

Are There Cross-Cultural Differences in Reasoning?

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Abstract

Psychologists have suggested that people from different cultures use different cognitive processes when they reason. Nisbett (2003), for example, proposes that East Asians tend to think holistically, dialectically, and on the basis of their experience, whereas Westerners tend to think analytically, logically, and abstractly. It follows that East Asians should tolerate contradictions to a greater degree than Westerners. We report an experiment in which East Asians were no more likely than Westerners to succumb to illusions of logical consistency, and an experiment in which they were no more likely than Westerners to reason solely from their experience.

Introduction

Culture is a plausible source of differences in the process of reasoning. Two separate strands of evidence appear to corroborate its effects. One strand shows that peoples from subcultures with no writing or schooling are reluctant to make inferences about hypothetical individuals (Luria, 1976). For instance, Cole and his colleagues gave a non-literate Kpelle rice farmer in Liberia this problem:

All Kpelle men are rice farmers.
Mr. Smith is not a rice farmer.
Is he a Kpelle man?

Westerners are likely to respond: no. But the farmer replied: "If I know him in person, I can answer that question, but since I do not know him in person, I cannot answer that question". This answer is typical of those individuals in cultures that have no writing (Cole, Gay, Glick, & Sharp, 1971). They tend to make inferences based on knowledge and experience rather than on logical acumen (Scribner, 1977). Preschool children and unschooled adults in Recife, Brazil, have the same bias. Yet, as Dias, Roazzi, and Harris (2005) have shown, when an inference is couched in the context of a distant planet, where no one could have any relevant knowledge, the bias disappears and non-literate participants reason in a competent way about contents outside their experience. The effect of schooling and of learning to read therefore seems to make people more amenable to reason hypothetically rather than to yield a new process of reasoning.

The second strand of evidence is due to Nisbett and his colleagues. They have proposed that socio-historical traditions lead to differences in cognition (see, e.g., Nisbett, 2003; Nisbett, Peng, Choi, & Norenzayan, 2001; Norenzayan, Smith, Kim, & Nisbett, 2002; Peng & Nisbett, 1999). Ancient

Chinese society, for instance, was agrarian and communal, and prized cooperation and social harmony. As a result, East Asians – Chinese, Koreans, and Japanese, who are the heirs of this tradition – are likely to attend to the entire visual field in perception, to attribute causes to the environment, and to reason on the basis of experience and in a dialectical way that tolerates contradictions. In contrast, ancient Greek society was organized in city-states, and prized individual agency, criticism, and logic. As a result, Westerners – who are the heirs of this tradition – are likely to attend to entities in a scene rather than to its background, to attribute causes to individual agents, and to reason in an analytical and logical way. Nisbett and his colleagues have reported a set of experiments supporting this account.

Our concern is with reasoning and with the two main studies describing differences in reasoning between East Asians and Westerners. In one study, Norenzayan et al. (2002) reported that Koreans were more influenced by their beliefs when they reasoned than were Westerners. The Koreans were more likely to accept a conclusion consistent with their beliefs, and to reject a conclusion inconsistent with their beliefs, regardless of whether the conclusion was deductively valid. Unsworth & Medin (2005), however, reanalyzed these data, and failed to detect any reliable difference between the two cultures. In the other study, Peng and Nisbett (1999) presented Chinese and American participants with vignettes depicting social conflicts. The participants then had to write down their thoughts about the conflicts. The investigators found that the Chinese participants made dialectical evaluations of the conflicts more often than the American participants did.

In short, experimental results suggest that cross-cultural differences in reasoning exist, but a key issue is whether these differences reflect entrenched cognitive processes or merely typical strategies. Entrenched cognitive processes should be difficult, if not impossible, for individuals to modify. Strategies, which are assembled from sequences of these processes, should be quite easy to modify (see van der Henst, Yang, & Johnson-Laird, 2002). Individuals might have a characteristic bias favoring one sort of strategy, but they might develop other strategies in appropriate circumstances. Investigators themselves sometimes claim that no difference exists in processes: "people in all cultures are likely to possess both [holistic and analytical] reasoning systems" (Norenzayan et al., 2002, p.654). But, they also sometimes claim that the differences are in more entrenched cognitive processes: "... if it was the social circumstances that

produced the cognitive differences between ancient Chinese and Greeks, then we might expect to find cognitive differences between modern East Asians and Westerners that map onto the differences between the ancient Chinese and Greeks” (Nisbett, 2003, p.77).

In our view, given the similarities in human genetic make-up and the universal nature of language (see, e.g., Chomsky, 1995; Hauser, Chomsky, & Fitch, 2002), the basic processes of reasoning are likely to be universal. Nisbett (2003, e.g., p. 8) appears to take for granted that reasoning depends on formal rules of inference. But, in common with other researchers (e.g., Cosmides, 1989; Oaksford & Chater, 2001), we are skeptical about this idea and suppose instead that reasoning depends on envisaging what is possible given the premises. According to this theory, human reasoners construct mental models of the possibilities compatible with the premises (see, e.g., Johnson-Laird & Byrne, 2002). Mental models are constrained by the principle of *truth*: they represent only what is possible, and represent a clause in the premises of an inference, whether it is affirmative or negative only if it holds in a possibility (Johnson-Laird & Savary, 1999). For example, an inclusive disjunction of the form: *A or B, or both*, has three mental models, which each represent a separate possibility:

A
 B
 A B

Individuals tend to interpret the absence of *B* from the first model as the negation of *B*. In contrast to mental models, *fully explicit* models represent the clauses in the premises whether they are true or false in all the possibilities:

A ¬ B
 ¬ A B
 A B

Reasoning is not a fixed deterministic process, and so individuals can develop different strategies when they reason about a series of problems (van der Henst et al., 2002). Knowledge can also modulate the construction of mental models (Johnson-Laird & Byrne, 2002), and it can block the representation of certain possibilities (Johnson-Laird, Girotto, & Legrenzi, 2004). According to this theory, the strategies that individuals develop to deal with a set of problems should be distinguished from the underlying cognitive processes of building and manipulating models.

In what follows, we report two experiments designed to investigate whether there was any difference in deductive reasoning between East Asians and Westerners. Experiment 1 called for the participants to evaluate whether or not sets of assertions were logically consistent. If East Asians reason dialectically and are more tolerant of contradictions, then they should be more likely than Westerners to judge that inconsistent sets of assertions are consistent, and less likely than Westerners to judge that consistent sets of assertions are

inconsistent. Experiment 2 investigated whether East Asians were more likely than Westerners to reason on the basis of their experience.

Experiment 1

If East Asians are tolerant of contradictions, then they should be poorer at detecting them. This experiment accordingly compared East Asians and Westerners in a task in which they had to judge whether or not sets of assertions were consistent. According to the model theory, individuals carry out this task by searching for a single mental model of a possibility in which all the assertions are true. If they find such a model, they judge that the assertions are consistent; otherwise, they judge that they are inconsistent (Johnson-Laird, Legrenzi, Girotto, & Legrenzi, 2000). Consider the following problem (adopted from Legrenzi, Girotto, & Johnson-Laird, 2003, Experiment 3):

Only one of the following assertions is true:

- The man is very patriotic or, the man is hot-blooded, or both.
- The man is hot-blooded, and the man joins the army.

The following assertion is definitely true:

The man is hot-blooded, and this man joins the army.

Write a description of the man. _____

The mental models of the initial disjunction of the two assertions represent four different possibilities:

very patriotic		
	hot-blooded	
very patriotic	hot-blooded	
	hot-blooded	joins army

The last of these models, which represents that the man is hot-blooded and joins the army, corresponds to the conjunction that is definitely true, and so individuals should judge that the assertions are consistent and formulate the following description of the man based on this model:

not very patriotic, hot-blooded, and joins the army

The initial clause comes from the tendency of individuals to interpret the absence of a predicate, such as *very patriotic*, which occurs in other models, as equivalent to its negation. In contrast to the mental models above, the fully explicit models of the initial disjunction, which do represent clauses that are false in a possibility (using negation) are as follows:

	very patriotic	not hot-blooded	not joins army
not	very patriotic	hot-blooded	not joins army
	very patriotic	hot-blooded	not joins army
	very patriotic	not hot-blooded	joins army

No model in this set corresponds to the conjunction that is definitely true, and so the overall description of the man is, in fact, inconsistent. Yet, because of the principle of truth, the description should yield an illusion of consistency, and so participants should be likely to write the description: *not very patriotic, hot-blooded, and joins the army*. Analogous problems should lead to illusions of inconsistency, in which participants respond that the assertions are inconsistent, when in fact they are consistent (see Table 1 below). If East Asians tend to accept logical contradictions, then they should be more likely than Westerners to succumb to illusions of consistency, and less likely than Westerners to succumb to illusions of inconsistency.

Method and procedure

We selected eight forms of problem from Legrenzi et al. (2003) shown in Table 1. There were two illusions of consistency, which we abbreviate as “C/I”, where “C” for “consistency” denotes the predicted response and “I” for “inconsistency” denotes the correct response. There were two control problems for them (C/C) for which the model theory predicts that individuals should make the correct responses. Likewise, there were two illusions of inconsistency (I/C) and their two controls (I/I). Each problem consisted of a disjunction of two assertions followed by a conjunction. The left hand column shows the disjunctions, and the corresponding conjunction for each problem. The table also shows the mental models and the fully explicit models for each of initial disjunctions. The comparison between the conjunction in a problem and the mental models of the disjunction yields the predicted response according to the model theory; and the comparison between the conjunction in a problem and the fully explicit models of the disjunction yield the correct response.

In place of *A*, *B*, and *C*, the actual problems had sensible clauses, such as those in our previous example: *the man is very patriotic, the man is hot-blooded, and the man will join the army*. The first author, who is bilingual in Chinese Cantonese and English, translated the materials from English into Chinese (traditional script). A second Chinese-English bilingual speaker translated the materials from Chinese back into English, and the two translators resolved all translation disagreements through discussion. The participants received each problem twice, but with different contents allocated at random.

Twenty volunteers at the Chinese University of Hong Kong (mean age 20.4 years) and twenty undergraduate students at Princeton University, USA (mean age 20.0 years), participated in the experiment for monetary compensation and course credit respectively. All Hong Kong participants were native speakers of Cantonese who understood English well. They received the instructions in both Chinese and English, and the key instructions were:

- In this experiment, we are interested in how culture can influence the way people reason logically. This is not a test of intelligence.

- You will be given 16 logical problems. In each problem, you will be given some assertions describing a target object. Please use the information in all the sentences to write a description of the individual. But, if you do not think that a consistent description is possible, please respond, “none”.

After the Chinese participants read the instructions, the first author answered their queries in Cantonese; and after the American participants read the instructions, he answered their queries in English. Each participant then received two blocks of the eight problems. (The Chinese students received one block in English and another in Chinese.) The order of the two blocks was counterbalanced. Each problem was presented on a separate sheet of paper, and the participants had four minutes to solve it.

Table 1. The form of the eight sorts of problem in Experiment 1 (from Legrenzi et al., 2003), and the mental models and the fully explicit models of the initial disjunction. The symbol “¬” denotes negation. C/I and C/C denote problems that should yield an illusion of consistency and their control problems respectively, and I/C and I/I denote problems that should yield an illusion of inconsistency and their control problems respectively.

The problems	Mental models of disjunction	Fully explicit models of disjunction
Only one is true: A or B or both. B and C.	a b b c	a b ¬c a ¬b c a ¬b ¬c ¬a b ¬c
Definitely true: 1. B and C. (C/I) 2. A and B. (C/C) 3. ¬B and C. (I/C) 4. ¬A and ¬B. (I/I)		
Only one is true: If A then B. B and C.	a b c b c ...	a b ¬c ¬a b ¬c ¬a ¬b c ¬a ¬b ¬c
Definitely true: 5. B and C. (C/I) 6. A and B. (C/C) 7. ¬A and ¬B. (I/C) 8. A and ¬B. (I/I)		

Results and discussion

Table 2 presents the percentages of both groups’ predicted errors, correct responses where they differed from the predicted responses, and matching errors, i.e., descriptions that included the predicates in the conjunction that was definitely true but that either made no mention of the third predicate or asserted that it might, or might not, be present.

Fourteen Princeton participants made a greater number of correct responses for the control problems than for the illusion problems (Binomial test, $p < .05$ with one tie). For problems presented in English, 10 Hong Kong participants

made a greater number of correct responses for the control problems than for the illusion problems (Binomial test, n.s. with three ties). But, for problems in Chinese, 15 Hong Kong participants made a greater number of correct responses for the control problems than for the illusion problems, and this difference was reliable (Binomial test, $p < .01$ with one tie). No reliable difference occurred between the Hong Kong and Princeton participants for the four sorts of problems (Mann-Whitney $U=23.5$, $z=.90$, $p=.37$). However, the Hong Kong participants had a marginal tendency to make more correct responses to the problems in English (42%) than to the problems in Chinese (34%; Wilcoxon signed test, $z=1.88$, $p=.06$, two-tailed). The theory predicts the occurrence of illusions of consistency and of illusions of inconsistency, but there were fewer illusions of inconsistency (I/C) than illusions of consistency (C/I; Wilcoxon test, $z=2.16$, $p < .05$).

Table 2. The percentages of predicted responses, correct responses (if they differ from the predicted responses), responses that were matching errors, for the four sorts of problem in Experiment 1. The balances of the percentages are miscellaneous errors each made on fewer than 15% of trials.

Forms of problem	Hong Kong		Princeton
	Chinese problems	English problems	
C/I:			
Predicted error response	30	28	29
Correct response	15	23	11
Matching error	55	40	60
C/C:			
Predicted correct response	60	58	41
Matching error	28	28	53
I/C:			
Predicted error response	15	15	23
Correct response	60	63	45
Matching error	15	15	21
I/I:			
Predicted correct response	55	58	69
Matching error	28	36	23

The principal result was that both the East Asians and Westerners succumbed to illusions of consistency, and performed better with control problems. This result is contrary to the view that East Asians are more tolerant of contradictions.

Experiment 2

The aim of the second experiment was to examine whether East Asians tend to reason on the basis of their knowledge, beliefs, and experience, whereas Westerner tend to reason logically. That is, East Asians should make inductions based

on knowledge and Westerners should make deductions where a task allows both sorts of inference. Although this hypothesis is not easy to test, we were able to examine it using problems (from Johnson-Laird et al., 2004) of the following sort:

If a pilot falls from the plane without a parachute then he dies.
This pilot did not die, however.
Why not?

The problem is ambiguous, because it allows two sorts of inference. One sort is an induction based on knowledge, e.g.:

The plane was on the ground and so the pilot didn't fall far.

The other sort of inference is a deduction that does not go beyond the information in the premises:

The pilot didn't fall from the plane without a parachute.

If East Asians are more likely than Westerners to invoke knowledge and experience in their reasoning, then they should make more inductions than Westerners.

Method and procedure

Thirty volunteers at the Chinese University of Hong Kong (mean age of 20.4 years) and twenty-one undergraduates at Princeton University, USA (mean age of 19.9 years) participated in this experiment for monetary compensation and course credit respectively. The participants were told that their task was to answer three questions and to respond as quickly as possible because we were interested in their spontaneous responses. In fact, there was no time limit. The participants were then given three ambiguous problems based on different contents. The Hong Kong participants received two problems in English and one problem in Chinese; the Princeton participants received three problems in English. Twenty of the Hong Kong participants received the problems after they had completed an unrelated deductive reasoning task (Experiment 1), and ten of them did not. Ten of the Princeton participants received the problems after they completed Experiment 1, and eleven of them did not.

Results and discussion

Both groups of participants tended to respond deductively: the means were 1.57 deductive responses out of three from the Hong Kong participants and 1.86 from the Princeton participants, and the difference was not reliable (Mann-Whitney $U=288.0$, $z=.80$, $p=.42$). The remaining responses were inductive. The Hong Kong participants did not differ reliably in the number of deductive responses between the problems in Chinese and the problems in English. However, as Table 3 shows, both groups were

more likely to make a deductive response after they had carried out the previous deductive experiment than otherwise (Fisher-Yates exact test, $p < .01$ and $p = .056$ respectively). Among Hong Kong participants, this effect occurred for problems in both languages. This result showed that both East Asians and Westerners tended to use the same strategy – deductive reasoning – when they had recently had occasion to use it.

Table 3: The number of participants in Experiment 2 who drew more deductive than inductive inferences after they had carried out an unrelated deductive task (Experiment 1), and not after they had done so.

Hong Kong participants		
	More deductive responses	More inductive responses
After Experiment 1	9	1
Not after Experiment 1	7	13
Princeton participants		
	More deductive responses	More inductive responses
After Experiment 1	9	2
Not after Experiment 1	4	6

General Discussion

Neither of our experiments found any significant differences between the reasoning of East Asians and Westerners. In Experiment 1, East Asians were no more likely than their Westerners to succumb to illusions of consistency, i.e., the illusion that a set of inconsistent premises are in fact consistent, nor were they less likely to succumb to illusions of inconsistency, i.e., the illusion that a set of consistent premises are in fact inconsistent. The failure to find a difference does not seem to be a result of lack of statistical power, because both groups did perform reliably better with control problems than with the illusions of consistency. The experiment also corroborates an unpublished study by Yingrui Yang et al. (2003), who found that Chinese and American participants performed comparably on a set of deductive problems that depended on quantifiers. In Experiment 2, East Asians were no more likely than Westerners to respond to ambiguous problems with inductions based on knowledge as opposed to pure deductions. Once again, we doubt whether this failure to find a difference is a result of lack of statistical power, because both groups were more likely to make a deduction if they had previously carried out an unrelated deductive task.

A recent phenomenon also suggests that deductive competence is a cultural universal. Su Doku puzzles depend solely on deduction. They were invented in the USA, but first became popular in Japan, and then spread to England in 2004, and latterly to Western Europe, Australia, and the USA. Recent studies from our laboratory have revealed that

naïve reasoners in Hong Kong and America were able to develop successful strategies to solve these puzzles (Lee, Goodwin, & Johnson-Laird, 2006).

What effects, if any, does culture have on reasoning? One effect is likely to concern the contents of inferences: different cultures have different beliefs, and so the premises of their inferences, whether explicit or implicit, are likely to differ too. But, no robust evidence exists for cultural differences in the underlying cognitive processes of reasoning. Those differences that have been reported (e.g., Peng & Nisbett, 1999; Dias et al., 2005) appear to be in the characteristic strategies that individuals use to reason. Our results, and the transfer effects of deduction on Experiment 2, are compatible with this account. Individuals assemble such strategies “bottom up” from an exploration of sequences of operations carried out by basic cognitive processes. As a result, strategies often differ from one individual to another (see van der Henst et al., 2002), and cultural conventions could also lead to the development of preferred strategies for reasoning. Nisbett (2003) describes Eastern reasoning as holistic and dialectical, and Western reasoning as analytical and logical. Our results, however, imply that these descriptions characterize historical traditions and perhaps the spontaneous strategies that individuals adopt when they first tackle a set of reasoning problems in psychological experiments. These strategies, however, are not deep-seated, or built into the underlying processes of reasoning. Hence, our participants revealed no such biases, and the popularity of Su Doku puzzles reveals no such biases, either. Nisbett may agree with this hypothesis: he has commented that the differences are matters of habit. He has also described a Canadian psychologist as thinking in East Asian ways after an extended time in Asia (Nisbett, 2003, p.68).

We leave the last word to John Locke (1690/1959), the arch Empiricist whom one might expect to argue that individuals in different cultures learn to reason in different ways. In fact, he wrote (p. 389):

He that will look into many parts of Asia and America will find men reason there perhaps as acutely as himself, who yet never heard of a syllogism, nor can reduce any one argument to those forms.

But the mind is not taught to reason by these rules; it has a native faculty to perceive the coherence or incoherence of its ideas and can range them right without any such perplexing repetitions.

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