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Culture and Probability Judgment Accuracy: The Influence of Holistic Reasoning

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Abstract

A well-established phenomenon in the judgment and decision-making tradition is the overconfidence one places in the amount of knowledge that one possesses. Overconfidence or probability judgment accuracy varies not only individually but also across cultures. However, research efforts to explain cross-cultural variations in the overconfidence phenomenon have seldom been made. In Study 1, the authors compared the probability judgment accuracy of U.S. Americans ($N = 108$) and Mexican participants ($N = 100$). In Study 2, they experimentally primed culture by randomly assigning English/Spanish bilingual Mexican Americans ($N = 195$) to response language. Results of both studies replicated the cross-cultural variation of probability judgment accuracy previously observed in other cultural groups. U.S. Americans displayed less overconfidence when compared to Mexicans. These results were then replicated in bilingual participants, when culture was experimentally manipulated with language priming. Holistic reasoning did not account for the cross-cultural variation of overconfidence. Suggestions for future studies are discussed.

Keywords

culture; priming; probability judgment accuracy; holistic reasoning; latinos

Increased societal ethnic diversity means that decisions that could have a powerful impact in areas such as the economy, health, war, and the environment are increasingly being reached by heterogeneous groups (Hofstede, 1997). Understanding how decisions are reached and the role culture plays in shaping this process can prove invaluable to our understanding of the sources of potential conflicts and thus help prevent miscommunication and misunderstandings.

An important phenomenon that may contribute to flawed decision making is overconfidence (see Johnson, 2004). Overconfidence refers to the observation that typically little doubt is placed on judgments or on the knowledge used to form them. The overconfidence phenomenon is pervasive in both lay people and experts in diverse domains such as medicine, law, engineering, and business (Griffin & Tversky, 2002; Yates, 1990). Overconfidence is often studied by asking individuals to provide probability judgment

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estimates for events with binary outcomes. This research paradigm entails asking participants to answer general knowledge questions (e.g., “Which animal runs faster?”) with a dichotomous answer (e.g., “(a) gazelle, (b) leopard”). After participants answer a question, they provide a probability judgment estimate that their selected response is correct. This paradigm allows the construction of calibration curves by superposing subjective and objective probabilities. Overconfidence is observed when an individual's subjective probability judgment of an outcome exceeds the objective probability of that outcome (Fischhoff, Slovic, & Lichtenstein, 1977; Yates, 1990).

Research indicates that overconfidence varies not only individually but across cultures as well. The cross-cultural variability of probability judgment accuracy has been established since the late 1970s. Wright et al. (1978) first documented cross-cultural variation in calibration curves. Following those initial findings, Yates et al. (Yates, Lee, & Bush, 1997; Yates, Lee, & Shinotsuka, 1996; Yates, Lee, Shinotsuka, Palatano, & Sieck, 1998; Yates, Lee, Sieck, Choi, & Price, 2002; Yates, Zhu, Ronis, Wang, Shinotsuka, & Toda, 1989) replicated this variation in other cultural groups and using tasks other than general knowledge questions. Specifically, they made comparisons across Chinese, White American, and Japanese participants using general knowledge, future events questions, and disease diagnosis. Across these studies, Chinese participants consistently displayed more overconfidence than participants from Britain and Japan. Although Japan is located in the East, the authors regarded it as a culture that has been subject to a great deal of Western influence. Subsequent studies indicated that participants from East Asia, Brazil, and Palestine displayed greater overconfidence when compared to participants from the United States (Lundeberg, Fox, Brown, & Elbedour, 2000; Whitcomb, Onkal, Curley, & Benson, 1995; Yates et al., 1989; Yates et al., 2002).

Critics proposed that item difficulty and response bias could account for cross-cultural differences in knowledge calibration. For example, early studies used questions that were harder to answer in other cultures. However, cross-cultural differences continued to emerge in studies designed to address these shortcomings by controlling item difficulty and offering incentives to motivate participants to provide their best answers (Yates et al., 1997; Yates et al., 2002).

As the cross-cultural variation of overconfidence was repeatedly observed, researchers proceeded to advance explanations that could underlie these differences, including attention capture, argument recruitment, and set for probabilistic thinking (Yates et al., 2002). Unfortunately, to our knowledge, none of these hypotheses have been formally tested. We would like to initiate this line of inquiry by investigating whether attention capture or holistic reasoning is related to the cross-cultural variation of overconfidence.

The Cross-Cultural Variability of Holistic Reasoning

Nisbett advanced the thesis that individuals from Eastern civilizations reason more holistically than individuals from Western civilizations, who display a preference for linear thinking (Nisbett, Peng, Choi, & Norenzayan, 2001; Peng & Nisbett, 1999). This cultural variation in thinking style is hypothesized to be the result of differences in world views and systems of thought, which are in turn the product of diverse socialization practices. Chinese philosophies, primarily influenced by holistic principles such as the principle of Yin-Yang, foster a complex view of the world. According to these theories, the world is composed of nonlinear or interactional relationships. Greek thought, on the other hand, has fostered analytical thinking. The advancement of modern science, in the field of mathematics for example, and post-Greek philosophy can be traced to the rise of Greek civilization. Nisbett (2003) postulated that Greek civilization was able to advance science as a result of the

linear, and therefore less complicated, view of the world fostered by its members. This linear, simple view of the world encouraged the formulation of testable predictions. For example, if one holds a precise, simple prediction of the way something works, curiosity is triggered by the testability of this prediction. This mechanism permits the scientific cycle to run its course: Predictions followed by tests and corrections (Nisbett, 2003). Complicated notions of how something works, on the other hand, encourage the formulation of nontestable predictions. Nontestability, in turn, hinders curiosity, making corrections impossible.

The Link Between Holistic Reasoning, Cognitive Style, and Decision-Making Biases

Theory indicates that human cognition is guided by two primary forms of reasoning: analytical and heuristic-based (Sloman, 1996). Empirical evidence in a variety of domains suggests that these two forms of reasoning work in parallel and, at times, one will override the other (see Gilovich & Griffin, 2002). Research has documented a link between East-West differences in holism and favored cognitive style, such that a heuristic-based cognitive style is more readily accessible in members of Asian cultures. Holistic thinkers favor experience-based reasoning by emphasizing experience from the senses, the embeddedness of form and content, and intuition over rules and logic when these two are in conflict. Conversely, the accessibility of analytical thought is more pronounced in members of Western cultures, who emphasize logic derived from inferential thought, rule-based reasoning, and the presence of necessary features when organizing concepts (Nisbett & Miyamoto, 2005; Norenzayan, Smith, Kim, & Nisbett, 2002). Evidence indicates that in tasks that assess categorization, conceptual structure, and deductive reasoning, participants of Chinese and Korean descent rely on instances that are readily accessible (exemplars) rather than apply formal rules in artificially created categorization tasks and during conceptual organization rely on intuition rather than on abstract logic (Norenzayan et al., 2002). Similarly, in tasks that assess perceptual processes, individuals of Asian descent emphasize similarities and relationships between objects and are less able to separate the object from the field, whereas individuals socialized in Western cultures emphasize rules and formal reasoning (Ji, Peng, & Nisbett, 2000).

Holistic reasoning has been previously associated with extensively documented judgment and decision-making phenomena such as the hindsight bias. This phenomenon refers to the predisposition of individuals to believe that they could have predicted the actual outcome of events even in the face of contradictory outcomes (e.g., the “I-knew-it-all-along” phenomenon). Choi and Nisbett (2000) asked Korean and U.S. American participants to predict the behavior of individuals placed under different behavioral and contextual constraints. For example, participants were asked to predict the helping behavior of a religious individual placed under a time constraint. Participants from both groups predicted beforehand that the religious individual would offer help to an individual in need regardless of situational constraints such as being late for an important meeting. However, in hindsight, participants from Korea exhibited less surprise when they learned that the individual did not behave as expected (e.g., did not engage in helping behavior) when compared to U.S. American participants. This same pattern of results was observed across variations of the task. Choi and Nisbett (2000) link the prominence of the hindsight bias in Korean participants to their predisposition to reason in a holistic fashion. They argue that holistic thinkers perceive the world as composed of complex and interactional relationships and experience less surprise because they adjust their predictions in the face of contradiction.

Even though holistic reasoning has been previously linked to cross-cultural differences in judgment and decision-making biases, it has not been studied as a factor that could account

for the cross-cultural variation of overconfidence. In addition, cross-cultural research and theory has focused on participants of Asian descent. Given these previous limitations, the purpose of our research was to address whether previous findings suggesting cross-cultural differences in both holism and overconfidence generalize to Mexicans and whether holism explains variability in overconfidence.

We expected to find cross-cultural differences in holism between Mexicans and U.S. Americans because even though Mexican culture was heavily influenced by Greek thought during the colonization period, Aztec and Mayan civilization practices in medicine, religion, and astronomy deviated from the practices encountered in ancient European civilizations. It can be said that they resembled Chinese practices in terms of a reliance on the collective and a belief in polytheism (Garcia, Sierra, & Balam, 1999; Uranga, 1952). The philosopher Vasconcelos (1935) famously discussed the integration of pre- and post-Columbian influences on the everyday practices of the Mexican people.

Cross-Cultural Research Beyond Multigroup Comparisons

Hong, Morris, Chiu, and Benet-Martinez (2000) proposed the application of an experimental approach to the field of cross-cultural psychology. Their review of evidence suggests that exposing bicultural individuals to cultural cues (e.g., culture-related symbols) brings forth a cultural perspective, activating pertinent beliefs, attitudes, and values. The strength of this approach when compared to the multigroup comparison methodology is the possibility to test causal links with experimental methodology. When conceptualized as group membership, culture is seen as a stable, “trait”-like characteristic. It is assumed that there are long-standing national differences in culture-bound variables (e.g., independence-interdependence). On the other hand, the finding that culture can be primed allows for the test of culture as a “state” variable, making the direct observation of effect possible. Research suggests that language may prime culture, activating relevant views and norms (see Chiu & Chen, 2004; Lechuga & Wiebe, 2009; for a review, see Oyserman & Lee, 2007). Ross, Xun, and Wilson (2002) randomly assigned Chinese-born bilingual participants to answer questionnaires in either Chinese or English and found that participants answering in Chinese used more open-ended collective statements to define the self and reported lower self-esteem and greater agreement with views characteristic of Chinese culture. In another investigation, Wong and Hong (2005) primed culture by exposing individuals to cultural icons and found that participants for whom Chinese culture was primed behaved more cooperatively when playing the traditional “prisoner dilemma” game than participants for whom U.S. American culture was primed.

Research also suggests that priming culture affects more than norms, values, and behavior, exerting an effect on “deeper” aspects of cognition such as strategy selection for information processing or cognitive style (Oyserman & Lee, 2008). In a study by Kuhnen and Oyserman (2002), participants were culture-primed with a pronoun-circling task emphasizing the interdependence (e.g., we, our, us) versus the independence (e.g., I, me, mine) of the self, and the subsequent effect on context-dependent versus context-independent cognitive processing style was assessed. Results indicated that participants primed with an interdependent self-view processed a series of small letters embedded within a larger letter, and thus more difficult to recognize, faster. Conversely, participants primed with an independent self-view recognized the larger letter faster. Moreover, these findings generalized to a memory task, indicating that individuals remember larger amounts of information when primed with an interdependent self-view, compared to an independent one. Researchers concluded that cross-cultural research using the priming methodology complements the descriptive findings of multigroup comparisons by providing direct evidence that culture exerts a causal effect.

We conducted two studies to investigate the influence of culture on overconfidence. In Study 1, we operationalized culture as group membership and in Study 2 as a temporally induced variable. In Study 1, we compared the knowledge calibration curves of Mexican and U.S. American participants. We predicted that Mexican participants should display more overconfidence. In addition, our second objective was to investigate whether differences in holistic reasoning between Mexicans and U.S. Americans account for cultural differences in overconfidence. To test this hypothesis, (a) we investigated whether Mexicans and U.S. Americans differed in holism scores and (b) whether holism mediated cross-cultural differences in overconfidence. In a similar vein, in Study 2 our objective was to compare the knowledge calibration curves of bilingual English/Spanish participants of Mexican descent by randomly assigning them to answer instruments in English versus Spanish. We predicted that participants assigned to the Spanish condition should display more overconfidence than participants assigned to the English condition. In addition, our objective was to investigate whether differences in holistic reasoning between the English and Spanish groups accounts for group differences in overconfidence. To test this hypothesis, we investigated, first, whether the English versus the Spanish group differed in holism scores and, second, whether holism mediated language group differences in overconfidence.

Study 1

Method

Participants—Participants were 100 monolingual Spanish-speaking students (the Mexican group) attending undergraduate psychology courses at a public university in northern Mexico and 108 monolingual English-speaking students (the U.S. American group) who were taking an Introductory Psychology course at a public university in the Western United States. The mean age of participants who constituted the Mexican group was 22.5 ($SD = 4.4$) years, and 23% were male. They were not compensated in any form. The mean age of participants who constituted the U.S. American group was 21.4 ($SD = 4.3$) years, and 50% were male. They received partial course credit for their participation.

Procedure—After providing documentation of informed consent, the U.S. American group received all materials in English, and the Mexican group received all materials in Spanish.

Study Materials—Test materials are described below in the sequence in which they were administered to participants.

Biodata questionnaire: Participants were asked to self-report basic demographic characteristics such as age, gender, ethnicity, and language proficiency.

General knowledge questions: Participants answered 100 general knowledge questions of medium difficulty. Participants were instructed to select a correct answer, from two alternatives, to each of the general knowledge questions and to provide a probability estimate (50% to 100%) that the chosen answer was correct.

Holistic thinking: Participants completed a short holistic tendency questionnaire developed by Choi, Dalal, Kim-Prieto, and Park (2003). This measure consists of 10 items that assess preference for holistic reasoning style. The Cronbach alphas for this scale were .61 for the Mexican sample and .59 for the U.S. American sample.

Scoring Procedures

Proportion correct: To investigate overall accuracy, the proportion of correct responses by each of the participants was calculated (Yates, 1990). The event “the answer that I chose is correct” was labeled Event A. A mean outcome index (d) was computed where $d = 1$ if Event A occurs and $d = 0$ if Event A does not occur.

Calibration: To investigate aspects of accuracy, calibration in the small CIS and bias were computed. CIS was calculated by subtracting the mean outcome index for a given probability category or d_j from the artificially created category describing the judgments that belongs to it (e.g., 50%) or f_j . This quantity was then multiplied by the total number of probability judgments that fell under that category or N . There were five artificially created categories (.50, .60, .70 ... 1.0); j th refers to the multiple judgments offered within categories. Bias was computed by subtracting the mean outcome index (d) from the mean probability judgments offered (f). The following formulas display these computations, respectively (Yates, 1990):

$$\text{CIS} = (1/N) \sum N_j (f_j - d_j)^2$$

$$\text{Bias} = f - d.$$

Smaller CIS and bias indices indicate better calibration.

Discrimination: To investigate an aspect of judgment quality that complements calibration, the extent to which participants discriminate between true and false occurrences of Event A was computed. Discrimination refers to the ability to distinguish judgments that are highly likely to be true from judgments that are not. Thus, probability statements for correct answers should differ on some quality from probability judgments for incorrect answers. The “Murphy resolution” (MR) statistic was employed by subtracting the mean outcome index (d) from the mean outcome index of the artificially aggregated categories (d_j). The following formula displays this computation (Murphy, 1973):

$$\text{MR} = (1/N) \sum N_j (d_j - d)^2$$

The larger the MR, the better the discrimination.

Results

A MANOVA with bias, CIS, and MR as dependent variables and gender as the between-subjects factor was computed. Multivariate tests revealed nonsignificant differences as a function of gender Wilks's $\lambda = 1.04$, $p = ns$. Calibration curves were constructed (Figure 1). To test for the effect of culture, separate ANOVAs on bias, CIS, and MR were conducted with culture (Mexican versus U.S. American) as the between-subjects factor. Results yielded significant results for culture on bias, $F(1, 206) = 35.20$, $p < .001$, partial $\eta^2 = .15$. The bias index of the Mexican group ($M = .13$, $SD = .11$) was larger than that of the U.S. American group ($M = .04$, $SD = .09$; $d = .90$). Results yielded significant results for the CIS index, $F(1, 206) = 7.16$, $p < .01$, partial $\eta^2 = .03$. The CIS index of the Mexican sample ($M = .009$, $SD = .002$) was larger than that of the U.S. American sample ($M = .008$, $SD = .002$; $d = .50$). The MR statistic did not differ as a function of cultural group, $F(1, 206) = 2.22$, $p = ns$.

To investigate whether holism accounted for the cross-cultural variation of the calibration and discrimination indices, we conducted an independent samples t test on holism scores

with culture (Mexican versus U.S. American) as the between-subjects factor. Results did not support our hypothesis; holism scores did not vary as a function of cultural group, $t(203) = .56, p = ns$.

A regression analysis was conducted to investigate whether holism mediated the cross-cultural differences on calibration. A cultural group variable was created by coding the U.S. American group “0” and Mexican group “1.” Following the Baron and Kenny (1986) approach, the bias and CIS indices were regressed separately on cultural group and holism. Next, holism was regressed on cultural group. Cultural group predicted bias ($\beta = .38, p < .001$) and CIS ($\beta = .18, p < .01$). Holism did not predict bias ($\beta = .04, p = ns$) but marginally predicted CIS ($\beta = .13, p = .06$). The conditions for mediation were not established; therefore, our hypothesis that holism would predict cross-cultural variation of overconfidence was not supported.

Discussion

The purpose of Study 1 was to investigate the generalizability of cross-cultural variation in probability judgment accuracy in Mexicans, an understudied population in cross-cultural research. Results indicated that Mexican participants exhibit greater overconfidence than U.S. American participants. This result parallels previous findings documenting significant over-confidence in Chinese, Brazilian, and Palestinian individuals. Moreover, the effect size was large for the bias index and medium for the CIS index. However, the influence of holism was not supported. Thus, we conducted a second study to investigate whether these initial results replicate using experimental methods when culture is operationalized as a “state” variable rather than as group membership.

Study 2

The purpose of Study 2 was to test the causal influence of culture by priming culture through language and assessing the subsequent effect on calibration and discrimination indices. A second objective was to test the influence of holistic reasoning on overconfidence and discrimination.

Method

Participants—Participants were 195 fluent English/Spanish bilingual students of Mexican descent who participated to fulfill a research requirement in an Introductory Psychology course at a public university in the southwestern United States. Bilingual participants were recruited by advertising a study for “100% fluent” English/Spanish bilinguals who were able to speak, read, and write in both languages. The mean age of participants was 19.5 ($SD = 1.7$) years. Forty percent of the participants were male.

Study Materials

Self-reported language proficiency: Participants answered a language history questionnaire where they self-reported writing, reading, and speaking proficiencies in addition to language acquisition age. Response options were recorded on a 10-point Likert-type scale ranging from 1 = *not at all* to 10 = *very well*. Such self-ratings of language proficiency have demonstrated validity in bilingual Hispanic college students (Delgado, Guerrero, Goggin, & Ellis, 1999).

General knowledge questions: Participants answered 100 general knowledge questions of medium difficulty. Participants were instructed to select a correct answer, from two alternatives, to each of the general knowledge questions and to provide a probability estimate (50% to 100%) that the chosen answer was correct.

Holistic thinking: Participants completed the same 10-item questionnaire as in Study 1. The Cronbach alpha for this scale was .51 for the English group and .68 for the Spanish group.

Procedure—An English/Spanish bilingual experimenter administered the language proficiency questionnaire and conducted all experimental sessions. Participants who self-reported high proficiency, in a language history questionnaire, in both languages were asked to participate in the study. To prime culture with language, bilingual participants were randomly assigned to answer all measures in either English or Spanish. All questionnaires were translated from English to Spanish and back-translated from Spanish to English by two independent translators (Brislin, 1980). Forty-seven percent of the participants were randomly assigned to the English language condition and 53% to the Spanish language condition.

Results

There were no significant differences in language proficiency between English and Spanish in the two groups, $t(197) = .83$, $p = ns$. Previous research has also demonstrated language proficiency equivalence in this bilingual population (Lechuga, 2008; Lechuga, Maldonado Santos, Garza-Caballero, & Villarreal, in press).

Calibration curves were constructed (Figure 2). To test for the effects of language, separate ANOVAs on bias, CIS, and MR with language condition as the between-subjects factor were computed. A significant effect of language on bias emerged, $F(1, 194) = 8.12$, $p < .01$, partial $\eta^2 = .04$. The mean bias index was larger for the Spanish condition ($M = .14$, $SD = .085$) than for the English condition ($M = .10$, $SD = .084$) ($d = .47$). Moreover, a significant effect on CIS emerged, $F(1, 194) = 5.11$, $p < .05$, partial $\eta^2 = .03$. The mean CIS index for the Spanish condition was larger ($M = .0088$, $SD = .002$) when compared to the English condition ($M = .0080$, $SD = .002$) (effect size $d = .40$). Lastly, a significant effect of language on the MR index emerged, $F(1, 194) = 11.84$, $p < .001$, partial $\eta^2 = .06$. The mean MR index for the Spanish condition was larger ($M = .018$, $SD = .006$) when compared to the English condition ($M = .015$, $SD = .005$) (effect size $d = .54$).

To investigate whether holism accounted for the variation of calibration and discrimination as a function of language group, we conducted an independent samples t test on holism scores with language group (English versus Spanish) as the between-subjects factor. Results did not support our hypothesis. Holism scores did not vary as a function of language group, $t(196) = .26$, $p = ns$. A regression analysis was conducted to investigate whether holism mediated the language group differences on calibration and discrimination. A language group variable was created by coding the English group “0” and Spanish group “1.” The bias, CIS, and MR indices were regressed separately on language group and holism. Next, holism was regressed on language group. Language group predicted bias ($\beta = .15$, $p < .05$), CIS ($\beta = .19$, $p < .01$), and MR ($\beta = .25$, $p < .001$). Holism did not predict bias ($\beta = .08$, $p = ns$), CIS ($\beta = .11$, $p = ns$), or MR ($\beta = .07$, $p = ns$). The conditions for mediation were not established; therefore, our hypothesis that holism would account for cross-cultural variation of overconfidence was not supported.

Discussion

In an experimental replication of Study 1, when bilingual participants were randomly assigned to a language condition, the overconfidence indices shifted in the expected direction. The results of Study 2 paralleled those of Study 1. Participants in the Spanish condition displayed greater overconfidence when compared to participants in the English condition. These findings strengthen the hypothesis that culture plays a role in overconfidence. Findings also converged in that language group did not exert an effect on

holism, and holism did not emerge as a significant predictor of the language group differences on overconfidence and discrimination.

General Discussion

The cross-cultural variation of probability judgment accuracy has been established by comparing primarily the calibration curves of participants of Asian descent against those of U.S. American participants (Yates et al., 2002). Our study is innovative in that it includes two previously understudied cultural groups in cross-cultural overconfidence research: Mexicans and Mexican Americans. Furthermore, culture was operationalized not only as a stable characteristic via group membership but also as a “state” dependent on contextual cues via language priming. Our results present a coherent picture.

Although discrimination did not vary across cultural groups, it did vary across language conditions. Better discrimination was achieved in bilingual participants assigned to the Spanish condition when compared to those assigned to the English condition. However, these results should be taken with caution given that researchers have recognized that Murphy's resolution is a biased estimate (Yaniv, Yates, & Smith, 1991). We would like to conduct further studies with another measure of discrimination before speculating on the meaning of these results.

Stone and Opel (2000) refer to knowledge calibration as the ability to translate knowledge into adequate probability judgments. Which variables could explain cross-cultural difference in this ability? We posited that holistic thinking may be one such variable, given its previous association with a preference for a heuristic-based cognitive style. However, our findings did not support this prediction. Given the results of our studies, we consider it necessary to consider other variables that have been previously linked to overconfidence. In a study, Stone and Opel (2000) asked participants to sort artworks into two time periods and to rate their confidence in the correctness of their answers. Participants who received environmental feedback in the form of a pretraining session designed to help them distinguish art works belonging to two time periods exhibited worsened calibration. Given these findings, what individual difference variable may have been manipulated by the pretraining session: information processing style? Future studies may look at the influence of manipulating information processing style on the cross-cultural variation of overconfidence.

Our studies were a first attempt at investigating factors that might account for the cross-cultural variation of overconfidence. This is a line of research worth pursuing since overconfidence has implications for the quality of all sorts of decisions. If the probabilities upon which the predictions of important outcomes rest are inflated, one can expect decision quality to suffer.

A limitation of our study is that we tested the effect of holistic reasoning descriptively and with an imprecise measure. Holistic reasoning is defined as a broad construct composed of several facets (Choi, Koo, & Choi, 2007). Individuals who favor holistic thought are individuals who will (a) perceive cause-effect relationships in separate elements that compose the world, (b) focus their attention equally on figure and ground, (c) prefer to resolve contradiction by seeking a middle ground, and (d) prefer a cyclical perception of change. At the time of our data collection, a more precise measure of holistic reasoning was being developed that assesses these aspects of holistic thought (Choi, Koo, & Choi, 2007).

A limitation of our study is that we did not account for random noise in choice and probability judgments as proposed by Wallsten & Gu (2003). In their study, they concluded that the previous cross-cultural differences found in calibration studies are the result of

increased variability in choices and subjective estimation responses on behalf of Asian participants. Given that we did not have an externally defined target event that would allow us to compute Bayesian posterior objective probabilities, we circumvented this limitation by testing whether controlling for random noise in probability judgments affected the findings. We proceeded to control random noise by entering the Scat(f) index as a covariate in a MANOVA. The “Scat(f)” statistic was computed by computing the variances of (f1) and (f0): (f1) represents the mean probability judgments made when event A occurs, and (f0) represents the mean probability judgments made when event A does not occur. We summed (f1) and (f0), and divided this quantity by the aggregate of the number of probability judgments when event (A) does occur (N1) and does not occur (N0). The following formula display this computation. $Scat(f) = [N1Var(f1) + N0Var(f0)]/[N1 + N0]$. A MANOVA with the aggregated culture and language conditions as the between-subjects variable and bias and CIS as the dependent variables was computed. Results yielded significant multivariate effects of Scat(f) (Wilks' $\lambda = 19.22$, $p < .001$) and language group (Wilks' $\lambda = 15.78$, $p < .001$). Results of between-subjects effects yielded significant effects of Scat(f) on bias ($F [1, 400] = 37.85$, $p < .001$, partial $\eta^2 = .09$) and on CIS ($F [1, 400] = 13.92$, $p < .001$, partial $\eta^2 = .03$). Moreover, a significant between-subjects effect of condition on bias ($F [1, 400] = 31.65$, $p < .001$, partial $\eta^2 = .07$) and on CIS ($F [1, 400] = 7.50$, $p < .01$, partial $\eta^2 = .02$) emerged, indicating that random noise exerted an effect but that the effect of culture could not be explained entirely by random variability in probability judgments.

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References

- Baron RM, Kenny DA. The mediator-moderator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*. 1986; 51:1173–1182. [PubMed: 3806354]
- Brislin, RW. Translation and content analysis of oral and written material. In: Triandis, HC.; Berry, JW., editors. *Handbook of cross-cultural psychology*. Vol. Vol. 1. Allyn & Bacon; Boston: 1980. p. 389-444.
- Chiu, C.-y.; Chen, J. Symbols and interactions: Application of the CCC model to culture, language, and social identity. In: Ng, SH.; Candlin, CN.; Chiu, C- y., editors. *Language matters: Communication, culture, and identity*. City University Press; Hong-Kong: 2004. p. 155-182.
- Choi I, Dalal R, Kim-Prieto C, Park H. Culture and judgment of causal relevance. *Journal of Personality and Social Psychology*. 2003; 84:46–59. [PubMed: 12518970]
- Choi I, Koo M, Choi JA. Individual differences in analytic versus holistic thinking. *Personality and Social Psychology Bulletin*. 2007; 33:691–705. [PubMed: 17440200]
- Choi I, Nisbett R. Cultural psychology of surprise: Holistic theories and recognition of contradiction. *Journal of Personality and Social Psychology*. 2000; 79:890–905. [PubMed: 11138759]
- Delgado P, Guerrero G, Goggin JP, Ellis BB. Self-assessment of linguistic skills by bilingual Hispanics. *Hispanic Journal of Behavioral Sciences*. 1999; 21:31–46.
- Fischhoff B, Slovic P, Lichtenstein S. Knowing with certainty: The appropriateness of extreme confidence. *Journal of Experimental Psychology: Human Perception and Performance*. 1977; 3:552–564.

- Garcia, H.; Sierra, A.; Balam, G. *Wind in the blood: Mayan healing and Chinese medicine*. North Atlantic Books; Berkeley, CA: 1999.
- Gilovich, T.; Griffin, D. Heuristics and biases: Then and now. In: Gilovich, T.; Griffin, D.; Kahneman, D., editors. *Heuristics and biases: The psychology of intuitive judgment*. Cambridge University Press; New York: 2002. p. 1-18.
- Griffin, D.; Tversky, A. The weighing of evidence and the determinants of confidence. In: Gilovich, T.; Griffin, D.; Kahneman, D., editors. *Heuristics and biases: The psychology of intuitive judgment*. Cambridge University Press; New York: 2002. p. 1-18.
- Hofstede, G. *Cultures and organizations. Software of the mind*. McGraw-Hill; New York: 1997.
- Hong Y, Morris MW, Chiu C, Benet-Martinez V. Multicultural minds: A dynamic constructivist approach to culture and cognition. *American Psychologist*. 2000; 55:709–720. [PubMed: 10916861]
- Ji L, Peng K, Nisbett RE. Culture, control, and perception of relationships in the environment. *Journal of Personality and Social Psychology*. 2000; 78:943–955. [PubMed: 10821200]
- Johnson, DDP. *Overconfidence and war: The havoc and glory of positive illusions*. Harvard University Press; Cambridge, MA: 2004.
- Kuhnen U, Oyserman D. Thinking about the self influences thinking in general: Cognitive consequences of salient self-concept. *Journal of Experimental Social Psychology*. 2002; 38:492–499.
- Lechuga J. Is acculturation a dynamic construct? The influence of priming culture on acculturation. *Hispanic Journal of Behavioral Sciences*. 2008; 30:324–339.
- Lechuga J, Santos Maldonado B, Garza-Caballero A, Villarreal R. Holistic Reasoning on the Other Side of the World: Validation of the Analism/Holism Scale in Mexicans. *Cultural Diversity and Ethnic Minority Psychology*. in press.
- Lechuga J, Wiebe JS. Can language prime culture in Hispanics? The differential impact of self-construals in predicting intention to use a condom. *International Journal of Psychology*. 2009; 44:468–476. [PubMed: 22029664]
- Lundeberg MA, Fox PW, Brown AC, Elbedour S. Cultural influences on confidence: Country and gender. *Journal of Educational Psychology*. 2000; 92:152–159.
- Murphy AH. A new vector partition of the probability score. *Journal of Applied Meteorology*. 1973; 12:595–600.
- Nisbett, R. *The geography of thought: How Asians and Westerners think differently and why*. The Free Press; New York: 2003.
- Nisbett RE, Miyamoto Y. The influence of culture: Holistic versus analytic perception. *Trends in Cognitive Sciences*. 2005; 9:467–473. [PubMed: 16129648]
- Nisbett RE, Peng K, Choi I, Norenzayan A. Culture and systems of thought: Holistic versus analytic cognition. *Psychological Review*. 2001; 108:291–310. [PubMed: 11381831]
- Norenzayan A, Smith EE, Kim BJ, Nisbett RE. Cultural preferences for formal versus intuitive reasoning. *Cognitive Science*. 2002; 26:653–684.
- Oyserman, D.; Lee, S. Priming “culture”: Culture as situated cognition. In: Kitayama, S.; Cohen, D., editors. *Handbook of cultural psychology*. The Guilford Press; New York: 2007. p. 255-322.
- Oyserman D, Lee S. Does culture influence what and how we think? Effects of priming individualism and collectivism. *Psychological Bulletin*. 2008; 134:311–342. [PubMed: 18298274]
- Peng K, Nisbett RE. Culture, dialectics, and reasoning about contradiction. *American Psychologist*. 1999; 54:741–754.
- Ross M, Xun WQE, Wilson AE. Language and the bicultural self. *Personality and Social Psychology Bulletin*. 2002; 28:1040–050.
- Sloman S. The empirical case for two systems of reasoning. *Psychological Bulletin*. 1996; 119:30–32.
- Stone ER, Opel RB. Training to improve calibration and discrimination: The effects of performance and environmental feedback. *Organizational Behavior and Human Decision Processes*. 2000; 83:282–309. [PubMed: 11056072]
- Uranga, E. *Análisis del ser del mexicano* [Analysis of Mexican self]. Porrúa y Obregon; Mexico: 1952.
- Vasconcelos, J. *Ulises criollo* [Ulises Creole]. Ediciones Botas; Mexico: 1935.

- Wallsten TS, Gu H. Distinguishing choice and subjective probability estimation processes: Implications for theories of judgment and for cross-cultural comparisons. *Organizational Behavior and Human Decision Processes*. 2003; 90:111–123.
- Whitcomb KM, Onkal D, Curley SP, Benson PG. Probability judgment accuracy for general knowledge. *Journal of Behavioral Decision Making*. 1995; 8:51–67.
- Wong, R. Y- m.; Hong, Y.- y. Dynamic influences of culture on cooperation in the prisoner's dilemma. *Psychological Science*. 2005; 16:429–434. [PubMed: 15943667]
- Wright GN, Phillips LD, Whalley PC, Choo GT, Ng K-O, Tan I, et al. Cultural differences in probabilistic thinking. *Journal of Cross-Cultural Psychology*. 1978; 9:285–299.
- Yaniv I, Yates JF, Smith JK. Measures of discrimination skill in probabilistic judgment. *Psychological Bulletin*. 1991; 110:611–617.
- Yates, F. *Judgment and decision making*. Prentice Hall; NJ: 1990. 1990
- Yates F, Lee J-W, Bush JG. General knowledge overconfidence: Cross-national variations, response style, and “reality.”. *Organizational Behavior and Human Decision Processes*. 1997; 70:87–94.
- Yates F, Lee J-W, Shinotsuka H. Beliefs about overconfidence, including its cross-national variation. *Organizational Behavior and Human Decision Processes*. 1996; 65:138–147.
- Yates JF, Lee J-W, Shinotsuka H, Palatano AL, Sieck WR. Cross-cultural variations in probability judgment accuracy: Beyond knowledge overconfidence. *Organizational Behavior and Human Decision Processes*. 1998; 74:89–117. [PubMed: 9705815]
- Yates, F.; Lee, J-W.; Sieck, WR.; Choi, I.; Price, PC. Probability judgments across cultures. In: Gilovich, T.; Griffin, D.; Kahneman, D., editors. *Heuristics and biases: The psychology of intuitive judgment*. Cambridge University Press; New York: 2002. p. 271-291.
- Yates JF, Zhu Y, Ronis DL, Wang D-F, Shinotsuka H, Toda M. Probability judgment accuracy: China, Japan, and the United States. *Organizational Behavior and Human Decision Processes*. 1989; 43:145–171.

Figure 1.
Calibration Curves across Cultural Groups

Figure 2.
Calibration Curves across Language Conditions