A Cross-Cultural Study on Conditional Reasoning and Hindsight Bias

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Abstract

The purpose of this study is to see whether hindsight bias is stronger among Japanese people than among French people using conditional reasoning and probability judgment task. We describe the relation between analytic thought (Westerners) and holistic thought (Easterners) in terms of SuperP. SuperP is a superordinate principle that describes a set of events possibly related to the *p* in an 'if *p* then *q*' conditional. The participants were asked to judge the probability of the two events of a given indicative conditional. The cultural differences on hindsight bias were not very strongly observed, but we inferred that information about the actual outcome might activate the SuperP. This phenomenon could be universal across cultures.

Introduction

Summing up previous cross-cultural studies on cognition, Nisbett (2003; Nisbett, Peng, Choi, & Norenzayay, 2001) argued that Westerners are more likely to engage in analytic thought, whereas Easterners are more likely to engage in holistic thought. 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 of individualist (Westerners) and collectivist (Easterners) cultures. According to Triandis (1995), individualism is defined as a social pattern that consists of loosely linked individuals who (i) view themselves as independent of collectives (family, co-workers, tribe, nation), (ii) are primarily motivated by their own preferences, needs, rights, and the contracts they have established with others, (iii) give priority to their personal goals over the goals of others, and (iv) emphasize rational analyses of the advantages and disadvantages of associating with others. Collectivism is defined as a social pattern that consists of closely linked individuals who (i) see themselves as parts of one or more collectives, (ii) are primarily motivated by the norms and duties imposed by those collectives, (iii) are willing to give priority to the goals of these collectives over their own personal goals, and (iv) emphasize their connectedness to members of these collectives. In the culture of collectivism, rule-based thinking is not adaptive, because it may break the in-group harmony that is an important goal of people in collectivist culture. Instead, dialectic thinking is preferred and holistic thought is appropriate to use the cognitive tool of dialectic.

Although many social psychologists (Nisbett et al., 2001) have demonstrated cultural differences in cognition using experimental tasks from cognitive psychology, we sometimes find discrepancies in the use of terminology between social psychologists and cognitive psychologists. For example, the

distinction between holistic and analytic thought is one of the important distinctions that dual process theories (which propose that human thinking has two sub processes) have emphasized (Evans & Over, 1996; Stanovich, 2004). Therefore, the first motivation of this study is to describe the cultural differences in thought using the terms and tasks of cognitive psychologists.

Choi and Nibett (2000) asked their participants to imagine a situation in which they expect plausible consequences. When Korean participants knew an unexpected consequence, they showed greater hindsight bias and thus were less surprised at the unexpected consequences than Americans. They inferred that these tendencies among the Koreans were due to the fact that they have more complex models for events than Americans, and thus they regarded these tendencies as a result of holistic thought vs. analytic thought. However, they did not made further discussion on what complex models are. We try to replicate these results using conditional reasoning tasks often used in the study of reasoning mechanisms.

Conditionals are grouped into two kinds of categories: indicative and deontic (Manktelow & Over, 1991). Conditionals of an indicative form codify common sense, scientific knowledge, or arbitrary rules, whereas those of a deontic form express laws, social agreement, moral rules, and so on. The goal of the former is to describe the world, whereas that of the latter is to show people how to act in the world. When an indicative conditional is stated, people often suppose causal relationship between the premise *p* and its consequence *q*. In this study we asked participants to do a conditional causal reasoning task.

Byrne (1989) reported that *Modus Ponens* (if *p* then *q*, and *p*, therefore *q*) is often suppressed by additional information in natural reasoning. For example, people usually conclude that John eats a fish for dinner when they are given "if John goes fishing then he eats a fish for dinner, and he goes for fishing". However, they are unlikely to do so when the statement "John is poor at fishing" is added. This can be related to the holistic way of thinking, because participants considered the situational information in choosing whether to infer the conclusion or not. On the other hand, in the case of the conditional "if X studies hard, X will do well in the next test", people are more likely to conclude "X will do well in the next test" when they are given added information that X had seen a copy of the question before the exam even if the antecedent is not satisfied. Manktelow and Fairley (2000) proposed that people suppose a superordinate principle that is related to the stated-*p* in the conditional. They called this SuperP. In the case of the conditional above, the SuperP is supposed to be anything that makes X do well in the next test. They demonstrated that people were more likely to infer the consequent when SuperP was satisfied both in causal and deontic reasoning.

We argue that the "complex models" (Choi & Nisbett, 2000) contain causality when they are used for expectation. Regarding causality, Cummins (1995; Cummins, Lubart, Alksnis, & Rist, 1991) argued that causal reasoning 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. The condition that John is poor at fishing is a typical example of DC. Using the term of SuperP, an alternative cause is a factor that satisfies SuperP, whereas a disabling condition is a factor that prevents SuperP from being satisfied even though stated-*p* has been satisfied. Thus SuperP is not only an enlarged set of stated-*p*, but it eliminates sets that do not cause the effect.

We infer that SuperP is one of the kinds of holistic thought, because having SuperP means considering situational factors beyond rule-based reasoning. Hence it is a surprise from the view of Nisbett that the theory of SuperP is constructed based on the data of Western participants (Manktelow & Fairley, 2000). Considering the previous results on cross-cultural studies, we predict that Easterners show this tendency more.

We interpret the results of Choi and Nisbett (2000) as that Korean people, belonging to an Eastern culture, are supposed to think holistically and thus to have more complex model to construct their subjective SuperP than Americans who, supposedly, think analytically.

On the other hand, as Manktelow and Fairley (2000) have noted, SuperP is, if it is codified, a superordinate principle. Therefore, it is plausible that this principle could be used for analytic thought, if it becomes explicit in some ways. We expect this inference leads a resolution for one of the problems on the usage of terminology. Although holistic thought is supposed to be implicit according to the dual process theorists, Nisbett says little on this distinction. We infer that SuperP supposition is holistic if it is done implicitly, whereas that it can be used analytically if it is explicit because SuperP expresses a category that can be used for conditional reasoning.

Therefore, we are going to examine if Easterners construct larger SuperPs than Westerners, and if Easterners construct these SuperPs more easily or more automatically than Westerners. In the *probability judgment of consequent task*, we present an indicative conditional with its antecedent satisfied, and ask the participants to estimate the probability of the consequent. Half of the participants receive information on the outcome such that the consequent did not occur before the probability judgment (outcome condition), whereas the other half do not (control condition). Next, they are informed that the consequent did not actually occur, and they are asked to point out possible DCs. In this procedure of producing DCs, we assume that the SuperP becomes explicit in participants' mind. Finally, they are asked to judge the probability that the consequent occurred returning to the time when they were not yet informed of the outcome. In the *probability judgment of antecedent task*, we present in indicative conditional with satisfied consequent, and participants are asked to judge the probability of the antecedent. The rest of the procedure is the same as that of the probability judgment of consequent task. As far as we know,

this is a new paradigm created by the mixture of conditional reasoning, probability judgment, creation of possible ACs or DCS, and outcome information (hindsight bias). In short, we assume that the outcome information activates SuperP implicitly whereas the creation of ACs or DCs makes SuperP explicit.

Based on the distinction between analytic and holistic thought (Nisbett et al., 2001), we predict the following regarding our experimental manipulation. We picked up French participants as a sample of Westerners and Japanese as a sample of Easterners.

1) Japanese participants will judge both the probabilities of consequent (the probability judgment of consequent task) and of antecedent (the probability judgment of consequent task) lower in the outcome condition than French participants because the hindsight bias is stronger for Japanese people than for French people. In other words, Japanese participants activate SuperP more easily to figure out what the outcome is than French participants.

2) Japanese participants will point out more factors than French participants, because they have more complex theories based on holistic thought. In other words, Japanese people have larger SuperP than French people.

3) We predict that the SuperP of Japanese people becomes available when the outcome is given, whereas the SuperP of French becomes available when they are asked to point out possible factors. Therefore, the effect of generating factors is reduced in the outcome condition only in Japanese participants. On the other hand, because the effect of outcome is less among French participants, the effect of generating factors are shown both in the control condition and in the outcome condition.

Method

Design

The design was 2 (nationality: Japanese, French) by 2 (outcome: control, outcome) by 2 (trial: prior, final) in each task. The "nationality" and "outcome" were between-subject factors.

Participants

Eighty-seven French university students at the University of Lyon 2 who majored in psychology and 98 Japanese university students at Kobe College, Ritsumeikan University, and Osaka International University who majored in psychology, sociology, or environmental sciences participated in this experiment. About 70 percents of the participants were female in both countries. In the probability judgment of antecedent task, 23 French students and 26 Japanese students participated in the control condition, and 19 French students and 26 Japanese students participated in the outcome condition. In the probability judgment of consequent task, 21 French students and 25 Japanese students participated in the control condition, and 24 French and 22 Japanese students participated in the outcome condition. In both populations, participants were nationals having Japanese or French as mother tongue.

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 conditional "if a student studies hard, then (s)he will pass the exam"(Mean AC=3.9; Mean DC=4.4) and Scenario B with conditional "if fertilizer is put on the plants, then they will grow quickly"(Mean AC=4.2; Mean DC=3.4). The scenarios are shown in Appendix.

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 either in the control condition or in the outcome condition. In the antecedent task, each participant was given an indicative 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. In the next page, they were informed that the antecedent was not actually satisfied, and they were asked to point out possible ACs in four minutes. In 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 an indicative conditional with satisfied antecedent, and was asked to estimate the probability that the consequent would occur. Half of the participants received information on the outcome that the consequent did not occur before the probability judgment (the outcome condition), whereas the other half did not (the control condition). In the next page, they were informed that the consequent did not actually occur, and they were asked to point out possible DCs in four minutes. In the final page, they were asked to judge the probability of the consequent thinking back to the time when they were not yet informed of the outcome. The experiment was run in regular classes in French and Japanese universities.

Results

The mean estimated probabilities of antecedent (the probability judgment of antecedent task) and of consequent (the probability judgment of consequent task), the mean numbers of DCs or ACs (factors) in each condition of Japanese and French students are shown in Table 1.

Table 1: Initial and final mean estimated probabilities, the number of possible factors, and the number of participants whose data were analyzed for each condition.

Antecedent	Control			
	Initial	Final	Factors	N
French	61.5	49.8	5.48	23
Japanese	62.5	51.7	3.81	26
	Outcome			
	Initial	Final	Factors	N
French	66.1	56.8	5.63	19
Japanese	72.8	71.4	4.52	25
Consequent	Control			
	Initial	Final	Factors	N
French	64.8	53.5	5.52	21
Japanese	72.2	64.4	4.52	25
	Outcome			
	Initial	Final	Factors	N
French	70.4	64.6	5.48	23
Japanese	74.8	74.2	4.29	24

An ANOVA was conducted following the design of 2 (nationality) by 2 (outcome) by 2 (trial) on the probability judgment of antecedent task data. The main effect of nationality was not significant ($F(1, 89)=2.148$, ns). The main effect of outcome was significant ($F(1, 89)=6.317$, $p<.05$). Very surprisingly, the estimated probabilities were higher in the outcome condition than in the control condition. The main effect of trial was significant ($F(1, 89)=17.500$, $p<.01$). The estimated probabilities got lower in the final estimation. The one-way interaction of trial and nationality was not significant ($F(1, 89)=1.230$, ns). The interaction of trial and outcome was not significant ($F(1,89)=2.259$, ns). The interaction of nationality and outcome was not significant ($F(1,89)=1.235$, ns). Although the decrease of estimated probability was less in the Japanese outcome condition than in the other three conditions, the two-way interaction was not significant ($F(1, 89)=.747$, ns).

The same analysis was run on the probability judgment of consequent data. The main effect of nationality was significant ($F(1, 89)=4.332$, $p<.05$). The estimated probability was higher among the Japanese than among the French participants. The main effect of outcome was not significant ($F(1, 89)=3.514$, ns). The main effect of trial was significant ($F(1, 89)=7.873$, $p<.01$). The one-way interaction of trial and nationality was not significant ($F(1, 89)=.904$, ns). The interaction of trial and outcome was not significant ($F(1,89)=1.893$, ns). The interaction of nationality and outcome was not significant ($F(1,89)=.077$, ns). Again, the two-way interaction was not significant ($F(1, 89)=.042$, ns).

The mean numbers of possible factors pointed by participants are shown in Table 1. Opposite to our prediction, the French participants tended to give more factors than the Japanese participants. An ANOVA was conducted following the design of 2 (nationality) by 2 (outcome) on the number of possible factors in each task. The main effect of nationality was significant in the probability judgment of antecedent task ($F(1, 89)=11.457$, $p<.01$). The main effect of outcome was not significant ($F(1,89)=1.109$, ns). The interaction of nationality and outcome was not significant ($F(1,89)=.463$, ns).

The main effect of nationality was significant in the probability judgment of antecedent task ($F(1, 89)=11.457$, $p<.01$). The main effect of outcome was not significant ($F(1,89)=.740$, ns). The interaction of nationality and outcome was not significant ($F(1,89)=.049<$ ns).

Discussion

Generally speaking, the results were ambiguous regarding our predictions. The biggest surprise was that the estimated probabilities were higher in the outcome condition than in the control condition. This did not match our first prediction. Further, we had a rough prediction that the probabilities given by Japanese participants could be lower than those given by French participants, because Japanese are believed to consider situational factors easily against the conditional rules, and because French are thought to prefer to take rule-based reasoning. However, in the probability judgment of consequent, the probabilities judged by French were lower. These results require us to reexamine what does the preference for rule-based reasoning among Westerners means.

We do not believe that this was by chance, because this effect was observed both in France and Japan, and in both tasks. One possible explanation is to suppose that our participants took precautions against the information on outcome, and overcompensated. The greatest experimental differences between the studies of Choi and Nisbett (2000) and ours are the scenarios used in the experiment and nationalities. Choi and Nisbett (2000) provided a story on a seminary student who was very likely to help others with a no-help outcome, whereas we provided a plausible conditional with an outcome against the conditional. A possible reason for the differences of results is that we provided our participants a situation where they are enhanced to do logical reasoning, whereas Choi and Nisbett provided a more natural setting. Thus, although our participants received outcome information, they made an effort to neglect this in order to do logical reasoning. As a consequent of this, they overcompensated.

The second difference was nationality. The participants of Choi and Nisbett (2000) were American and Korean. It is possible that such hindsight bias is stronger among Korean than among Japanese. We need to pursue further research on this topic.

The data did not match our second prediction. Although, the differences were not so important, French pointed out more DCs and ACs than Japanese did. Even if Japanese are believed to consider situational factors more than French from the assumption of holistic thought, in the situation where participants are asked to point out factors, we infer either that the cultural difference is less than it is thought to be, or that French could point out more factors than Japanese. Again, we have not yet find reasons for these results. We

infer that the possible DCs or ACs in the image of people are affected by many factors. For example, domain specific knowledge may be needed to infer the causality in the plant-fertilizer case. It is plausible that French participants had more knowledge on these. We conclude that this dependent variable may not be appropriate to asses the analytic-holistic thinking style.

The effects of generating DCs or ACs were strong, as shown by the main effect of trial. This shows that, when being asked to generating possible DCs or ACs, people in both countries take these factors into consideration to make probabilistic judgment. Further, according to the descriptive statistics of data, the effect of pointing out DCs or ACs on the final probability judgment was reduced when the outcome is informed in the initial judgment in Japanese participants. This effect disappeared in the probability judgment of antecedent task as shown in Table 1. Except for the fact the probability in the outcome condition was higher, the result on this disappearance was consistent with the third prediction. We infer that DCs or ACs were available for Japanese, hence the generation has less effect in Japanese people than in French people. However, because two-way interaction was not significant, we do not accept the conclusion above.

Generally, we conclude that even if these cultural differences exist, it may not be so strong. One possible reason for the absence of the expected cultural differences is the use of indicative conditionals. According to Nisbett (Nisbett et al., 2001; Peng & Nisbett, 1999), rule-based reasoning supported by analytic thought is not adaptive in collectivist culture because it may break in-group harmony. Rather, people in collectivist culture should go "middle way", and dialectic or holistic thinking is needed to do this. However, this might be only the case with deontic reasoning concerning how people act. Because indicative reasoning concerns just the description of the world, it does not refer to how people act in the real world. Therefore, indicative reasoning itself does not concern human adaptation in a culture. We expect that we find stronger cultural differences when we use deontic reasoning.

The present research is the first step to use this paradigm in order to describe cultural differences between French and Japanese. At this point, it provides us more with problems to be solved than with results describing cultural differences.

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References

Byrne, R. M. J. (1989). Suppressing valid inferences with conditionals. *Cognition*, **31**, 61-83.

Cummins, D. D. (1995). Naïve theories and causal deduction. *Memory and Cognition*, **23**, 646-658.

Cummins, D. D., Lubart, T., Alksnis, O., & Rist, R. (1991). Conditional reasoning and causation. *Memory & Cognition*, **19**, 274-282.

Choi, I. and Nisbett, R. E. (2000). Cultural psychology of surprise: Holistic theories and recognition of contradiction. *Journal of Personality and Social Psychology*, **79**, 890-905.

Evans, J. St. B. T, & Over, D. E. (1996). *Rationality and reasoning*. Hove, UK: Psychology Press.

Manktelow, K. I. and Fairley, N. (2000). Superordinate principles in reasoning with causal and deontic conditionals. *Thinking and Reasoning*, **6**, 1-25.

Manktelow, K. I. and Over, D. E. (1991). Social roles and utilities in reasoning with deontic conditionals. *Cognition*, **39**, 85-105.

Nisbett, R. E. (2003). *The geography of thought: How Asians and Westerners think differently…and why*. New York: The Free Press.

Nisbett, R. E., Peng, K., Choi, I., & Norenzayan, A. (2001). Culture and system of thought: Holistic versus analytic cognition. *Psychological Review*, **108**, pp 291-310.

Peng, K., & Nisbett, R. E. (1999). Culture, dialectics, and reasoning about contradiction. *American Psychologist*, **54**, 741-754.

Stanovich, K. E. (2004). *The robot's rebellion: finding meaning in the age of Darwin*. Chicago: The University of Chicago Press.

Triandis, H. C. (1995). *Individual and collectivism*. Boulder, CO: Westview Press.

Appendix

Scenario A

Please imagine that students are going to take an exam at a university. The lecturer said, "if a student studies hard, then (s)he will pass the exam." Mary is a student at the university. She studied hard. But it turned out that Mary did not pass the exam later. Now if you had been asked the following question before you knew that Mary did not pass the exam, what might have been your answer?

What is the probability that Mary will pass the exam in this situation?

Scenario B

Please imagine that you are interested in gardening. People say, "if fertilizer is put on the plants, then they will grow quickly." John likes growing plants. Fertilizer was put on the plants. But it turned out that the plants did not grow quickly. Now if you had been asked the following question before you knew that the plants did not grow quickly, what might have been your answer?

What is the probability that the plants will grow quickly in this situation?

Note. These are the scenarios used in the outcome condition. The underlined sentences are deleted in the control condition.