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Cultural Differences in the Representativeness Heuristic:

Expecting a Correspondence in Magnitude between Cause and Effect

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Abstract

Based on previous research on cultural differences in analytic and holistic reasoning, we hypothesized that when explaining events, North Americans would be more likely than East Asians to expect causes to correspond in magnitude with those events (i.e., big events stem from big causes and small events stem from small causes). In a series of studies, Canadian and Chinese participants judged the likelihood that high or low magnitude events were caused by high or low magnitude causes. Overall, Canadians expected events and their causes to correspond in magnitude to a greater degree than did Chinese. We also showed that Canadians primed to reason holistically expected less cause-effect magnitude correspondence than did those primed to reason analytically.

Key words: culture, attribution, heuristics, representativeness, holism,

Cultural Differences in the Representativeness Heuristic:

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In the 1960s, mathematician and meteorologist Edward Lorenz created a computer simulation of hydrodynamic flow (Lorenz, 1963). Allegedly, while using the program to model weather patterns, Lorenz entered the value .506 rather than the actual value .506127. He was surprised to find that the outcomes stemming from the two ostensibly similar initial values varied substantially. Upon publishing the findings, one meteorologist remarked that if the theory were correct, one flap of a [seagull](http://en.wikipedia.org/wiki/Gull)'s wings could change global weather patterns forever. Over time, through some form of cultural metamorphosis, the ungainly seagull transformed into a delicate butterfly and the term ‘butterfly effect’ was born. Regardless of whether or not this amusing anecdote is true, Lorenz found that seemingly negligible variations in initial conditions led to dramatic divergences in outcome patterns.

## The butterfly effect has surprised many of us because it violates our expectations of cause-effect magnitude correspondence. Why do we expect big causes to lead to big effects and small causes to lead to small effects? Is it simply because we seldom observe violations of this association and thus have developed a heuristic that serves us well most of the time? The present research indicates that the explanation is far more interesting and complex.

*The Representativeness Heuristic*

*Categorization*. Kahneman and Tversky (1973) demonstrated that when categorizing targets into groups, people relied mostly on the degree of similarity between the target and a prototypical member of each group. For example, when judging a fictional student’s academic discipline based on his personality, people relied on the personalities of typical students from each discipline. Furthermore, the authors demonstrated that this strong tendency to rely on the degree of similarity caused errors in judgment because people ignored the percentages of students enrolled in each discipline, the base rates. Kahneman and Tversky (1972) referred to this type of judgment as the representativeness heuristic.

*Causal Judgments.* Most of the research conducted on the representativeness heuristic has focused on judgments people make in categorization contexts (Gilovich & Savitsky, 2002). However, the representativeness heuristic is not limited to categorization. People also use this heuristic when making causal judgments, such as when searching for causes that are similar to an effect. Relatively little research has been conducted on the representativeness heuristic in the domain of causal judgments. Nonetheless, across a variety of domains including medicine, pseudoscientific systems, and psychoanalysis, people employ the representativeness heuristic when making causal judgments by relying on similarities between causes and effects (Gilovich & Savitsky).

Einhorn and Hogarth (1986) divided such similarities into two categories, physical resemblance and congruity of strength. Beliefs that causes physically resemble effects are prevalent in traditional medicine, for example, when cures that resemble diseases are sought (Gilovich & Savitsky, 2002). The second category, the tendency to search for causes that resemble effects in congruity of strength is especially interesting because strength has been identified as one of the fundamental meaningful dimensions people use when judging entities (Osgood, 1957, referred to as potency and included adjective pairs such as large-small and strong-weak). Nisbett and Ross (1980) also proposed that people may seek causes that correspond in magnitude with events they are trying to explain. However, few studies have empirically tested people’s expectations of a correspondence in magnitude between causes and effects.

*Empirical Research on Expectations of Cause-Effect Magnitude Correspondence*

 In one of the first studies that indirectly provided supporting evidence that people expect cause-effect magnitude correspondence, Shultz and Ravinsky (1977) demonstrated that French-Canadian schoolchildren typically chose causes that were similar to effects. For example, in one scenario, they attributed a loud noise to a heavy rather than a delicate lever. However, the other scenarios used would fall under Einhorn and Hogarth’s physical resemblance category, such as attributing physical retaliation to physical rather than verbal aggression.

McCauley and Jacques (1979) also provided indirect supporting evidence of an expectation of cause-effect magnitude correspondence. In their study, American participants read one of two headlines, “A man shoots at the president and misses” or “A man shoots at the president and kills him.” Participants then estimated the probabilities that the man was acting alone and as a member of a group. The authors found that participants attributed the more consequential effect, the successful assassination, to the group and the less consequential effect, the unsuccessful assassination, to the individual. However, this study does not provide strong evidence supporting an expectation of cause-effect magnitude correspondence because participants could be attributing the more consequential effect to a conjunction of causes, a group, more than a single cause, a lone gunman.

McClure, Lalljee, and Jaspars (1991) examined if people explained extreme and moderate effects by using a conjunction of causes or a single cause. For example, British participants read an extreme crime involving multiple murders and mutilation of bodies, and a moderate crime involving hitting people with a bottle at a football match. Most participants explained the extreme crime by generating single-cause explanations that tended to correspond in magnitude with the effects.

A recent set of studies by Ebel-Lam, Fabrigar, MacDonald, and Jones (2008) provided more direct support for an expectation of cause-effect magnitude correspondence. Canadian participants read a scenario describing either a high or moderate magnitude effect. For example, participants read that either a plane crashed killing everybody onboard (high magnitude) or that with difficulty the pilot successfully landed the plane (moderate magnitude). Participants estimated the likelihood that a number of high and moderate magnitude causes had led to the effect. Participants attributed high magnitude effects to high magnitude causes and low magnitude effects to low magnitude causes.

Either directly or indirectly, the aforementioned studies provided consistent evidence that people (at least, Americans, British, and Canadians) typically expect a correspondence in magnitude between an effect and its cause. Why is this so and is it true across cultures? Research from the cultural psychology literature may provide some clues.

*Cultural Differences in Analytic and Holistic Reasoning*

Contrary to a Washington newspaper article mocking Walter Reed’s suggestion that yellow fever with all of its devastating effects was caused by a tiny mosquito (Nisbett & Ross, 1980), Asian folk wisdom states, “One tiny insect may be enough to destroy a nation.” Research indicates that compared with North Americans (including Americans and Canadians), East Asians (including Chinese, Japanese, and Koreans) differ in their reasoning about cause-and-effect relationships (Choi, Dalal, Kim-Prieto, & Park, 2003; Nisbett, Peng, Choi, & Norenzayan, 2001). That is, East Asians tend to reason holistically, whereas North Americans tend to reason analytically (Nisbett et al., 2001).

Across a variety of domains, East Asians attend to situational factors or contexts more than North Americans do, and North Americans attend to focal people or objects more than East Asians do (Miller, 1984; Morris & Peng, 1994). For example, one set of studies found that when describing an underwater scene, the first element Americans typically mentioned was a focal element, such as a large fish in the center of the picture. In contrast, the first element Japanese typically mentioned was a contextual element, such as seaweed (Masuda & Nisbett, 2001). In addition, Japanese focused on the entire scene as a unit and their ability to recall a focal object from the scene was impaired when the background was altered. Alternatively, Americans focused on the focal objects independent of the background and changing the background had little or no effect on their ability to recall a focal object.

 Focusing relatively different amounts of attention on focal objects and contexts has implications for other aspects of cognition, such as the ability to detect covariation among stimuli. People who focus on focal objects more than contexts should be less likely to detect covariation between elements in a scene compared with people who attend to both focal objects and contexts. Ji, Peng, and Nisbett (2000) asked participants to estimate the degree of covariation between images on a computer screen and this is exactly what they found. That is, compared with American estimates, Chinese estimates were better calibrated with actual levels of covariation.

If Easterners attend more to contextual elements and notice a greater degree of covariation between elements than do North Americans, then they should explain effects differently. This pattern has been found when people make attributions. When people observe a person’s behavior in a social situation, a number of elements are present other than the person. That is, other people are often involved and there is a surrounding context or situation in which the person is acting. If an observer focuses relatively more attention on the situation, then she should be more likely to attribute causality to that situation. Alternatively, if an observer focuses relatively more attention on the focal person, then she should attribute causality to that person. Consistent with this reasoning, past research has shown that Asians tend to make more situational attributions whereas Americans tend to make more dispositional attributions (e.g., Miller, 1984 with Indian participants; Morris & Peng, 1994 with Chinese participants).

Choi et al. (2003) further explicated the cultural differences in reasoning by providing evidence that Easterners may have more complex causal theories and therefore consider more causal factors in their attributions than do Westerners, who may have relatively simple causal theories. For example, in Choi et al., American and Korean participants read that a graduate student killed his or her advisor, along with 97 pieces of information related to the student or advisor. When asked to select items that were pertinent to establishing a motive for the murder, Koreans considered a greater number of items as relevant than did Americans. Additionally, Choi et al. developed and included a 10-item measure of holistic tendency. The measure included statements such as, “Any phenomenon has numerous numbers of causes, although some of the causes are not known.” They found that Koreans were more holistic than were Americans, and within each culture, the higher a participant’s holistic tendency, the greater the number of items considered relevant to establishing a motive.

*Present Research*

To summarize the cross-cultural literature, East Asians reason holistically whereas North Americans reason analytically. It is important to note that holism does not appear to be a simple uniform construct determined by a single cognitive mechanism. For example, researchers have focused on at least four factors under the umbrella term holism: causality (Choi et al., 2003), attitude toward contradiction (e.g., Peng & Nisbett, 1999), perception of change (Ji, Nisbett, & Su, 2001), and locus of attention (e.g., Masuda & Nisbett, 2001; see also Nisbett et al., 2001). The present research focused on the causality factor. With respect to causality, East Asians reason holistically by focusing on many causes, whereas North Americans reason analytically by focusing on relatively fewer causes (Choi, et al., 2003).

If an observer tends to focus on one or a few causes only when explaining an effect, then the observer should expect a greater correspondence in magnitude between cause and effect. For example, imagine judging how likely each of two buildings sold for a higher price. The two buildings look very similar except that one is larger than the other. If all else were equal, one would expect the larger building to sell for more because size is one factor that determines the value of a building. However, there are a number of other factors that also determine the value of a building, such as location. If an observer tends to focus on only one cause, such as the size of the building in this case, when trying to understand a high magnitude effect, the high selling price, then that person should expect a high magnitude cause, the large building, to be far more likely than a low magnitude cause, the small building.

Alternatively, if an observer tends to focus on many factors when explaining an effect, then the observer should expect a lesser correspondence in magnitude between cause and effect. Considering the previous example, if an observer tends to focus on numerous factors, including size, location of the building, and other factors, when trying to understand a high magnitude effect, such as a high selling price, then a high magnitude cause, the large building, is not as necessary. Although this multiple-cause observer may also reason that the large building would likely sell for more than the small building, this effect would tend to be less extreme when compared with the single-cause observer. The lesser correspondence between the magnitudes of cause and effect makes sense because one of the other factors, such as location, could be working against the larger building and in favor of the smaller building when it comes to selling price.

Therefore, based on previous research on cultural differences in analytic and holistic reasoning, specifically regarding differences in perceptions of causal complexity, we hypothesized that expectations of a correspondence in magnitude between effects and their causes would be stronger among North Americans than among East Asians. Specifically, we hypothesized that when explaining an effect, North Americans would tend to look for causes that correspond in magnitude with the effect. In contrast, East Asians would be less likely than North Americans to expect such a correspondence in magnitude between effects and their causes. Lastly, we predicted that the cultural differences in the tendency to look for causes that correspond in magnitude with effects would be explained by differences in analytic and holistic reasoning. We conducted a series of studies to test these hypotheses.

Study 1

The purpose of Study 1 was to test the hypothesis that Canadians would expect a greater correspondence in magnitude between effects and their causes than would Chinese. Participants read hypothetical scenarios with consequences of high or low magnitude and indicated how likely the effect was due to causes that were high or low in magnitude. We used two different versions of scenarios with two different samples, one in Study 1a and the other in Study 1b.

Study 1a

Method

# *Participants*

Fifty-nine European-Canadians (45 women) were recruited from Queen’s University, and 60 Chinese (30 women) were recruited from Beijing University. In all of the studies in this paper, Canadian participants were Caucasians of European ancestry and Chinese were Chinese nationals, mostly of Han descent. Canadian participants received course credit or $5 for their participation, and Chinese participants received a small gift.

*Materials and Procedure*

Participants read a questionnaire describing a disease outbreak that either killed some people (high magnitude effect) or hospitalized them (low magnitude effect). The effect was followed by two potential causes, a highly infectious strain of bacteria (high magnitude cause) or a standard strain of bacteria (low magnitude cause) (see Appendix). Participants rated the likelihood that each of the two causes had led to the effect on a 9-point scale (1 = *not likely at all*, 9 = *extremely likely*). In summary, Study 1a had a 2 (culture: Canadians vs. Chinese) by 2 (effect magnitude: high vs. low) by 2 (cause magnitude: high vs. low) design. The cause magnitude factor varied within-participants, and the other factors varied between-participants.

*Cause and Effect Magnitude.* To operationalize the magnitude of effects, we selected single events, such as a disease outbreak, and varied the severity of the consequences associated with that event, e.g., few or many deaths. We then selected causes that people would intuitively associate with that event, such as a virus. To operationalize the magnitude of these causes, we chose causes such that if all else were equal, a more extreme version, such as a treatment-resistant strain of the virus, would be associated with the more extreme effect to a greater extent than would a less extreme version, such as a standard strain of the virus. This same procedure for generating study materials was followed in all the studies reported in this paper.

The study materials were generated by two Canadian and two Chinese researchers to ensure they were familiar and realistic to both cultures. Pilot testing indicated that Canadians and Chinese perceived the magnitudes and independent likelihoods of effects and causes to be equivalent. This same procedure for generating and pilot testing study materials was followed in all the studies reported in this paper.

*Translation.* All materials were first developed in English and then translated into Chinese. The Chinese and English versions were then compared by two Chinese researchers who have lived in North America for at least four years. Additionally, a back-translation procedure was used to check consistency of meaning, and finally the translations were checked by at least three Chinese researchers in China to ensure they were free of error and that they sounded natural. The same procedure for translating study materials was followed in all the studies reported in this paper.

Results

*Test of Cause-Effect Magnitude Correspondence*

Preliminary analyses indicated no significant gender effects, *F*s > 1, as was true for all studies reported in this paper. Thus gender will not be discussed further.

A 2 (culture) X 2 (effect magnitude) X 2 (cause magnitude) mixed-model analysis of variance (ANOVA) revealed a significant main effect of effect magnitude, *F*(1, 115) = 13.55, *p* < .001, such that participants in the high magnitude effect condition gave higher likelihood ratings for the causes (*M* = 5.89, *SD* = .91), in comparison with those in the low magnitude effect condition (*M* = 5.27, *SD* = .92). This pattern indicated a stronger reaction to the high magnitude effect compared with the low magnitude effect. The effect magnitude by cause magnitude interaction was significant, *F*(1, 115) = 160.18, *p* < .001, ηp2 = .58. Overall, participants tended to associate the high magnitude effect with the high magnitude cause (*M* = 7.73, *SD* = 1.40) more than with the low magnitude cause (*M* = 4.05, *SD* = 1.77), and the low magnitude effect with the low magnitude cause (*M* = 6.82, *SD* = 1.67) more than with the high magnitude cause (*M* = 3.72, *SD* = 2.21). More importantly, the culture by effect magnitude by cause magnitude interaction was significant, *F*(1, 115) = 13.80, *p* < .001, ηp2 = .11. As hypothesized, Canadians tended to exhibit a stronger cause-effect magnitude correspondence than Chinese (see Figure 1).

Follow-up independent-sample *t* tests on the interaction indicated that, to account for the high magnitude event, Canadians rated the high magnitude cause as more likely than did Chinese and rated the low magnitude cause as less likely than did Chinese. For the low magnitude event, Canadians rated the high magnitude cause as less likely than did Chinese and rated the low magnitude cause as more likely than did Chinese, *t*s > 2.10, *p*s < .04.

Study 1b

Method

# *Participants*

Eighty-four European-Canadians (57 women) were recruited from Queen’s University, and 60 Chinese (33 women) were recruited from Beijing University. Canadian participants received course credit or $5 for their participation, and Chinese participants received a small gift.

*Materials and Procedure*

Study 1b followed a similar design and procedure to Study 1a, but had a different scenario. The scenariodescribed either a long negotiation delay (high magnitude effect) or a brief negotiation delay (low magnitude effect). The causes were a major disagreement (high magnitude cause) or a minor one (low magnitude cause) (see Appendix). In summary, Study 1b followed a 2 (culture: Canadians vs. Chinese) by 2 (effect magnitude: high vs. low) by 2 (cause magnitude: high vs. low) design, with the cause magnitude varying within-participants, and the other factors varying between-participants.

Results

*Test of Cause-Effect Magnitude Correspondence*

The results were similar to those obtained in Study 1a. A 2 (culture) X 2 (effect magnitude) X 2 (cause magnitude) mixed-model analysis of variance (ANOVA) revealed a significant main effect of effect magnitude, *F*(1, 140) = 4.12, *p* = .04, such that the likelihood ratings for causes were higher in the high magnitude effect condition (*M* = 5.53, *SD* = .81) than in the low magnitude effect condition (*M* = 5.25, *SD* = .82). The effect magnitude by cause magnitude interaction was significant, *F*(1, 140) = 133.36, *p* < .001, ηp2 = .49. Overall, participants tended to associate high magnitude effects with high magnitude causes (*M* = 7.10, *SD* = 1.63) more than low magnitude causes (*M* = 3.96, *SD* = 1.87), and low magnitude effects with low magnitude causes (*M* = 6.75, *SD* = 1.81) more than high magnitude causes (*M* = 3.74, *SD* = 1.77). More importantly, the culture by effect magnitude by cause magnitude interaction was significant, *F*(1, 140) = 20.68, *p* < .001, ηp2 = .13. As hypothesized, Canadians tended to exhibit a stronger cause-effect magnitude correspondence than Chinese (see Figure 2).

Follow-up independent-sample *t* tests on the interaction indicated that, to account for the high magnitude event, Canadians rated the high magnitude cause as more likely than did Chinese and rated the low magnitude cause as less likely than did Chinese. For the low magnitude event, Canadians rated the high magnitude cause as less likely than did Chinese and rated the low magnitude cause as more likely than did Chinese, *t*s > 2.28, *p*s < .03

Thus, for both the disease (Study 1a) and the negotiation (Study 1b) scenarios, Canadians associated high magnitude effects with high magnitude causes more than low magnitude causes and low magnitude effects with low magnitude causes more than high magnitude causes. And in both scenarios, Chinese exhibited this pattern to a significantly lesser degree.

## Study 2

The purpose of Study 2 was to replicate the results from Study 1 using a different format. Study 1 manipulated the magnitudes of causes and effects in detailed scenarios. In Study 2, we used simple scenarios that were described using pictures of common effects. Again, participants read hypothetical scenarios with consequences of high or low magnitude and indicated how likely the effect was due to causes that were high or low in magnitude.

Method

# *Participants*

Seventy-eight European-Canadians (46 women) were recruited from Queen’s University, and 60 Chinese (27 women) were recruited from Beijing University. Canadian participants received course credit or $5 for their participation, and Chinese participants received a small gift.

*Materials and Procedure*

Participants were randomly assigned to a high or low effect magnitude condition. In each condition, they were presented first with a picture of two basketball players, one tall (high magnitude cause) and one short (low magnitude cause), and indicated the likelihood that each of the two players had scored the most points (high magnitude effect) or the least points (low magnitude effect) in a game. Next, participants were presented with a picture of two tornadoes that had traveled through a city, one wide (high magnitude cause) and one narrow (low magnitude cause), and indicated the likelihood that each tornado had caused extensive damage (high magnitude effect) or no damage (low magnitude effect). The likelihood judgments were made on a 9-point scale (1 = *not likely at all*, 9 = *extremely likely*). In summary, Study 2 had a 2 (culture: Canadians vs. Chinese) by 2 (effect magnitude: high vs. low) by 2 (cause magnitude: high vs. low) design. The cause magnitude factor varied within-participants, and the other factors varied between-participants.

Results

*Likelihood Estimate Computation*

Each participant completed both scenarios (basketball game and tornadoes). For each scenario, participants gave two likelihood estimates, one for a high-magnitude cause and one for a low magnitude cause. The pattern of the results was the same for each of the two scenarios. Therefore, we combined the scenarios by averaging the two likelihood estimates for the high magnitude causes and by averaging the two likelihood estimates for the low magnitude causes. These two averages were then treated as repeated-measures variables.

*Test of Cause-Effect Magnitude Correspondence*

A 2 (culture) X 2 (effect magnitude) X 2 (cause magnitude) mixed-model analysis of variance (ANOVA) revealed a significant main effect of effect magnitude, *F*(1, 134) = 23.72, *p* < .001, such that participants in the high magnitude effect condition gave higher likelihood ratings for the causes (*M* = 5.72, *SD* = .67), in comparison with those in the low magnitude effect condition (*M* = 5.22, *SD* = .45). The effect magnitude by cause magnitude interaction was significant, *F*(1, 134) = 50.20, *p* < .001, ηp2 = .27. Overall, participants tended to associate high magnitude effects with high magnitude causes (*M* = 6.80, *SD* = 1.28) more than with low magnitude causes (*M* = 4.63, *SD* = 1.30), and low magnitude effects with low magnitude causes (*M* = 5.91, *SD* = 1.71) more than high magnitude causes (*M* = 4.54, *SD* = 1.73). Replicating the results from Study 1, the culture by effect magnitude by cause magnitude interaction was significant, *F*(1, 134) = 7.48, *p* = .007, ηp2 = .05. As hypothesized, Canadians exhibited a stronger cause-effect magnitude correspondence than Chinese (see Figure 3).

Follow-up independent-sample *t* tests on the interaction indicated that, to account for the high magnitude event, Canadians rated the high magnitude cause as more likely than did Chinese and rated the low magnitude cause as less likely than did Chinese. For the low magnitude event, Canadians rated the high magnitude cause as less likely than did Chinese and rated the low magnitude cause as more likely than did Chinese, ts > 1.96, ps < .05

Thus, in two detailed scenarios represented by words in Study 1 and two simple scenarios represented by pictures in Study 2, Canadians associated high magnitude effects with high magnitude causes more than low magnitude causes and low magnitude effects with low magnitude causes more than high magnitude causes. Furthermore, for all four scenarios, Chinese exhibited this pattern to a significantly lesser degree.

Study 3

Studies 1 and 2 found that compared with Chinese, Canadians expect effects and their causes to correspond in magnitude to a greater degree. We argue that the pattern of results is caused by cultural differences in holistic reasoning. However, a simple alternative explanation exists: The results from Studies 1 and 2 could be explained by a stronger preference to choose midpoints on scales by Chinese than by Canadians. In both studies, participants rated their likelihood judgments on a Likert-type scale. Chen, Lee, and Stevenson (1995) found evidence that East Asians typically prefer points closer to the midpoints of such scales, even though the degree of midpoint-response bias in their study was weak, especially comparing Chinese and Canadians. Furthermore, other studies have found no such tendency (e.g., Ji, Schwarz, & Nisbett, 2000).

Nonetheless, we designed Study 3 to rule out the possibility that Chinese were engaging in such a moderacy-response bias. Instead of rating the likelihoods of causes on a scale, participants chose the cause they perceived to have most likely led to the effect. If the same pattern of results as in Studies 1 and 2 emerged regarding participants’ choices, then these results would provide strong evidence against the alternative explanation.

Method

# *Participants*

Sixty-three European-Canadians (48 women) and 63 Chinese nationals living in Canada (44 women) were recruited from Queen’s University. Participants received course credit or $5 for their participation. At the time of the study, the Chinese nationals had lived in Canada for an average of 28.83 months (*SD* = 13.54).

*Materials and Procedure*

Participants were randomly assigned to either the high or the low effect magnitude condition. Within each condition, participants read three scenarios. One scenario was taken from from Study 1 (disease outbreak described in words) and two scenarios were taken from Study 2 (basketball game and tornadoes depicted in pictures). In the high magnitude effect condition, all three scenarios described high magnitude effects and likewise in the low magnitude effect condition, all three scenarios described low magnitude effects. For each scenario, participants chose the more likely cause of the effect, between the high and the low magnitude causes. Additionally, participants indicated their confidence in each choice on an 8-point scale (1 = *not at all confident*, 8 = *extremely confident*). In summary, Study 3 had a 2 (culture: Canadians vs. Chinese) by 2 (effect magnitude: high vs. low) by 2 (cause magnitude: high vs. low) design. The cause magnitude factor varied within-participants, and the other factors varied between-participants.

Results

*Test of Cause-Effect Magnitude Correspondence.*

Each participant chose three causes, one for each scenario. Each choice was analyzed separately by conducting a 2 (culture) by 2 (effect magnitude) by 2 (cause magnitude) log-linear analysis. For all three scenarios, the analyses revealed significant interactions between effect magnitude and cause magnitude, all G2s > 25.72, all *df* = 1, all *p*s < .001, indicating that for each scenario, participants were more likely to associate high magnitude effects with high magnitude causes than with low magnitude causes, and low magnitude effects with low magnitude causes than with high magnitude causes. More importantly, for all three scenarios, the analyses revealed significant culture by effect magnitude by cause magnitude interactions, all G2s > 13.58, all *df* = 1, all *p*s < .001. For all three scenarios, Canadians were more likely to exhibit the magnitude matching pattern than were Chinese (see Table 1 for frequency counts). Thus, we successfully replicated the results from Studies 1 and 2 using a method that did not rely on a Likert-type scale, suggesting that a midpoint preference by Chinese was unlikely to account for the results obtained in Studies 1 and 2.

*Confidence Ratings.*

A 2 (culture) by 2 (effect magnitude) by 3 (scenario) mixed-model ANOVA indicated no significant interactions, all *p*s > .79. The effect magnitude main effect was significant, *F*(1, 122) = 5.94, *p* = .02, ηp2 = .05, indicating that participants were more confident in their choices in the low magnitude condition (*M* = 6.25, *SD* = .99) than in the high magnitude condition (*M* = 5.80, *SD* = 1.15). In addition, the culture main effect was significant, *F*(1, 122) = 11.20, *p* < .001, ηp2 = .08, such that Chinese were more confident of their choices overall (*M* = 6.33, *SD* = .82) than were Canadians (*M* = 5.71, *SD* = 1.24). Therefore, on this scale, Chinese were not more likely than Canadians to prefer responses near the midpoint of the scale, providing further evidence that a midpoint preference by Chinese was unlikely to account for the results obtained in Studies 1 and 2.

In summary, Study 3 replicated the results of Studies 1 and 2 using a different method and ruled out the potential alternative explanation that Chinese were engaging in a moderacy-response bias. In fact, Chinese responded significantly further from the midpoint than did Canadians on confidence ratings of their likelihood judgments.

Study 4

The purpose of Study 4 was to directly test the hypothesis that analytic and holistic reasoning was responsible for the cultural differences in the tendency to expect a correspondence in magnitude between cause and effect. We developed an exercise to prime either analytic or holistic reasoning in Canadian participants. Participants completed the exercise, then read a scenario describing a high or low magnitude effect, and rated the likelihood that high or low magnitude causes had led to that effect. We used two different versions of scenarios with two separate samples, one in Study 4a and the other in Study 4b.

Study 4a

# *Participants*

Sixty-seven European-Canadians (49 women) were recruited from Queen’s University. Participants received course credit or $5 for their participation.

*Materials and Procedure*

*Analytic versus Holistic Prime.* We primed analytic and holistic thinking by focusing participants’ attention on either a simple or a complex causal field, respectively. For the prime, participants completed an exercise ostensibly unrelated to the rest of the study. All participants read that “Getting into a competitive university such as Queen’s University is a major achievement. The majority of high school students do not make it into any university at all, and a large number of applicants to Queen’s are turned away every year.” In the analytic prime condition, participants then listed the most significant event in their life that had enabled them to get into Queen’s and described how it had done so. Lastly, they completed a diagram consisting of two ellipses, one labeled “Event” and the other “Getting into Queen’s,” by writing the significant event in the event ellipse and by drawing an arrow between it and the getting into Queen’s ellipse. The exercise was designed to focus each participant’s attention on a single cause that had led to a major event in his or her life. The holistic prime was identical to the analytic prime, except that participants listed the three most significant events. Holistic reasoning not only involves focusing on numerous causes, but also focusing on the interactions between such causes. Therefore, participants also described how the three events had influenced each other. The diagram consisted of four ellipses, three on the periphery labeled “Event” and one in the center labeled “Getting into Queen’s.” After writing the three events in the event ellipses, participants drew arrows from each one to the Queen’s ellipse. Lastly, they drew arrows connecting the three events to describe how these events had influenced or interacted with each other. The holistic prime was designed to focus participants’ attention on a larger causal field and on the connectedness of causes within that field.

*Magnitude Manipulations.*  After the prime, participants read the disease scenario from Study 1 and rated the likelihood that each of the two causes had led to the effect on a 9-point scale (1 = *not likely at all*, 9 = *extremely likely*). In summary, Study 4a had a 2 (prime: analytic vs. holistic) by 2 (effect magnitude: high vs. low) by 2 (cause magnitude: high vs. low) design. The causal magnitude factor varied within-participants, and the other factors varied between-participants.

Results

*Test of Cause-Effect Magnitude Correspondence*

A 2 (prime: analytic versus holistic) X 2 (effect magnitude) X 2 (cause magnitude) mixed-model analysis of variance (ANOVA) revealed a significant main effect of effect magnitude, *F*(1, 63) = 12.47, *p* < .001, such that participants in the high magnitude effect condition gave higher likelihood ratings for the causes (*M* = 5.97, *SD* = .94), in comparison with those in the low magnitude effect condition (*M* = 5.35, *SD* = .92). The effect magnitude by cause magnitude interaction was significant, *F*(1, 63) = 78.92, *p* < .001, ηp2 = .56. Overall, participants tended to associate high magnitude effects with high magnitude causes (*M* = 7.17, *SD* = 1.56) more than low magnitude causes (*M* = 4.51, *SD* = 1.98), and low magnitude effects with low magnitude causes (*M* = 7.00, *SD* = 1.30) more than high magnitude causes (*M* = 4.44, *SD* = 1.76). More importantly, the prime by effect magnitude by cause magnitude interaction was significant, *F*(1, 63) = 12.02, *p* < .001, ηp2 = .16. As hypothesized, Canadians primed to reason analytically exhibited a stronger cause-effect magnitude correspondence than Canadians primed to reason holistically (see Figure 4).

Follow-up independent-sample *t* tests on the interaction indicated that, to account for the high magnitude event, analytically-primed Canadians rated the high magnitude cause as more likely than did holistically-primed Canadians and rated the low magnitude cause as less likely than did holistically-primed Canadians. For the low magnitude event, analytically-primed Canadians rated the high magnitude cause as less likely than did holistically-primed Canadians and rated the low magnitude cause as more likely than did holistically-primed Canadians, *t*s > 1.96, *p*s < .05

*Comparison with Non-Primed Participants from Study 1a*

Participants in Study 1a completed the identical disease scenario but without any prime. Therefore, we compared participants from Study 4a with those from Study 1a to determine more specifically what effect the analytic and holistic primes had on participants. First, we compared analytically primed Canadians with those who received no prime. The prime by effect magnitude by cause magnitude interaction was not significant, *F*(1, 86) = 1.36, *p* = .25, revealing that Canadians primed to reason analytically did not differ from those who received no prime. Next we compared holistically primed Canadians with those who received no prime. The prime by effect magnitude by cause magnitude interaction was significant, *F*(1, 91) = 21.39, *p* < .001, ηp2 = .19, revealing that Canadians primed to reason holistically expected less cause-effect magnitude correspondence than did Canadians who received no prime. Lastly, we compared holistically primed Canadians with Chinese from Study 1a who received no prime. The culture by effect magnitude by cause magnitude interaction was not significant, *F*(1, 91) = 1.47, *p* =.23, revealing that Canadians primed to reason holistically did not differ from Chinese who received no prime.

Study 4b

# *Participants*

One hundred twenty-one European-Canadians (75 women) were recruited from Queen’s University. Participants received course credit or $5 for their participation.

*Materials and Procedure*

The procedure was identical to Study 4a except that participants read a money scenario after the prime. We also included a control condition in which participants did not receive any prime. The money scenario described a Canadian individual who had either accumulated greater than average savings (high magnitude effect) or lesser than average savings (low magnitude effect). The scenario was followed by two potential causes, one of high magnitude (the individual had a higher than average income) and one of low magnitude (the individual had a lower than average income). In summary, Study 4b had a 3 (prime: none, analytic, or holistic) by 2 (effect magnitude: high vs. low) by 2 (cause magnitude: high vs. low) design. The causal magnitude factor varied within-participants, and the other factors varied between-participants.

Results

*Test of Cause-Effect Magnitude Correspondence*

A 3 (prime) X 2 (effect magnitude) X 2 (cause magnitude) mixed-model analysis of variance (ANOVA) revealed a significant main effect of effect magnitude, *F*(1, 115) = 8.72, *p* = .004, such that participants in the high magnitude effect condition gave higher likelihood ratings for the causes (*M* = 5.52, *SD* = .97), in comparison with those in the low magnitude effect condition (*M* = 4.77, *SD* = .98). The effect magnitude by cause magnitude interaction was significant, *F*(1, 115) = 239.66, *p* < .001, ηp2 = .68. Overall, participants tended to associate high magnitude effects with high magnitude causes (*M* = 6.97, *SD* = 1.53) more than low magnitude causes (*M* = 3.43, *SD* = 2.01), and low magnitude effects with low magnitude causes (*M* = 6.57, *SD* = 1.51) more than high magnitude causes (*M* = 3.07, *SD* = 1.64). More importantly, the prime by effect magnitude by cause magnitude interaction was significant, *F*(2, 115) = 6.81, *p* = .002, ηp2 = .11. We conducted follow-up 2 (prime) by 2 (effect magnitude) X 2 (cause magnitude) mixed-model analyses of variance (ANOVA) to determine more specifically the effects of the primes. As hypothesized, Canadians primed to reason analytically exhibited a stronger cause-effect magnitude correspondence than Canadians primed to reason holistically, *F*(1, 61) = 10.16, *p* = .002, ηp2 = .14. Canadians primed to reason analytically did not differ in the tendency to make this association compared with Canadians who received no prime, *F*(1, 87) = .22, *p* = .64. Lastly, Canadians primed to reason holistically tended to exhibit a weaker cause-effect magnitude correspondence than were Canadians who received no prime, *F*(1, 82) = 10.26, *p* = .002, ηp2 = .11 (see Figure 5).

Analytically-primed Canadians did not differ from those receiving no prime, and thus we collapsed the two groups together, referred to them as analytic-Canadians, and compared them with holistically-primed Canadians. Follow-up independent-sample *t* tests on the interaction indicated that, to account for the high magnitude event, analytic-Canadians rated the high magnitude cause as more likely than did holistically-primed Canadians and rated the low magnitude cause as less likely than did holistically-primed Canadians, *t*s > 2.10, *p*s < .04. For the low magnitude event, analytic-Canadians rated the high magnitude cause as less likely (*M* = 2.78, *SD* = 1.16) than did holistically-primed Canadians (*M* = 3.50, *SD* = 1.28), *t* = 1.96, *p* < .05, and rated the low magnitude cause as marginally more likely than did holistically-primed Canadians, *t =* 1.91, *p* = .07.

In summary, for both the disease (Study 4a) and the negotiation (Study 4b) scenarios, analytically primed Canadians associated high magnitude effects with high magnitude causes more than low magnitude causes, and low magnitude effects with low magnitude causes more than high magnitude causes. And in both scenarios, holistically primed Canadians exhibited this pattern to a significantly lesser degree. Additionally, comparing participants from Study 4a with participants from Study 1a who completed the same materials without any prime revealed that the analytic prime had no effect. Instead, the holistic prime was the one that caused Canadians to expect less cause-effect magnitude correspondence. This pattern of results was replicated in Study 4b by comparing the participants who received either the analytic prime or the holistic prime with participants in a control condition who received no prime. Lastly, comparing holistically primed Canadians in Study 4a with Chinese in Study 1a who received no prime revealed no cultural differences in the tendency to expect a cause-effect magnitude correspondence.

General Discussion

Across three studies, Canadians expected a greater correspondence in magnitude between effects and their causes than did Chinese. In a fourth study, both analytically primed Canadians and Canadians who received no prime were more likely to expect the correspondence in magnitude between cause and effect than were holistically primed Canadians, whereas the holistically primed Canadians showed similar responses to Chinese participants. The results not only demonstrated cultural differences in the extent to which people expect a correspondence in magnitude between cause and effect, but they also demonstrated the underlying factor responsible for such cultural differences, namely the causal complexity factor of analytic or holistic reasoning.

*Alternative Explanations*

One potential alternative explanation for the results is that Chinese may be less familiar with the scenarios than are Canadians. If people are reasoning about the cause of an effect in a context where causes and effects do tend to correspond in magnitude in the real world, then the tendency to predict such an association would be prudent. Therefore, if Canadians are more familiar than Chinese are with a scenario, and thus the underlying causes of the effect in that scenario, then Canadians should expect a greater degree of correspondence between cause and effect.

This potential alternative explanation has at least two problems. First, when choosing and designing our scenarios, we were very careful to generate scenarios that were familiar and understandable to both cultural groups. Indeed, a number of scenarios that were initially proposed by either the Canadian or Chinese researchers were rejected because they did not meet these criteria. Second, even if a cause-effect magnitude correspondence existed for all the scenarios we used, and all our efforts at ensuring equivalent levels of familiarity with the scenarios failed, the familiarity explanation would not fit with the pattern of results in Studies 4a and 4b. It would be difficult to explain, based on familiarity with the scenarios, why priming Canadians to think holistically would cause them to respond similar to Chinese, namely by expecting a lesser degree of cause-effect magnitude correspondence.

*Theoretical Contributions*

*Culture and Attributions.* Gilovich and Savitsky (2002, p. 618) defined the representativeness heuristic as the tendency to process information “on the basis of one overarching rule: ‘Like goes with like.’” Most of the research on this heuristic has been conducted in the context of categorization, whereas little research has explored the representativeness heuristic in the context of attributions. Although some have speculated on the tendency to expect cause-effect magnitude correspondence when making attributions (Einhorn & Hogarth, 1986; Nisbett & Ross, 1980), little research has systematically investigated this speculation. Our studies contribute to the attribution literature by providing strong empirical evidence in support of this proposal.

In addition, we demonstrated that the degree to which people expect cause-effect magnitude correspondence differs across cultures. Throughout our studies, both cultures associated causes and effects on the basis of magnitude similarity, and this pattern of results indicates that both Canadians and Chinese exhibited judgments consistent with the representativeness heuristic. However, the fact that Canadians expected a greater degree of correspondence in magnitude when making causal judgments indicates that they exhibit a more extreme form of the representativeness heuristic in this context, compared with Chinese. Our study is the first we are aware of to demonstrate cultural differences in the degree to which people employ the representativeness heuristic in the context of attributions.

In addition, in examining the literature on the representativeness heuristic, we are aware of no studies that have demonstrated any causal mechanisms. Our finding that the degree to which people expect cause-effect magnitude correspondence is in part determined by whether or not they reason analytically or holistically enhances our understanding of the cognitive underpinnings of the representativeness heuristic in the context of attributions. Furthermore, the fact that this tendency differs across cultures signals the need to investigate whether cultural differences would emerge for other heuristics.

An important caveat here is that we demonstrated cultural differences in the representativeness heuristic in the context of causal judgments based on a similarity in magnitude. We have provided no evidence regarding whether or not the same pattern of results would emerge with respect to the representativeness heuristic in other contexts, such as attributing causes based on their physical resemblance to effects.

*Cultural Universals.* Notably, within the domain of our scenarios and designs, participants from both cultures expected a cause-effect magnitude correspondence. What differed across cultures was the degree to which people expected this correspondence. Norenzayan and Heine (2005) outlined a taxonomy of cultural universals, defined as core mental attributes shared by people everywhere. The taxonomy consists of four levels of cultural universality: accessibility, functional, existential, and nonuniversality. Accessibility universals, the most stringent level of universality, are psychological processes that are available to all people, used for the same function, and accessed to the same degree. Functional universals, the second most stringent level of universality, are cognitively available to all people, used for the same function, but accessed to different degrees. Existential universals, the third most stringent level of universality, are cognitively available to all people, but they may be used in markedly different ways and are accessed to different degrees. Nonuniversals are those processes that are not cognitively available to all people.

Although we only sampled people from two cultures, our pattern of results demonstrating that participants from both cultures expected cause-effect magnitude correspondence, but to different degrees, would potentially qualify as a functional universal. Our studies provide the first evidence we are aware of regarding the universality and cultural variability of the representativeness heuristic. What appears on the surface to be a simple heuristic, the tendency to associate high magnitude effects with high magnitude causes and low magnitude effects with low magnitude causes, is applied to different degrees depending on how our host culture has shaped our minds to process information.

*Practical Implications*

The pattern of results could also have important practical implications. One potential application is in the domain of behavioral decision making. According to the U.S. Federal Reserve, per capita personal debt in the United States has increased by at least a factor of 10 between 1945 and 2005, reaching unprecedented levels (Massey, 2008). Canadian debt levels are following a similar trend according to the Bank of Canada. The causes of this trend are surely complex and we do not intend to oversimplify them or claim that our research has solved this problem. However, our results could potentially contribute to better understanding and ameliorating the situation. For example, North Americans may be more likely to believe that in order to accumulate wealth or to resolve their debt problems, they need to focus on cutting back on major costs and purchases. In doing so, they may pay little attention to the financial impact of minor routine expenses. Consistent with this possibility, financial experts are advising people to cut back on minor expenses, such as the purchase of a daily cup of coffee at a trendy café, because such purchases add up over time. Thus, for people who find themselves in debt, realizing the importance of reducing minor routine expenses could enable them to more quickly and effectively ameliorate their financial hardship. In addition, the results from Study 4, demonstrating that the tendency to expect a magnitude correspondence is reduced when primed to think holistically, provides hope that people can reduce the degree to which they overlook minor expenses in such situations. We are investigating some of these implications in our ongoing research.

Meanwhile, this research could have mirror-image implications for East Asians. For example, East Asians may underestimate the importance of major health-related behaviors because they believe that other minor health-related behaviors will compensate. For example, when told by a medical expert that ceasing a pernicious behaviour, such as smoking, is essential for dealing with a major illness, such as lung cancer, Easterners may be more likely to believe that their other health-related behaviors, such as eating well, will compensate for the detrimental effects of smoking.

The present research also has practical implications for problem solving and negotiation. The human world is becoming increasingly interconnected and many nations are becoming more ethnically diverse. People from different cultures are realizing the growing need to work together to solve problems, such as those currently undermining political and financial stability, as well as those plaguing our natural environment. When investigating the cause of a high magnitude effect, Westerners’ tendency to expect high magnitude causes may lead them to overlook relatively lower magnitude causes that might have played a key role. On the other hand, Chinese might overemphasize factors that played a minor role at the expense of those that played a major role. These different tendencies to emphasize high versus low magnitude causes could potentially lead to disagreement or international conflict. In a world in which cross-cultural interaction is crucial, further understanding cultural differences in reasoning about cause and effect relationships could prove important both for finding solutions to the problems and for negotiating diplomatic resolutions to the inevitable disagreements that will arise between nations.

People associate big causes with big effects and small causes with small effects. However, the degree to which we make this association is at least partially determined by the reasoning processes we are imbued with from the culture in which our minds developed. Some physicists believe that our universe, created by the big bang, will end in a big crunch. Perhaps a more holistic interpretation of this scenario would result in the universe that began from the big bang ending in a small crunch.

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Appendix

*Scenario used in Studies 1a, 3, and 4a*

 *Effects*

-- 21 people at a major downtown company became ill. They were stricken with symptoms of nausea and vomiting. Within 3 days, 11 of these individuals had experienced a rapid but horrific death and the other 10 were still in hospital. (*High magnitude*)

 *--* 7 people at a major downtown company became ill. They were stricken with symptoms of nausea and vomiting. Within 3 days, 3 of these individuals had recovered and the other 4 were still experiencing minor symptoms. (*Low magnitude*)

 *Causes:*

*--* An employee came into contact with a highly infectious type of super-bacteria, while on a business trip. (*High magnitude*)

 *--* An employee came into contact with a standard type of bacteria, while on a business trip.(*Low magnitude*)

*Scenario used in Study 1b*

 *Effects*

-- Two parties are negotiating a new contract. This negotiation took over 31 weeks to reach an agreement, which is much longer than usual compared with other similar negotiations.(*High magnitude*)

-- Two parties are negotiating a new contract. This negotiation took only 2 weeks to reach an agreement, which is typical compared with other similar negotiations. (*Low magnitude*)

*Causes:*

-- Two negotiating parties could not agree on one major point, which amounted to 41% of the total contract value. (*High magnitude*)

-- Two negotiating parties could not agree on one minor point, which amounted to 10% of the total contract value. (*Low magnitude*)

Table 1

Frequencies of Canadian and Chinese cause magnitude choices (and percentages within each culture) (Study 3).

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | Disease Outbreak |  | Basketball Game |  | TornadoDamage |  |
|  |  | Causes |  | Causes  |  | Causes |  |
| Effect | Culture | High | Low | High | Low | High | Low |
| High | Canadian | 29(90.6%) | 3(9.4%) | 30 (93.8%) | 2(6.2%) | 28(87.5%) | 4(12.5%) |
|  | Chinese | 18(56.2%) | 14(43.8%) | 20(62.5%) | 12(37.5%) | 19(59.4%) | 13(40.6%) |
| Low | Canadian | 4(12.9%) | 27(87.1%) | 3(9.7%) | 28(90.3%) | 4(12.9%) | 27(87.1%) |
|  | Chinese | 14(45.2%) | 17(54.8%) | 13(41.9%) | 18(58.1%) | 13(41.9%) | 18(58.1%) |

Figure Captions

*Figure 1.* Canadian and Chinese likelihood estimates (+ *SE*) of high and low magnitude causes leading to high and low magnitude effects (Study 1a).

*Figure 2.* Canadian and Chinese likelihood estimates (+ *SE*) of high and low magnitude causes leading to high and low magnitude effects (Study 1b).

*Figure 3.* Canadian and Chinese likelihood estimates (+ *SE*) of high and low magnitude causes leading to high and low magnitude effects (Study 2).

*Figure 4.* Analytically primed and holistically primed Canadian likelihood estimates (+ *SE*) of high and low magnitude causes leading to high and low magnitude effects (Study 4a).

*Figure 5.* No prime, *a*nalytically primed, and holistically primed Canadian likelihood estimates (+ *SE*) of high and low magnitude causes leading to high and low magnitude effects (Study 4b).

*Figure 1*

*Figure 2*

*Figure 3*

*Figure 4*

*Figure 5*