only option was to walk, in the other half that their only option was to drive to the stores. An example is:

| A. Price SEK 675 | Distance 4800 meters |
| B. Price SEK 725 | Distance 2200 meters |

When the participants were prepared to respond, they pressed return so that the text disappeared. Then they typed an A or B. After that another screen appeared, asking the participants to press return when they were prepared for a new choice problem.

In the block with concurrent choices, one of the choices appeared on the screen above the other as in this example:

| A. Drive | B. Walk |
| C. Price SEK 675 | Distance 4800 meters |
| D. Price SEK 725 | Distance 2200 meters |

After having considered all information, the participants pressed return so that the text disappeared. Then they responded to the first
choice problem by typing an A or B. After pressing return once again, the participants indicated their second choice by typing C or D. The presentation sequence was in all other respects the same as in the block of single choices.

Participants were presented each concurrent choice problem twice, whereas the single choice problems were presented once with walking as the forced choice and a second time with driving as the forced choice. Within each block the orders between the choice problems were individually randomized. Which choice alternatives that were designated A or B, or C or D, was counterbalanced within and across participants. After having performed the experiment, participants were requested to fill out a questionnaire measuring their attitude towards driving.

A session lasted for approximately 45 minutes. Participants were debriefed and paid after having completed the session.

Results

The results are given in Table 2 for the groups with positive and negative attitudes toward driving. The table shows the percentages of choices of the attractive and non-attractive stores for each travel mode in the concurrent decisions as well as the percentages of choices of the attractive stores when participants were forced to walk or drive in the single choices. The attractive stores (with the cheapest product) were either situated at a short or long distance.
Table 2.
Mean Percentages of Choices of the Attractive and Non-Attractive Store in Single Choices when Forced to Walk or Drive and in Concurrent Decisions for Choices of Walking or Driving Related to Distance to the Store and Attitude toward Driving.

<table>
<thead>
<tr>
<th>Distance to attractive store and attitude toward driving</th>
<th>Short</th>
<th></th>
<th>Long</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Positive</td>
<td>Negative</td>
<td>Positive</td>
<td>Negative</td>
</tr>
<tr>
<td>Single choices</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walk to attractive store</td>
<td>97.9</td>
<td>97.9</td>
<td>57.3</td>
<td>80.2</td>
</tr>
<tr>
<td>Drive to attractive store</td>
<td>91.7</td>
<td>90.6</td>
<td>76.0</td>
<td>94.8</td>
</tr>
<tr>
<td>Concurrent choices</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walk to attractive store</td>
<td>62.5</td>
<td>78.1</td>
<td>29.2</td>
<td>53.6</td>
</tr>
<tr>
<td>Walk to non-attractive store</td>
<td>5.7</td>
<td>8.3</td>
<td>8.8</td>
<td>9.9</td>
</tr>
<tr>
<td>Drive to attractive store</td>
<td>27.6</td>
<td>11.5</td>
<td>59.9</td>
<td>24.0</td>
</tr>
<tr>
<td>Drive to non-attractive store</td>
<td>4.2</td>
<td>2.1</td>
<td>2.1</td>
<td>12.5</td>
</tr>
</tbody>
</table>

In single choices, when the distance was short the attractive store was almost always chosen by both participants with a positive attitude and a negative attitude toward driving. When the distance was long, positive attitude participants less frequently chose the attractive store than the negative attitude participants. However, when forced to walk both groups chose the attractive store less frequently at the long distance. A 2 (group: positive attitude vs. negative attitude towards driving) by 2 (forced travel mode: driving vs. walking) by 2 (distance to attractive store: short vs. long) mixed factorial analysis of variance (ANOVA) with repeated measures on the last two factors was performed. The analysis revealed a significant main effect of group, $F(1, 46) = 6.69, p < .05, MS_e = .50$, a significant main effect of distance, $F(1, 46) = 18.51, p < .001, MS_e = 1.46$, a significant interaction between group and distance, $F(1, 46) = 6.93, p < .05, MS_e = .55$, and a significant interaction between travel mode and distance, $F(1, 46) = 29.13, p < .001, MS_e = .66$. Separate Bonferroni-
corrected t-tests at $p=.05$ showed that participants with a positive attitude significantly less frequently chose the attractive store when the distance was long than when it was short. Furthermore, when forced to walk the attractive store was on average chosen significantly less frequently at the long distance.

In the concurrent choices, when the distance was short and participants chose to drive, those with a positive attitude more frequently chose the attractive store than did participants with a negative attitude. The same differences were obtained for the long distance. This pattern was reversed for participants who chose to walk. No noticeable differences were observed between the attitude groups for the choices of walking or driving to the non-attractive stores. An additional 2 (group: positive attitude vs. negative attitude towards driving) by 2 (travel mode: driving vs. walking) by 2 (distance to attractive store: short vs. long) mixed factorial analysis of variance (ANOVA) with repeated measures on the last two factors performed on the percentages of choices of walking or driving to the non-attractive store did not reveal any significant effects. In contrast, a parallel ANOVA on the choices of the attractive store yielded a significant main effect of travel mode due to more frequent choices of walking than driving, $F(1, 46) = 9.74, p<.01, MS_e=3.03$, a significant interaction between group and travel mode, $F(1, 46) = 8.19, p<.01, MS_e=2.55$, and a significant interaction between travel mode and distance, $F(1, 46) = 23.67, p<.001, MS_e=3.16$. Bonferonni-corrected t-tests at $p=.05$ showed that participants with a positive attitude chose to drive significantly more frequently than did participants with a negative attitude whereas the reverse was true for choices to walk. Only participants with a negative attitude significantly more frequently chose to walk than drive. Choices to walk were significantly more frequent than choices to drive at the short distance. Choices of walking were significantly more frequent at a short distance than a long distance whereas the reverse was the case for choices to drive.
Discussion

The basic goal of this research was to investigate a phenomenon referred to as an attentional bias. If a decision maker tries to maximize overall utility when he or she faces concurrent decisions, paying attention to the additional benefits obtained from the combinations of outcomes should be expected. As shown by Tversky and Kahneman (1981), this is however not always the case. For integration to occur, a decision maker must attend to all possible outcomes. It is possible that he or she never enumerates and evaluates all combinations of outcomes simply because of the added cognitive strain. It is therefore plausible to assume that an evaluation of single outcomes takes place before an evaluation of combined outcomes. Besides, strong preferences for single choices can be found in many situations. If a decision maker displays such strong preferences for a single option or outcome, this preference may detract attention from the fact that certain other combinations are more preferable. A decision maker may then never become aware of combinations of outcomes that would be even more attractive if one of these outcomes is very attractive. Even when cognitive strain is absent, it is thus possible that a decision maker evaluates outcomes in a sequential manner (Simon, 1982), starting with the single outcomes.

In the present experiment it was hypothesized that participants who expressed a positive attitude toward driving to a larger extent would ignore distance when making concurrent decisions as compared to participants with a less positive attitude. The results showed very clearly that distances to the attractive store were more or less ignored by participants with a positive attitude toward driving, thus they chose very frequently to drive to the attractive store. When the distance to the attractive store was short, choices of driving were however less frequent for participants with a positive attitude. On the other hand, participants with a negative attitude also tended to ignore distance and chose to walk at the long distances. Yet, independently of whether they were forced to drive or forced to walk, both participants with a negative and positive attitude almost always chose the attractive store when it was close,
but the non-attractive (closer) store when they were forced to walk and the attractive store was at the long distance. Thus, participants were more sensitive to distance when they did not chose travel mode.

When forced to walk to the attractive store at the long distance, participants with a positive attitude less frequently chose the most attractive store than did negative attitude participants. This suggests that participants with a positive attitude toward driving choose to drive at shorter distances (cf. Gärling et al., 2000). If so, the interpretation of the results from the concurrent decisions needs to be qualified. However, since participants with a positive attitude also less frequently at the long distance chose to drive to the less attractive store, there may be a difference in how they perceive distance. This is an issue that needs attention in future research.

It is possible to interpret the results as if participants failed to follow a utility-maximization principle by ignoring distance information. Still, participants did not do this completely. If it is assumed that integration is directed by participants' attitudes towards driving, the results showed that some integration took place. Thus, in contrast to Tversky and Kahneman (1981) and Boe and Gärling (1998b), the results indicated that outcomes of concurrent decisions are integrated. In Boe and Gärling (1998b) it was suggested that outcome uncertainty counteracted integration. In the present experiment there were no uncertainty about the outcomes, and the reduced number of options and outcomes of each decision probably decreased the cognitive load involved in making a decision.

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