The Role of Explanation Coherence of Two Premises on Property Induction

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Abstract

Three experiments on property induction were conducted to explore whether an incoherent premise discounted the believability of the conclusion when there were two premises. In all three experiments, a single premise increased or decreased the likelihood of the conclusion depending on the nature of explanatory coherence of a premise and a conclusion. However, when there were two premises, one that shared the reason with the conclusion (coherent premise), and one that does not (incoherent premise), the believability of the conclusion was affected differently in three experiments. When two premises and the conclusion were presented simultaneously in Experiment 1, the believability of the conclusion was increased. That is, an incoherent premise did not seem to affect the believability of the conclusion as much as the coherent premise. The incoherent premise seemed to decrease the believability of the conclusion a little bit when the two premises and the conclusion were presented sequentially so that each premise was not ignored in Experiment 2. The incoherent premise decreased the believability of the conclusion below the baseline condition in Experiment 3, where participants were asked to write down reasons for each premise being true. Results of three experiments suggested that only the confirming evidences were processed under natural conditions. A few possible theoretical implications were considered.

Introduction

When someone asks a question whether a target object has a certain property (target property), such as "Does an ostrich lay eggs?", and you do not know the answer, you might induce the answer by checking whether some object (source object), usually objects that are similar to the target object, has the target property. In the ostrich example, you would answer "yes" if you think ostriches are similar to geese and know that geese lay eggs. As this example shows, what conclusion you make depends on what objects are used as source objects.

What object is an effective source object in property induction depends on a number of factors: The nature of the target property, the level of knowledge of the person, and the cultural background of the person, to name a few. People used different source objects depending on their knowledge and occupation (Proffitt, Coley, & Medin, 2000). Also there seems to be a culture difference in property induction (Choi, Nisbett, & Smith, 1997). Even though the level of knowledge and the cultural background of the person affect the property induction, the effect of the nature of the target property on property induction has been the focus of most research. More specifically, what objects are effective as source objects in inducing two types of properties, and how the information of the source objects are used for property induction have been more widely investigated.

There are two types of target properties, blank properties and nonblank properties, and the effectiveness of source objects seems to differ between the two types. The effectiveness of a source object seems to depend on the similarity between the target object and the source object for blank properties for which we do not have any other information to rely on (e.g., 'have BCC in blood') (Osherson, Smith, Wilkie, Lopez, & Shafir, 1990; Rips, 1975; Sloman, 1993). However, the similarity between the target object and the source object does not seem to work for nonblank properties for which we have other information to infer about the target object having the target property (e.g., 'can cut the wire') (Smith, Shafir, & Osherson, 1993). As the relationship between objects and the target property are diverse (Murphy & Medin, 1985), there are many ways of inducing nonblank properties: People seem to use other relevant information, such as body size or strength, in inducing nonblank properties (Smith *et al*., 1993). People rated the believability of the conclusion differently when the target property is about shape from when the target property is about behavior (Heit & Rubinstein, 1994).

One way of inducing nonblank properties is comparing the reason for the target object having the target property with the reason for the source object having the target property. Sloman (1994, 1997) proposed that the explanation coherence between the premise and the conclusion affect the plausibility of the conclusion. If the target object and the source object share the same explanation, informing the participants that the source object has the target property increases the believability of the conclusion that the target object has the target property. For instance, computer programmers and secretaries have bad backs because they sit all day long. Therefore, informing the participants that "Computer programmers have bad backs" would make the conclusion "Secretaries have bad backs" more plausible than when the participants are not informed about the computer programmers having bad backs. However, if the target object and the source object do not share the same reason, informing the participants that the source object has the target property decreases the believability of the conclusion that the target object has the target property. In the bad back example, for instance, furniture movers had bad backs because they lift heavy things. Therefore, informing that "Furniture movers had bad backs" would make the conclusion "Secretaries

have bad backs" less plausible. That is, premises that have different explanations seem to discount the plausibility of the conclusion. Sloman called this the explanation discounting principle.

As has been described, the explanation discounting principle explains empirical results quite well when there is just one piece of relevant information. However, it is not specific about how it works when there are multiple pieces of relevant information, especially when there is conflicting information. There can be a few modified versions of the explanation discounting principle. The most extreme form of the explanation discounting principle would assume that the participants use all the information in inducing properties in equal degree (equivalence hypothesis, but hereafter I use equivalence hypothesis and the explanation discounting principle interchangeably). However, the equivalence hypothesis needs to be tested, because when there is more than one piece of relevant information, people do not use all the information they have. People are known to be cognitive misers (Nisbett & Ross, 1980). They seem to use information that confirms their predictions or hypotheses, but ignore information that disconfirms. They produced cases that confirmed their hypotheses (Wason, 1960) or they were more willing to search information that confirms than information that is likely to disconfirm (Shaklee & Fischhoff, 1982). Therefore if the confirmation strategy is the default way of using information, then it is quite likely that the explanation discounting principle may not apply when there is more than one piece of relevant information.

In this paper, we intend to explore whether the explanation discounting principle works when there are two premises in property induction tasks. There are two kinds of premises: "Same" premises, in which the source object has the target property for the same reason as the target object, and "Different" premises, in which the source object has the target property for reasons different from that of the target. In three experiments, we are mainly interested in the believability of the conclusion of the mixed conditions where one Same premise and one Different premise are presented. If the implicit equivalence hypothesis of the explanation discounting principle was correct, the conclusion in the mixed conditions should be rated not higher than that of the baseline condition, where the conclusion is presented without any premises. On the other hand, if the confirmation strategy is the default mode of using multiple pieces of information in property induction, the conclusion in the mixed conditions should be rated not lower than that of the baseline condition.

The premises and the conclusion were presented simultaneously in Experiment 1 to explore whether the explanation discounting principle applies when there are two premises. Experiment 1 is regarded as a natural condition because we did not try any manipulation to make the premises being processed. Experiments 2 and 3 were intended to find the boundary condition where the explanation discounting principle applies. Each premise and the conclusion were presented successively in Experiment 2 to make each premise salient and not be ignored. In Experiment 3, participants were asked to write down the reason why the object has the target property for each premise.

Experiment 1

There were two goals for Experiment 1. First, we wanted to replicate Sloman's (1994, 1997) finding that one Same premise increased the plausibility of the conclusion, and one Different premise decreased the plausibility of the conclusion. Second, we wanted to compare the explanation discounting principle against the confirmation strategy by presenting two premises, one Same premise and one Different premise.

Method

Design There were five experimental conditions in Experiment 1. In two single-premise conditions, one premise was presented on top of the conclusion. There was a horizontal line between premises and the conclusion. In the Same condition, one Same premise was presented, and in the Different condition, one Different premise was presented. Two premises were presented with the conclusion in the remaining three two-premises conditions: In the S+S condition, two Same premises were presented on top of the conclusion. In the S+D condition, the Same premise was presented on the top line and the Different premise was presented on the next line. In the D+S condition, the Different premise was presented on the top line and the Same premise was presented on the next line. Each participant was randomly assigned to one of the five experimental conditions. Therefore, the premise condition was a between subjects variable.

Participants Ninety-five Sungkyunkwan University students who attended an "Introduction to Psychology" course participated as a requirement for the course. Nineteen participants were randomly assigned to each experimental condition. None of them had participated in property induction experiments prior to the current experiment.

Material Twelve properties were used in the experiment as the target property. The target properties and the corresponding occupations were selected based on the results of an item selection experiment. In the item selection experiment, two hundred Sungkyunkwan University students were asked to write down at least two occupations that have the target property and the reasons they have the target properties over 24 properties. The 24 properties were selected from 32 items used in Sloman (1994, 1997) and judged appropriate in Korea. Of the 24, 12 properties were selected as experimental material. All premises and conclusions took the form of an occupation or class of people having the target property, such as "Veterans have problems getting jobs."

Procedure There were three stages in the experiment. At Stage 1, participants were presented only the conclusion of

twelve induction problems, and were asked to rate the probability of each conclusion. Each conclusion was presented on a computer monitor screen one at a time. The presentation order of the twelve conclusions was randomized within a subject. The rating at Stage 1 was used as a baseline rating of the participant. After they finished baseline estimation, they did an intervening task for more than five minutes (Stage 2). The intervening task was not related with property induction, or any of the properties or the occupations used in the experiment. After the participants completed the intervening task, they were presented twelve experimental property induction problems and asked to rate the probability of each conclusion considering the premises. After they finished rating twelve induction problems, they were given the induction problems and their ratings for each problem and were asked to type in the reason for their response. The presentation order of the twelve induction problems was randomized within a subject. Presentation of the items and recording of responses in Stages 1 and 3 were manipulated by a program written in Visual Basic 6.0. Pentium-class PCs and computer monitors were used in Stages 1 and 3.

Results and discussion

Rating Average ratings of the baseline (Stage 1) and the experiment phase (Stage 3) for each premise condition are presented in Fig. 1. As the difference between the rating in the baseline phase and that of the experiment phase was the main interest, ratings in the baseline phase and that of the experiment phase were regarded as a within-subjects variable, and one factor within-subjects ANOVA was conducted for each premise condition**.**

In single-premise conditions, presenting a Same premise increased the rating in the Same condition, $F(1, 18) = 4.87$, $p < .05$, $MSE = 92.96$, and presenting a Different premise decreased the rating in the Different condition, $F(1, 18) = 51.93$, $p < .001$, $MSE = 21.92$. Results in the single-premise conditions replicated Sloman's (1994) results and corroborated the explanation discounting principle.

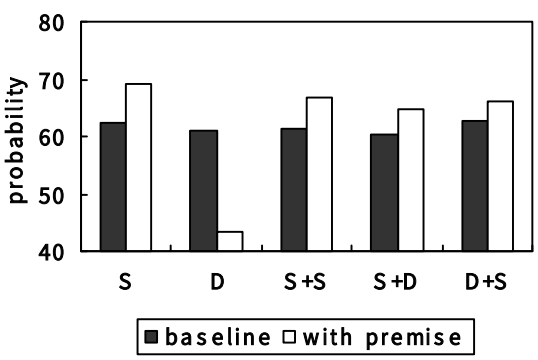

Figure 1. Average ratings of the conclusion: Experiment 1. (S: Same; D: Different)

However, the explanation discounting principle did not seem to apply in the two-premises conditions. Presenting two premises increased the rating of the conclusion in the S+S condition, $F(1, 18) = 21.92$, $p < .001$, $MSE = 13.25$, and in the S+D condition, $F(1, 18) = 11.09$, $p < .001$, $MSE = 17.54$, and did not affect the rating of the conclusion in the D+S condition, $F(1, 18) = 2.14$, ns. According to the explanation discounting principle, the conclusion in the S+D and D+S conditions, in which there was a premise that has the target property for reasons different from that of the target object, was expected to yield ratings at least not higher than that of the baseline phase. However, even in the D+S condition, where the difference from the baseline is smaller than the S+D condition, the average rating for the experiment phase was a little larger than that of the baseline, though not statistically significant. Thus, the results in S+S, S+D, D+S conditions seemed to fair better with the confirmation strategy. That is, participants might have processed only the information that can confirm or strengthen the plausibility of the conclusion when there are two pieces of conflicting information. The possibility of adopting the confirmation strategy got further support from participants' subjective reasons for their responses.

Subjective report The reasons participants wrote down for their conclusions in the experiment were classified into 11 possible categories in the single-premise condition and 20 possible categories in the two-premises conditions.

In the single-premise conditions, participants seemed to use the information in the premise. More specifically, in the Same condition, about 65% of the reasons matched that of the experimenter. In the Different condition, about 35% reported that the reasons for the premise and the conclusion did not agree. In general, results in the single-premise conditions suggested the explanation discounting principle seemed to apply when there is just one piece of relevant information.

However, participants seemed to mainly use confirming information and ignore disconfirming information when there were two premises. More specifically, in the S+S condition, 58% of the responses mentioned the premises and the conclusion had the same reason. In the S+D and D+S conditions, 29% of the responses mentioned only the Same premise, and 21% mentioned reasons they spontaneously made to make both the premise and the conclusion shared the same reason. In other words, in about half of the responses, participants searched for reasons that are the same as the conclusion. Of the remaining 50%, 22% of the response mentioned only the conclusion. As a whole, participants' subjective reports in two-premises conditions strongly suggested that they adopted the confirmation strategy.

Experiment 2

The results of Experiment 1 strongly suggested that participants processed only a part of the information given to them. That is, they seemed to use information that gave

support for the conclusion, and ignore information that was incoherent with the conclusion. Experiments 2 and 3 were intended to test this possibility of non-use of disconfirming information by making premises salient so that disconfirming information was not to be ignored. In Experiment 2, premises were made salient by presenting the premise(s) and the conclusion one after the other.

Method

Participants Ninety-five Sungkyunkwan University students participated in Experiment 2. They were recruited in the same way as that of Experiment 1. Nineteen participants were randomly assigned to one of the five premise conditions.

Material The materials of Experiment 2 were identical to that of Experiment 1.

Procedures The procedures of Experiment 2 were identical to that of Experiment 1, except for the following changes in the temporal order of presenting premises and conclusion at Stage 3. At Stage 3 of Experiment 2, the premise on the top line of the screen appeared and remained visible until participants made responses indicating their rating of the conclusion. The second premise, if there was one, appeared on the screen 3 seconds after the start of the first premise and remained visible until participants made responses. Finally, the conclusion appeared on the screen 3 seconds after the onset of the last premise, and remained visible until the response. The sequential presentation of the premises and the conclusion was intended to make sure that the premises not be ignored.

Results and Discussion

Rating Average ratings of the baseline and the experiment phase for each premise condition are presented in Fig. 2. In single-premise conditions, presenting a Same premise increased the rating in the Same condition, $F(1, 18) = 6.00$, $p < .001$, $MSE = 21.92$, and presenting a Different premise decreased the rating in the Different condition, $F(1, 18) = 16.29$, $p < .001$, $MSE = 133.96$.

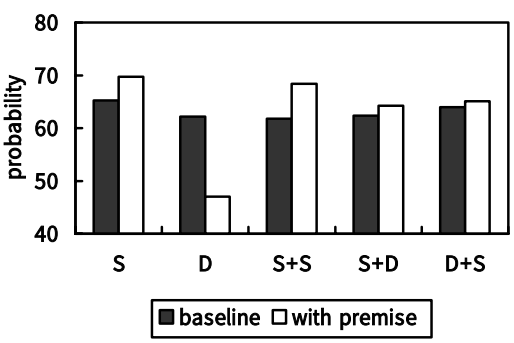

Figure 2. Average ratings of the conclusion: Experiment 2. (S: Same; D: Different)

Presenting two premises increased the rating of the conclusion in the S+S condition $F(1, 18) = 14.15$, $p < .001$, $MSE = 29.26$, but did not affect the rating of the conclusion in the S+D condition, $F(1, 18) = 1.50$, ns, and in the D+S condition, $F(1, 18) = .79$, ns. Different from Experiment 1, the ratings of the two mixed conditions, the S+D and the D+S conditions, were not different from that of a baseline, which suggested that making premises not ignored by presenting one after the other makes all the information attended and as a consequence can exert both facilitating and discounting effect on property induction, even though the discounting effect seems not as strong as the facilitating effect.

Subjective report As in Experiment 1, participants seemed to use the information in the premise in the single-premise conditions. More specifically, in the Same condition, about 73% of the reasons matched that of the experimenter. In the Different condition, about 44% reported that the reasons for the premise and the conclusion did not agree.

The pattern of responses in the two-premises conditions of Experiment 2 was similar to that of Experiment 1. 52% of the responses mentioned that the premises and the conclusion had the same reason in the S+S condition. In the S+D and D+S conditions, 28% of the responses mentioned only the Same premise, and 22% mentioned reasons they spontaneously made to make both the premise and the conclusion share the same reason. Furthermore, 26% of the responses mentioned only the conclusion.

In general, results of Experiment 2 were quite similar to that of Experiment 1, but sequentially presenting premises did at least partially succeed to make information that disconfirms the conclusion affect the believability of the conclusion.

Experiment 3

Presenting the premises and the conclusion successively changed the pattern of results a little in Experiment 2. In Experiment 3, the disconfirming premise was forced to be processed by asking participants to write down reasons why each premise could be true.

Method

Participants Ninety-five Sungkyunkwan University students participated in Experiment 3. They were recruited in the same way as that of Experiment 1. Nineteen participants were randomly assigned to one of the five premise conditions**.**

Material The materials of Experiment 3 were identical to that of Experiment 1.

Procedures The procedures of Experiment 3 were identical to that of Experiment 1, except for the following three changes. First, in Experiment 3, participants were tested in groups. Nineteen participants in each premise condition were seated in a large class room. They were seated in a way such that there was at least one seat unoccupied in all directions. Second, participants were given a small booklet. Third, participants were asked to write down the reasons for the premises being true and the believability rating of the conclusion. Separate booklets were given at each stage, so that participants could not look at their baseline ratings when they did induction problems. In the booklet for Stage 3, the conclusion was printed in a page following the page where premises and their responses for the premises were written, so that participants could not read their reasons for the premises**.**

Results and Discussion

Rating Average ratings of the baseline and the experiment phase for each premise condition are presented in Fig. 3. In single-premise conditions, presenting a Same premise increased the rating in the Same condition, $F(1, 18) = 8.03$, $p < .05$, $MSE = 61.53$, and presenting a Different premise decreased the rating in the Different condition, $F(1, 18) = 38.02$, $p < .001$, $MSE = 78.76$.

Presenting two premises increased the rating of the conclusion in the S+S condition $F(1, 18) = 9.55$, $p < .01$, $MSE = 74.76$, but decreased the rating of the conclusion in the S+D condition, $F(1, 18) = 8.70$, $p < .01$, $MSE = 38.00$, and D+S condition, $F(1, 18) = 9.71$, $p < .01$, $MSE = 65.67$.

In general, making premises salient by writing down reasons why they can be true did not affect the effects of confirming information, probably because the confirming information had already exerted its influence due to the confirmation strategy people spontaneously use in most situations. However, presenting a disconfirming premise decreased the rating of the conclusion in Experiment 3 in a much larger degree, and succeeded to give very strong support for the explanation discounting principle when there were two conflicting premises.

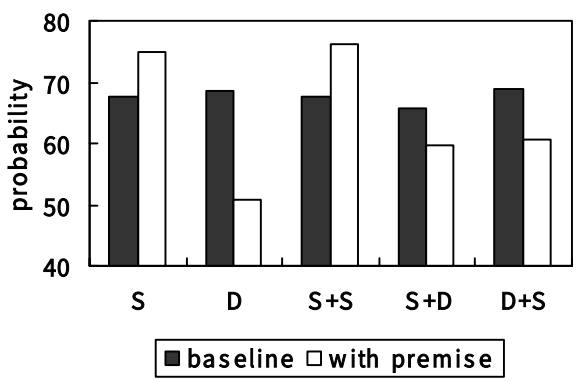

Figure 3. Average ratings of the conclusion: Experiment 3. (S: Same; D: Different)

As a whole, the results of the three experiments seemed to suggest that the explanation discounting principle seemed to work only when the disconfirming information became salient by either being presented one by one or by forcing respondents to think about the reasons.

General Discussion

Three experiments were conducted to explore whether the explanation discounting principle works when there are two conflicting premises. The results of the three experiments can be summarized as follows: (1) Both the confirmation strategy and the explanation discounting principle seemed to work when there was just one premise. In three experiments, it has been consistently observed that the Same premise increased the rating of the conclusion, supporting the confirmation strategy, and that the Different premise decreased the rating of the conclusion, supporting the explanation discounting principle. Results of the single-premise conditions suggested that people seemed to search for relevant information and use it when they had just one piece of relevant information. (2) However, only the Same premise(s) seemed to affect the plausibility of the conclusion when there were two premises under natural conditions. Ratings in the two mixed conditions were higher than or equal to the baseline in Experiment 1, but got equal or lower than the baseline when the premises were forced to be processed in Experiments 2 & 3. Our interpretation that only the confirming information seemed to influence the judgments and decisions is in good agreement with the information processing strategies generally accepted in cognitive psychology, such as Johnson-Laird & Byrne (1991) and Nisbett & Ross (1980).

However, the explanation discounting principle can explain the results of the three experiments if the implicit assumption that all information is processed in the same degree was modified. First, as I mentioned in the Introduction, the explanation discounting principle did not make any explicit assumption concerning the fate of conflicting information. Therefore, our interpretation of the discounting principle might be an unfair test of the discounting principle. Second, the relevance of the confirming premise and the disconfirming premise might be different. For instance, if we adopt the coherence of Thagard (1992), confirming premises share more attributes with the conclusion than the disconfirming premises. More specifically, the confirming premise shares the reason and the consequences of the reason with the conclusion (e.g., in the bad back example, both programmers and secretaries share two attributes, sit all day long and have bad backs), whereas the disconfirming premise shares only the consequences (e.g., furniture movers and secretaries have one attributes in common, they have bad backs). Therefore, the explanation discounting principle can explain the results of current experiments if their relevance were used as

relative weights of each premise. However, the explanation discounting principle still has problems explaining why making premises salient decreased the believability of the conclusion below the baseline in Experiment 3.

One aspect that has to be solved in the preceding argument is who, what, or when determines the processing order of the information. That is, deciding whether certain information is confirming or disconfirming to the conclusion can be solved only after we figure out the conclusion in the property induction tasks. Therefore the order of processing information might be different from the order the information is given. If this is the case, then there have to be multiple stages of processing. For instance, a primitive assessment of the relevance/confirmation of premises to the conclusion precedes the detailed processing of the relevant or confirming information.

Acknowledgements

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