# A Cross-Cultural Study of Hindsight Bias and Conditional Probabilistic Reasoning

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**Abstract**

Choi and Nisbett (2000) reported that Koreans showed stronger hindsight bias than Americans. The purpose of this study was to see whether hindsight bias is stronger among Easterners than among Westerners using a probability judgment task, and to test an 'explicit-implicit' hypothesis and a 'rule-dialectics' hypothesis. We predict that the implicit process is more active among Easterners to generate hindsight bias, and that Easterners are more dialectical thinkers, whereas Westerners are more rule-based thinkers. French, British, Japanese, and Korean participants were asked to make probabilistic judgments in a scenario including conditional probabilistic judgment (Experiment 1) and in a Good Samaritan scenario (Experiment 2). In the results, Easterners showed greater hindsight bias generally, and their cognition was more implicit and dialectic.

Key words: Social cognition; Psychology; Cross-cultural analysis.

When we come across an unexpected event, we often believe that we could have predicted it. This is a robust psychological phenomenon known as the hindsight bias (Fischhoff, 1975). This bias is a mistaken belief that one could have predicted a given outcome once the outcome is known.

Hindsight bias has been assumed to be universal among human beings. However, Choi and Nisbett (2000) reported that Koreans showed greater hindsight bias than Americans. In their

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experiment, Korean and American participants were asked to estimate the probability of 'help' of a victim by a religious and generous man in a Good Samaritan scenario. People usually expect that the man must help the victim in this scenario. Half of their participants were given an outcome that actually he did not help. When Korean participants knew the unexpected outcome, they estimated that the probability of help was lower than Americans did, even though they were asked to do so supposing hypothetically that they did not know the outcome. This decrease of estimated probability is the measure of hindsight bias, and thus it was inferred that Koreans show a greater hindsight bias. Choi and Nisbett (2000) inferred that these tendencies among the Koreans were due to their having more complex models for events than Americans. The term 'complex model' is included in the concept of holistic cognition that is contrasted with analytic cognition. Nisbett (2003; Nisbett, Peng, Choi, & Norenzayan, 2001) argued that Westerners are more likely to engage in analytic cognition, whereas Easterners are more likely to engage in holistic cognition. According to his definition, analytic cognition involves detachment of the object from its context, a tendency to focus on attributes of the object to assign it to a category, and a preference for using rules about the categories to explain and predict the object's behavior. On the other hand, holistic cognition has an orientation to the context or the field as a whole, attention to relationships between a focal object and the field, and a preference for explaining and predicting events on the basis of such relationships.

Nisbett et al. (2001) explained these cultural differences using the distinction between individualist and collectivist cultures. It has been claimed that Western people have established an individualist culture, whereas Eastern people have developed a collectivist culture. Analytic cognition is held to be adaptive in the culture of individualism, whereas holistic cognition is adaptive in the culture of collectivism. Regarding the processes of hindsight bias, we consider two possible more detailed hypotheses. One is a hypothesis based on the distinction between explicit and implicit processes, and the other is one based on the distinction between rule-based thinking and dialectical thinking.

As Yama, Nishioka, Horishita, Kawasaki, and Taniguchi (2007) pointed out, the distinction between analytic and holistic is also important and one of the properties that distinguish between two systems proposed by dual process theorists (Evans & Over, 1996). According to dual process theories, holistic cognition is fundamentally implicit in that it requires processing of many contextual elements. Analytic cognition is, on the other hand, is assumed to be explicit. We call the account that Easterners are more likely to do implicit processing the 'explicit-implicit' hypothesis. The process of hindsight bias is inferred to be implicit (Hawkins & Hastie, 1990). Therefore, according to the 'explicit-implicit' hypothesis, the observation by Choi and Nisbett (2000) that hindsight bias was stronger for Easterners can be attributed to Easterners being more affected by the outcome information implicitly.

This implicit process is contrasted with the explicit access. We assume that people implicitly revise their working models just by an unexpected outcome so that they make a causal inference from their models to the outcome. However, if the causal information is available explicitly, the hindsight bias is reduced. Regarding causality, Cummins (1995) argued that causal inference is sensitive to two factors: alternative causes (AC) and disabling conditions (DC). An AC is a cause that is not the one cited in the causal rule but is capable of evoking the effect cited in the rule. A DC is an event that could prevent an effect from occurring in the presence of a cause.

Another specified hypothesis utilizes the distinction between rule-based thinking and dialectical thinking. Rule-based thinking is related to analytic cognition, whereas dialectical thinking is related to holistic cognition. In the culture of collectivism, rule-based thinking is not adaptive, because it may lead to a conclusion that one side is completely justified whereas the other is not in a conflict situation, and thus it may break the in-group harmony that is an important goal of people in a collectivist culture. Instead, in a collectivist culture, dialectical thinking, which requires people to consider situational factors and thus leads them to find the middle way, is preferred and holistic thought is appropriate to the use of dialectics (Peng & Nisbett, 1999).

We name this the hypothesis of 'rule-dialectics'. In interpreting the cultural differences in hindsight bias reported by Choi and Nisbett (2000), it is also possible to apply the distinction between rule-based and dialectical thinking. The participants could suppose a rule based on the scenario that, if a person is very religious and generous, then (s)he is very likely to help a victim. The given antecedent is true in the scenario, hence, the probability that (s)he helped the victim is high. In the outcome condition, their participants were asked to hypothetically suppose that they did not know the outcome information that John did not help the victim. If participants stick to the rule, this supposition gets stronger, and thus, the hindsight bias decreases, whereas if the participants use dialectics and consider both the rule and the outcome information, the hindsight bias gets greater.

The purpose of this study is to test the 'explicit-implicit' hypothesis and the 'rule-dialectics' hypothesis. We manipulate

implicitness and explicitness in the following paradigm. The first step is almost the same as that of previous studies on hindsight bias (Choi & Nisbett, 2000; Fischhoff, 1975). Participants receive information about a target event. Participants in the control condition are asked to estimate the probability of the plausible consequence of an event. Participants in the outcome condition are informed of the outcome that another unexpected consequence occurred, and they are asked to estimate the probability of the original expected outcome as if they had not received the outcome information. In the second step, all the participants are asked to suppose that the outcome is the unexpected one, and to point out possible factors for the unexpected consequence. This manipulation establishes explicit causal links between the original information and the unexpected consequence. In the third step, the participants are asked to judge the probability that the expected outcome occurred returning to the time when they had not been yet been informed of the outcome.

As shown in Table 1, four possible models of 'revision of working models' can be supposed based on the 'explicit-implicit' hypothesis and the 'rule-dialectics' hypothesis. The 'rule-based without explicit revision' model supposes that the rule-based tendency is so strong that even the explicit causal inference does not revise the working models. Hence, according to this model, the estimations are high in all the conditions. Secondly, the 'rule-based with explicit revision' model supposes that the outcome information does not make the causal information available, and thus does not revise the working models, but after pointing out possible factors for the unexpected outcome, the models are revised explicitly so that the estimated probability decreases. Hence the estimates become low in the final judgment. Thirdly, the 'rule-based with implicit revision' model supposes that, although implicit revision is made by outcome information, the participants try to reason hypothetically hence they keep the original models to suppress the revised models, or adjust the implicitly revised models to neglect the outcome information. Therefore, even after they pointed out reasons, the estimated probability does not decrease in the outcome condition. The fourth is the 'implicit revision' model that is equivalent the dialectics model. It supposes the implicit revision of the working models by the outcome information, hence the estimate of probability of the initial judgment in the outcome condition is lower. The hindsight bias is predicted only by this model.

We used British and French participants as samples of Westerners, and Koreans and Japanese as samples of Easterners. We predict that the data patterns of British and French could fit one of three rule-based models. According to the prediction from the 'rule-dialectics' explanation, they fit the 'rule-based with explicit revision' model. However, if implicit revision is universal to some extent, they will fit the 'rule-based with implicit revision' model. On the other hand, we predict that the data patterns of Koreans and Japanese will fit the implicit revision model.

Table 1. Prediction on estimated probability.

| Models | Control Initial | Control Final | Outcome Initial | Outcome Final |
|---|---|---|---|---|
| RB without ER | High | High | High | High |
| RB with ER | High | Low | High | Low |
| RB with IR | High | Low | High | High |
| IR (Dialectic) | High | Low | Low | Low |

RB: Rule-based, ER: Explicit revision, IR: Implicit revision.

## Experiment 1

In Experiment 1 we asked participants to do a conditional causal reasoning task. When an indicative conditional is stated, people often posit a causal relationship between the premise *p* and its consequence *q*. In the *probability judgment of consequent task*, we presented an indicative conditional with its antecedent satisfied, and asked our participants to estimate the probability of the consequent. Half of the participants received information on the outcome such that the consequent did not occur before the probability judgment (the outcome condition), whereas the other half did not (the control condition). In the *probability judgment of antecedent task*, our participants were given an indicative conditional with satisfied consequent, and were asked to judge the probability of the antecedent.

### Method

*Design* The design was 4 (nationality: British, French, Japanese, Koreans) by 2 (outcome: control, outcome) by 2 (trial: initial, final) in each task. 'Nationality' and 'outcome' were between-subject factors .

*Participants* Ninety-eight British university students (49 in the control condition and 49 in the outcome condition) , 86 French university students (44 in the control condition and 42 in the outcome condition), 100 Japanese university students at (51 in the control condition and 49 in the outcome condition), and 95 Korean university students (46 in the control condition and 49 in the outcome condition) participated in this experiment. About 70 percents of the participants were female in each sample.

*Materials* Based on the mean generation counts of possible DCs and ACs (Cummins, 1995), we chose two kinds of conditionals (slightly revised so that natural scenarios were

created). We created Scenario A with the conditional "if a student studies hard, then (s)he will pass the exam" and Scenario B with the conditional "if fertilizer is put on the plants, then they will grow quickly". All the materials were initially written in English. They were translated to French, Japanese, and Korean, and then back-translated to English.

*Procedure* Materials were printed on booklets. Each participant was given a booklet containing either Scenario A or B, either the probability judgment of antecedent task or the probability judgment of consequent task, and was either in the control condition or in the outcome condition. In the antecedent task, each participant was given a conditional with the information that the consequent occurred, and was asked to estimate the probability that the antecedent was satisfied. Half of the participants received information on the outcome that the antecedent had not been satisfied before the probability judgment (the outcome condition), whereas the other half did not (the control condition). The participants in the outcome condition were asked to judge the probability supposing that they did not know the outcome. On the next page, they were informed that the antecedent was not actually satisfied, and were asked to point out possible ACs in four minutes. On the final page, they were asked to estimate the probability that the antecedent had been satisfied thinking back to the time when they were not yet informed of the outcome. In the probability judgment of consequent task, each participant was given a conditional with satisfied antecedent, and was asked to estimate the probability that the consequent would occur. The procedure was almost the same as that of the probability judgment of consequent task. The experiment was run in regular classes in French, British, Japanese, and Korean universities.

## Results and Discussion

Table 2. Mean estimated probabilities for each condition (%).

| | Control Initial | Control Final | Outcome Initial | Outcome Final |
|---|---|---|---|---|
| French | 63.1 | 51.6 | 68.5 | 61.1 |
| British | 68.9 | 54.1 | 62.4 | 69.7 |
| Japanese | 67.3 | 57.9 | 73.8 | 72.8 |
| Korean | 75.1 | 61.0 | 66.4 | 66.5 |

The mean estimated probability of each condition is shown in Table 2. Because we found no significant differences between the *probability judgment of consequent task* and the *probability judgment of antecedent task*, we analyzed both sets of data together. We also found little difference between the data of Scenarios A and B.

An ANOVA was conducted following the design of 4 (nationality) by 2 (outcome) by 2 (trial). The main effect of nationality was significant ($F(3,371)=2.83$, $p<.05$). The main effect of outcome was significant ($F(1,371)=7.83$, $p<.01$) : surprisingly, the estimated probabilities were higher in the outcome condition than in the control condition. The main effect of trial was significant ($F(1,371)=33.19$, $p<.01$): the estimated probabilities were lower in the final judgment.

The interactions between nationality and outcome ($F(3,371)=1.95$, *n.s.*) and nationality and trial were not significant ($F(3,371)=1.21$, *n.s.*). The interaction between outcome and trial was significant ($F(1,371)=30.58$, $p<.01$). Furthermore, the interaction between nationality, trial and outcome was significant ($F(3,317)=3.10$, $p<.05$).

In order to interpret the interaction, a sub-analysis was conducted in each nationality. For French participants, the simple main effect of outcome was not significant ($F(1,371)=3.56$, *n.s.*). The simple main effect of trial was significant ($F(1,371)=16.74$, $p<.01$). The estimated probabilities were higher in the final judgment. The simple interaction was not significant ($F(1,371)=.79$, *n.s.*). These results show that the French participants did not show hindsight bias. The outcome information did not make them revise their working models. They only revised their working models after pointing out the DCs or ACs. The response patterns of the French fit the 'rule-based with explicit revision' model.

With the British, the simple main effects of outcome ($F(1,371)=1.48$, *n.s.*) and trial were not significant ($F(1,371)=2.98$, *n.s.*). The simple interaction was significant ($F(1,371)=26.03$, $p<.01$). The simple-simple main effect of outcome was not significant in the initial judgment ($F(1,742)=2.32$, *n.s.*), whereas the estimated probabilities of the final judgment were significantly lower in the control condition ($F(1,742)=13.18$, $p<.01$). This pattern fits the 'rule-based with implicit revision' model.

The pattern of the Japanese data was almost the same as that of the British. The simple main effect of outcome was not significant ($F(1,371)=3.77$, *n.s.*). The simple main effect of trial was significant ($F(1,371)=5.85$, $p<.05$). The simple interaction was significant ($F(1,371)=8.56$, $p<.01$). The simple-simple main effect of outcome was not significant in the initial judgment ($F(1,742)=2.38$, *n.s.*), whereas it was significant in the final judgment ($F(1,742)=12.26$, $p<.01$). The data pattern fits the 'rule-based with implicit revision' model.

In the Koreans, the simple main effect of outcome was not significant ($F(1,371)=.174$, *n.s.*). The simple main effect of trial was significant ($F(1,371)=10.23$, $p<.01$). The simple interaction was significant ($F(1,371)=10.53$, $p<.01$). The

simple-simple main effect of outcome was significant in the initial judgment ($F(1,742)=4.00$, $p<.05$), whereas it was not significant in the final judgment ($F(1,742)=1.64$, *n.s.*). The pattern of the Koreans was identical to our prediction for Easterners. They exhibited hindsight bias. It means that, when the outcome information was given, implicit access was made to revise their working models.

Hindsight bias was thus seen only among Korean participants. This might be consistent with both the result of Choi and Nisbett (2000) that hindsight bias was stronger for Koreans than Americans, and those of Heine and Lehman (1995) that the Japanese did not show strong hindsight bias. Heine and Lehman inferred that it was because Japanese were less confident generally. But, it is an open question. We infer that hindsight bias is a product of implicit access to revised working models, but it is not generated if the working models are amended so that they compensate the implicitly decreased probability.

The hypothesis of cultural differences based on the distinction between explicit and implicit processing was not completely supported. It can be inferred that the British used implicit revision in Experiment 1. Although French did not seem to use it, implicit revision may be universal to some extent. The difference between Choi and Nisbett 's (2000) study and our study is that they used a story about a seminary student who was very likely to help others with a no-help outcome, whereas we used conditionals. Generally speaking, people are enjoined to assume the truth of the premises in logical reasoning. Hence, the British and Japanese participants might *suppose* that the premise was true, and *suppose* that they did not know the unexpected outcome when estimating the probability. We addressed these possibilities in a second experiment which involved an adaptation of Choi and Nisbett's materials.

## Experiment 2

### Method

*Design* The design was 4 (nationality: British, French, Japanese, Koreans) by 2 (outcome: control, outcome) by 2 (trial: initial, final) in each task. "Nationality" and "outcome" were between-subject factors.

*Participants* Ninety-three British university students participated. However, 24 of them had grown up in ethnic minority, mainly South Asian, cultures in Great Britain, and so 33 in the control condition and 36 in the outcome condition were used for the ANOVA. Ninety-seven French university students participated (three participants had missing data, hence 46 in the control condition and 48 in the outcome condition were used for statistical analysis), along with 114 Japanese university students (57 in the control condition and 57 in the outcome condition), and 102 Korean university students (52 in the control condition and 50 in the outcome condition). About 70 percent of the participants were female in each sample.

*Materials* The same Good Samaritan scenario as that used in Choi and Nisbett (2000) was used in Experiment 2, in which the target man, John, is expected to help a victim. The participants were asked to estimate the probability that John helped the victim.

*Procedure* Materials were printed in booklets. Each participant was given a booklet containing the Good Samaritan scenario, and was asked to estimate the probability that John helped the victim. Half of the participants received information on the outcome that he had not helped the victim before the probability judgment (the outcome condition), whereas the other half did not (the control condition). The participants in the outcome condition were asked to judge the probability supposing that they did not know the outcome. The second and the third pages were almost the same as those of Experiment 1. The experiment was run in regular classes in French, British, Japanese, and Korean universities.

### Results and Discussion

The mean estimated probabilities in each condition are shown in Table 3. An ANOVA was conducted following the design of 4 (nationality) by 2 (outcome) by 2 (trial). The main effects of nationality ($F(3,371)=1.49$, *n.s.*) and outcome were not significant ($F(1,371)=.15$, *n.s.*). The main effect of trial was significant ($F(1,371)=80.63$, $p<.01$). The estimated probabilities were generally lower in the final judgment.

Table 3. Mean estimated probabilities for each condition (%).

| | Control Initial | Control Final | Outcome Initial | Outcome Final |
|---|---|---|---|---|
| French | 76.2 | 63.5 | 75.1 | 73.1 |
| British | 66.9 | 57.8 | 78.4 | 73.4 |
| Japanese | 86.7 | 71.7 | 74.5 | 69.1 |
| Korean | 81.9 | 70.8 | 72.2 | 66.2 |

The interaction between nationality and outcome was significant ($F(3,371)=5.25$, $p<.01$). Hence the following analyses were done. The simple main effect of outcome in the French data was not significant ($F(1, 742)=1.75$, *n.s.*). The simple main effect of outcome in the British was significant ($F(1, 742)=13.02$, $p<.01$); very surprisingly, the estimated probabilities were higher in the outcome condition. The simple main effect of outcome in the Japanese was significant ($F(1, 742)=6.42$, $p<.05$); the estimated probabilities were lower in the

outcome condition. The simple main effect of outcome in the Korean data was significant ($F(1, 742)=5.40$, $p<.05$); the estimated probabilities were lower in the outcome condition.

The interaction between nationality and trial was not significant ($F(3,371)=.77$, *n.s.*). The interaction between outcome and trial was significant ($F(1,371)=16.11$, $p<.01$). The simple main effect of outcome of initial judgment was significant ($F(1, 742)=4.10$, $p<.05$). The estimated probabilities were generally lower in the outcome condition. The simple main effect of outcome of final judgment was not significant ($F(1, 742)=1.97$, *n.s.*). Finally, the two-way interaction was not significant ($F(3,317)=.77$, *n.s.*).

In short, the data patterns of the French and British fit the 'rule-based with implicit revision' model, whereas that of the Koreans and Japanese fit the 'implicit revision' model.

## General Discussion

As shown in Table 4, the best fit model is assigned to each condition of Experiments 1 and 2. Neither the 'explicit-implicit' hypothesis nor the 'rule-dialectics' hypothesis alone was able to explain all the aspects of cultural differences seen in these experiments. Rather, we believe that they explain them in combination with each other as shown in Table 4.

Hindsight bias can be caused by the implicit revision of working models. This was inferred to be made not only by Easterners but also by Westerners based on the results that the estimated probabilities did not decrease in the outcome condition in some conditions. Only the French data of Experiment 1 fit the prediction about Westerners based on both the 'explicit-implicit' and 'rule-dialectics' hypotheses. The Japanese data of Experiment 2 and the Korean data fit the prediction about Easterners based on both the hypotheses. In other cases, although the participants were inferred to be affected by the outcome information implicitly, they did not show hindsight bias, presumably because of adjusting their working models while keeping the original ones. These cases mean that implicit revision is universal to some extent, especially since the data of Experiment 2 show that both French and British participants did it. The reason why they did not show hindsight bias is inferred to be that they adjusted their working models so that they followed a rule originally induced from the scenario.

Whether people adjust their working models to follow a rule is sensitive to the situation. Comparing the results of Japanese participants in Experiments 1 and 2, they made this adjustment when conditionals were used, whereas they did not when the Good Samaritan scenario was used. We interpret the differences as showing that the pressure to compensate was stronger in Experiment 1. The difference between Experiments 1 and 2 is reflected in the data of the French participants.

Finally, another possible interpretation of these results is that Easterners are more likely to revise their belief. Further investigation is needed to access this open question.

Table 4. The inferred summary of Experiment 1 and 2.

| | Experiment 1 (Conditional) | Experiment 2 (Good Samaritan) |
|---|---|---|
| French | RB with ER | RB with IR |
| British | RB with IR | RB with IR |
| Japanese | RB with IR | IR(hindsight bias) |
| Korean | IR(hindsight bias) | IR(hindsight bias) |

Note. RB: Rule-based, ER: Explicit revision, IR: Implicit revision.

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