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Priming interdependence affects processing of context information in causal inference—But not how you might think

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ABSTRACT

Cultural mindset is related to performance on a variety of cognitive tasks. In particular, studies of both chronic and situationally-primed mindsets show that individuals with a relatively interdependent mindset (i.e., an emphasis on relationships and connections among individuals) are more sensitive to background contextual information than individuals with a more independent mindset. Two experiments tested whether priming cultural mindset would affect sensitivity to background causes in a contingency learning and causal inference task. Participants were primed (either independent or interdependent), and then saw complete contingency information on each of 12 trials for two cover stories in Experiment 1 (hiking causing skin rashes, severed brakes causing wrecked cars) and two additional cover stories in Experiment 2 (school deadlines causing stress, fertilizers causing plant growth). We expected that relative to independent-primed participants, those interdependent-primed would give more weight to the explicitly-presented data indicative of hidden alternative background causes, but they did not do so. In Experiment 1, interdependents gave less weight to the data indicative of hidden background causes for the car accident cover story and showed a decreased sensitivity to the contingencies for that story. In Experiment 2, interdependents placed less weight on the observable data for cover stories that supported more extra-experimental causes, while independents' sensitivity did not vary with these extra-experimental causes. Thus, interdependents were more sensitive to background causes not explicitly presented in the experiment, but this sensitivity hurt rather than improved their acquisition of the explicitly-presented contingency information.

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1. Introduction

Motivational and individual differences can affect performance on basic cognitive tasks (e.g., Beilock & Carr, 2005; Grimm, Markman, Maddox, & Baldwin, 2008; Henrich, Heine, & Norenzayan, 2010). Of particular interest here are differences in performance on cognitive tasks that are due to the differences between the cultural mindsets typically labeled "individualistic" and "collectivistic." Individualism, typically associated with Western societies, and especially the United States, places emphasis on the individual as separate from others, with a focus on the promotion of individual well-being. Collectivism, typically associated with Eastern societies, and in particular East Asian societies, places emphasis on relationships and connections among individuals, with a focus on the promotion of community well-being (Markus & Kitayama, 1991; Oyserman & Lee, 2008). Recent work demonstrates that these cultural mindsets are not merely associated with one's nationality, but rather, individualism and collectivism can be primed in people from both Western and East Asian societies (e.g., Gardner, Gabriel, & Lee, 1999; Oyserman, Sorensen, Reber, & Chen, 2009). These situationally-primed mindsets are sometimes referred to as "independence" and "interdependence" (for individualism and collectivism, respectively; e.g., Gardner et al., 1999; Hamedani, Markus, & Fu, 2013)—a terminology that we adopt here.

Of particular relevance to the current paper, research demonstrates that cultural mindsets can affect not only self-concept and social attribution (e.g., Morris & Peng, 1994; Singelis, 1994), but also basic non-social cognitive processing (e.g., Kühnen, Hannover and Schubert, 2001; Masuda & Nisbett, 2006; see Miyamoto & Wilken, 2013; Oyserman, Coon, & Kemmelmeier, 2002; Oyserman & Lee, 2008, for reviews). A growing body of evidence suggests that individuals exhibiting greater interdependence (or collectivism) demonstrate greater holistic thinking and context-sensitivity in their perception, memory, and reasoning relative to individuals exhibiting greater independence (or individualism; e.g., Choi, Nisbett, & Norenzayan, 1999;

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Ji, Peng, & Nisbett, 2000; Ji, Zhang, & Nisbett, 2004; Masuda & Nisbett, 2001; for a review see Miyamoto & Wilken, 2013). Such a systematic difference in basic cognitive processing should influence a wide range of cognitive tasks with implications for reasoning and decision-making.

An important cognitive ability is detecting which events co-occur in the environment and using that covariation information to make predictions and causal inferences. For example, if someone suspected that an allergy to shellfish caused her shortness of breath, it would be important for her to detect the covariation between eating shellfish and subsequently gasping for air so that she could accurately infer the cause of her malady and prevent it in the future. A component of accurate causal inference is determining to what extent the outcome may be produced by hidden or unobserved causes not currently under explicit consideration (e.g., Hagmayer & Waldmann, 2007; White, 2008)—for example, she may find herself gasping for air when she has not eaten shellfish, but when she is in restaurants where knives or dishes are contaminated by onions, peanuts or other allergens. Here we tested the hypothesis that individuals primed with an interdependent cultural mindset would demonstrate greater sensitivity to such background contextual information when making causal inferences from co-occurrence information.

1.1. Cultural mindsets and the processing of contextual information

Recent theorizing suggests that a unifying mechanism underlies at least some of the mindset-related performance differences on cognitive tasks: An interdependent or collectivist mindset is associated with holistic processing, including greater attention to background contextual information, whereas an independent or individualistic mindset is associated with more analytic processing and attention to salient features (Kühnen et al., 2001; Miyamoto, Nisbett, & Masuda, 2006; Miyamoto & Wilken, 2013; Nisbett & Masuda, 2006). For example, East Asians are better than Americans at detecting background changes in the change blindness paradigm (Masuda & Nisbett, 2006) and they exhibit larger field-dependency effects on tasks requiring a separation between objects and the larger field in which they appear (Ji et al., 2000). Additionally, East Asians' judgments of facial emotions are more influenced by the emotions on faces surrounding the one being judged and they spend more time looking at those surrounding faces than do Americans (Masuda, Ellsworth, Mesquita, Leu, Tanida, & Van, 2008).

The previous findings reflect differences across cultures, but similar cognitive consequences have been observed for primed cultural mindsets—suggesting that the differences in cultural mindset, in fact, cause differences in the cognitive processing. For example, in visual tasks independent-primed participants more frequently detect a simple figure within a complex one when performing the embedded figures task—a demonstration of relative insensitivity to the context. Additionally, they report the local letter more quickly than the global letter in the Navon (1977) letter-identification task (Kühnen & Oyserman, 2002). Conversely, interdependent-primed participants more frequently detect the missing or erroneous component of a picture in the picture completion task—a demonstration of sensitivity to the context (Kühnen et al., 2001). Similarly, interdependent-primed participants report the global letter in the Navon letter identification task more quickly than the local letter. In free recall, interdependent-primed participants better remember joint item and location information than independent-primed participants (Kühnen & Oyserman, 2002). Finally, interdependent-primed participants suffer more interference in a flanker task than do independent-primed participants when a target is flanked by incongruent stimuli (e.g., rightward-pointing arrow surrounded by leftward-pointing arrows; Lin & Han, 2009). Collectively, these results suggest that interdependent and collectivist participants may be more sensitive to the whole – that is, to background and context – on a range of perceptual and cognitive tasks.

1.2. Effects of contextual information in causal inference

Kim, Grimm, and Markman (2007) examined the relative sensitivity of independent- and interdependent-primed participants to background contextual information for two explicitly-presented candidate causes (i.e., potential fertilizers) of the same outcome (i.e., flowers blooming). They assessed how participants' judgments of a causal candidate (e.g., a blue liquid) changed as it became more confounded with a stronger alternative cause explicitly presented in the experiment (e.g., a red liquid). Interdependent-primed participants in this study demonstrated greater sensitivity to the "context" (i.e., the presence or absence of the red liquid when judging the blue one) than did independent-primed participants in two ways: First, they exhibited greater levels of conditionalization (i.e., they controlled for the confounded cause to a greater extent). Second, they showed greater levels of discounting (i.e., a greater reduction in their judgments of the candidate cause in the presence of a strong alternative; see Spellman, 1996, and Goedert & Spellman, 2005, on differentiating conditionalization and discounting). The Kim et al. (2007) results suggest that having an interdependent mindset increases sensitivity to an explicitly-presented background cause.

Another means of measuring sensitivity to background causal information is to assess how participants weight information about alternative causes that are not explicitly represented. To the extent that the outcome occurs in the absence of the explicitly considered cause (e.g., the woman in the initial allergy example finds herself gasping for air when she has not eaten shellfish), there must be at least one alternative unobserved cause of the outcome. This information – the extent to which the outcome occurs in the absence of the cause – determines boundary conditions for making causal inferences (Cheng, 1997). For example, it would be impossible to determine the efficacy of a putative cause (e.g., shellfish) if the outcome (e.g., gasping) always occurred both when the cause was present and when the cause was absent. Furthermore, one could construe the task of drawing causal inferences as a task of parsing out those occurrences of the outcome that are produced by the candidate cause from those occurrences of the outcome that are produced by one or more background causes (e.g., White, 2008). And even though these background causes may or may not be directly observed, their presence may be inferred when the outcome occurs in the absence of the candidate cause (Cheng, 1997, p. 376; Hagmayer & Waldmann, 2007; Luhmann & Ahn, 2007; Rottman, Ahn, & Luhman, 2011).

To illustrate these ideas, Table 1 represents the contingency between two binary events: a single candidate cause (e.g., shellfish) and a single outcome (e.g., gasping). To tease apart the action of the candidate cause and other background causes one could separately consider the top and bottom rows of the table and calculate the probability of the effect given the presence of candidate cause [$P(E|C)$ = Cell A/(Cell A + Cell B)], and the probability of the effect given the absence of the candidate cause [$P(E|\sim C)$ = Cell C/(Cell C + Cell D)]. The $P(E|C)$ is the result of instances of the effect that occur when the candidate cause is present, but may be produced either by the candidate cause or by background causes. In contrast, the $P(E|\sim C)$ is the result of instances of the effect produced only by background causes. In particular, given that Cell C represents instances when the candidate cause is absent and the effect is present, the extent to which it is non-zero suggests the action of one

Table 1
Contingency table.

		Outcome (e.g., gasping)	
		Present	Absent
Cause (e.g., shellfish)	Present	A	B
	Absent	C	D

Note. Cell labels represent the number of times the cause and the outcome were jointly present (Cell A), jointly absent (Cell D), or occurred alone (Cells B and C, respectively).

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or more hidden or unobserved causes (Hagmayer & Waldmann, 2007; Luhmann & Ahn, 2007, 2011; Rottman et al., 2011).

A number of lines of research in causal explanation and causal inference suggest that American participants frequently prefer fewer or even single causes of an outcome and may fail to consider alternative causes not explicitly presented to them (Dougherty, Gettys, & Thomas, 1997; Fernbach, Darlow, & Sloman, 2010; Lombrozo, 2007; Lu, Yuille, Liljeholm, Cheng, & Holyoak, 2008; McKenzie, 1994). Consistent with this view, work in causal learning shows that North American participants do not weight the cells depicted in Table 1 equally, giving less weight to the Cell C information relevant for detecting potential background causes. When participants anticipate that a cause produces an effect, their causal judgments typically demonstrate the following weighting of the cell frequency information: A > B ≥ C > D (Levin, Wasserman, & Kao, 1993; Mandel & Lehman, 1998; Mutter & Plumlee, 2009). When asked to explicitly rank the importance of the information contained in each of the cells, the same pattern of cell-weighting is observed (Levin et al., 1993; Wasserman, Dorner, & Kao, 1990). Most prevailing formal theories of causal inference from covariation do not predict this particular cell-weighting (e.g., ΔP implies an equal weighting of the cells, Jenkins & Ward, 1965; and causal power implies A = B > C = D, Cheng, 1997; cf. Hattori & Oaksford, 2007).[1] Nonetheless, to the extent that individuals differ in their weighting of Cell C information, it would suggest differences in their sensitivity to background causes.

Thus, if interdependent participants are more sensitive to background contextual information, we might expect them to place greater weight on Cell C than do the independent North American participants observed in these samples. Given that the failure to consider alternative causes may lead to non-normative inferences under certain circumstances (e.g., Fernbach, Darlow, & Sloman, 2011), it would be of interest to find an individual difference – and even better, one that can be primed – that increases sensitivity to causal alternatives.

1.3. Overview of current studies

Two experiments assessed the cell weightings of independent and interdependent-primed participants who learned about a single explicitly-presented candidate cause. The goal of the experiments was to test for differences in the sensitivity of interdependents and independents to the causal background when there was only one explicitly-presented cause—a situation requiring inference to causes not explicitly presented in the experiment. Given that individuals with an interdependent self-construal may be more sensitive to contextual or background information, we hypothesized that interdependent participants would be more sensitive than independents to frequency information from Cell C.

2. Experiment 1

2.1. Method

2.1.1. Participants

Participants were 166 college students (105 female) aged 17 to 29 years ($M = 20.5$, $SD = 2.3$) enrolled at either Seton Hall University ($n = 85$) or The College of New Jersey ($n = 81$). They participated in partial completion of a course requirement. To reduce variability in chronic cultural mindset, only individuals born and living continuously in the United States and who indicated that English was their first and primary language were allowed to participate.

2.1.2. Procedure

Participants first completed the priming task in which they read and circled all of the pronouns in one of two brief paragraphs (adapted from Gardner et al., 1999; Oyserman et al., 2009). For those receiving the independent prime, the story was told from the first person singular point of view (pronouns: I, me, my); for those receiving the interdependent prime, the story was told from the first person plural (pronouns: we, us, our). Participants were re-primed with a different paragraph, but same priming condition, between blocks of the causal judgment task.

For the causal judgment task, participants sat at computers running E-Prime 2.0 (Psychology Software Tools, Pittsburgh, PA) and read one of two cover stories, adapted from Fugelsang and Thompson (2000), in which they were asked to either determine the extent to which hiking in the woods causes a skin rash among patients in different doctor's offices or the extent to which severed brakes is the cause of car accidents in cars in different counties (see Appendix A for complete cover stories). Participants were then instructed on how to use the judgment scale (e.g., in the skin rash case, −100 indicates hiking in the woods completely prevents skin rashes, 0 indicates no effect, and +100 indicates hiking in the woods completely causes skin rashes). They then saw 12 trials, each presenting complete frequency information corresponding to the rows depicted in Table 2. These frequencies were constructed by Mandel and Lehman (1998) with the intent that all cells would support the same maximum correlation with participants' causal judgments (i.e., calculating down each column in Table 2, the frequencies associated with each cell have the same means and standard deviations). Table 3 depicts an example of what participants would have seen on an individual trial for the skin rash and car accident stories. After completing the trials for one cover story, participants read the other cover story and, again, saw the complete set of 12 trials. The order of the cover stories and the order of the trials were randomized.

2.1.3. Design and data analysis

The experiment was a 2 (prime: interdependent, independent) × 2 (cover story: skin rashes, car accidents) × 4 (cell: A, B, C, D) mixed design with prime manipulated between-groups and both cover story and cell within-groups. The participants only made causal judgments, but the primary dependent measure was the cell weighting. To determine cell weights, we calculated separate Pearson correlation coefficients between each participant's judgments (within cover story) and each of the cell frequencies (i.e., separate correlations for each of the cells, A, B, C, and D). We then transformed these correlations into Fisher's z so that they could be used as measures in the analyses and took the absolute value of z as the participant's cell weight. In addition to the cell weights,

Table 2
Cell frequencies and objective contingencies for each of the 12 trials.

A	B	C	D	*Phi coefficient*
2	5	2	1	−0.36
1	2	5	2	−0.36
1	5	2	2	−0.36
2	2	5	1	−0.36
2	1	5	2	−0.05
2	5	1	2	−0.05
1	2	2	5	0.05
5	2	2	1	0.05
2	1	2	5	0.36
5	2	1	2	0.36
5	1	2	2	0.36
2	2	1	5	0.36

Note: Each row of the table represents a single trial. The trials represent every combination of cells with frequencies of 5, 2, 2, and 1. Thus, each column has the same frequency total and therefore would yield the same weight were participants equally weighting the cells.

[1] This pattern is systematically altered when participants expect a preventive relation between a cause and outcome such that they now weight B > A > D > C (Mandel & Vartanian, 2009) and explicitly rank Cell B as the most important piece of cell information (Levin et al., 1993, Exp. 2). A full discussion of the cognitive mechanisms driving the cell-weight inequality is beyond the scope of this paper. However, we direct the reader to several sources for this discussion (Hattori & Oaksford, 2007; Mandel & Lehman, 1998; McKenzie & Mikkelsen, 2007).

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Table 3
Example of information presented on a single trial in the skin rash and car accident conditions.

Skin rash cover story	Car accident cover story
Dr. Chulicari's Office	Suffolk County
7 children WENT HIKING IN THE WOODS.	7 cars HAD SEVERED BRAKE LINES.
2 of the 7 developed a skin rash.	2 of the 7 were involved in car accidents.
3 children DID NOT GO HIKING IN THE WOODS.	3 cars DID NOT HAVE SEVERED BRAKE LINES.
2 of the 3 developed a skin rash.	2 of the 3 were involved in car accidents.
Type in any number between −100 and 100 to indicate the effect of HIKING on DEVELOPING A SKIN RASH.	Type in any number between −100 and 100 to indicate the effect of SEVERED BRAKE LINES on CAR ACCIDENTS.

we calculated the correspondence between participants' judgments and the objective contingency by calculating the Fisher's transformed correlation between each participant's judgments and *phi*.[2]

We performed mixed linear model analyses (MLM) with maximum likelihood estimation (West, Welch, & Galecki, 2007), modeling the $2 \times 2 \times 4$ design as fixed effects and modeling participants' random intercepts. In MLM, participants' random intercepts are similar to the effect of "subject" traditionally modeled in a repeated-measures ANOVA. We assessed the significance of fixed effects using the F distribution and between-within degrees of freedom (Rabe-Hesketh & Skrondal, 2008; West et al., 2007), and the significance of participants' random intercepts using Wald's z (Rabe-Hesketh & Skrondal, 2008). We performed two sets of analyses: 1) First, overall analyses of the factorial design irrespective of the hypothesis. 2) Second, planned comparisons based on our a-priori hypothesis that interdependents would place greater weight on Cell C information than independents. Throughout, we report 95% confidence intervals on the marginal means of the fixed effects. All significant interactions were followed by tests of the simple main effects. Consistent with reporting standards for MLM, we report the intraclass correlation coefficient (ICC), computed from a model with only fixed and random intercepts (Singer & Willett, 2003, p. 96). The ICC is calculated as the proportion of variability around the fixed mean that is due to participants' random intercepts. Thus, the ICC indicates the amount of variability in the data that is due to between-participant differences. Given that our hypotheses were for the fixed and not random effects, we report the random effects and the ICC associated with each analysis in Appendix B, so as not to detract from the reporting of the results of interest. Additionally, we report the raw causal judgment data as a function of prime, *phi*, and cover story for both Experiments 1 and 2 in Appendix C.

2.2. Results

2.2.1. Cell weighting

2.2.1.1. Overall analyses. As in other studies (e.g., Mandel & Lehman, 1998), overall participants did not give equal weight to each of the cells, $F(3,1148) = 9.07$, $p < .001$; see Table 4. Nor did they give any of the cells as much weight as they should: Were participants to produce the objective contingency as their causal rating for all trials, they would equally weight each cell with the absolute value of Fisher's $z = 0.63$. Bonferroni post hoc comparisons on the main effect of cell revealed the pattern A > B = C > D: participants weighted Cell A more heavily than Cell B, $p < .001$, $d = 0.40$, Cells B and C approximately equally, $p < .169$, $d = .18$, and Cell C more heavily than Cell D, $p < .001$, $d = 0.33$.

There was a very small main effect of priming, $F(1,164) = 4.25$, $p = .041$, $d = 0.02$, such that independent-primed participants placed greater weight on the data overall ($M = 0.464$, CI [.44, .49]) than did interdependents ($M = 0.457$, CI [.43, .47]). Although there was no priming by cell interaction ($p > .30$), there was a difference in cell weights between interdependents and independents when considering the cover story [priming by cover story interaction, $F(1,1148) = 4.97$, $p = .026$]; see right column of Table 4. Interdependent-primed participants weighted the cell frequencies more heavily for the skin rash than for the car accident cover story, $F(1,1148) = 9.44$, $p = .002$, $d = 0.23$. For independent-primed participants there was no effect of cover story, $F < 1$, $d = 0.02$.

2.2.1.2. Planned comparisons testing differential weighting of cell C. Our main hypothesis – that interdependent-primed participants would weight Cell C more heavily than would independent-primed participants – was not confirmed. We tested it by analyzing the cell C weights (see "C" column in Table 4), with priming and cover story as fixed effects. This analysis revealed only a priming by story interaction, $F(1,164) = 6.91$, $p = .009$ (all other $ps > .24$). Consistent with the overall analysis, cover story did not influence the Cell C weights of independents, $F < 1$, $d = 0.00$. But the interdependents weighted Cell C less heavily for car accidents than for skin rashes, $F(1, 164) = 13.49$, $p < .001$, $d = .49$, and less heavily than the independents weighted Cell C for car accidents, $F(1, 164) = 3.89$, $p = .050$, $d = .30$. The weights of the independents and interdependents for the skin rash cover story did not differ, $p = .24$, $d = .18$. In sum, the results were opposite our prediction: At least for the car accident cover story, interdependents placed less weight on Cell C data than did independents.

2.2.2. Correspondence between judgments and objective contingency

Of particular interest was whether the differential weighting of data by the interdependent-primed participants for the car accident cover story would translate into differences in how their judgments corresponded with the objective contingencies. We found that it did: Interdependent-primed participants demonstrated less sensitivity to the contingencies for the car accident than for the skin rash cover story (see Fig. 1).

There was a priming by cover story interaction, $F(1, 164) = 13.23$, $p < .001$, and no other effects, $ps > 0.21$.[3] Simple main effects tests revealed that among interdependent-primed participants there was a greater correspondence between their judgments and the objective contingency for the skin rash than car accident cover story, $F(1,164) = 114.92$, $p < .001$, $d = 0.41$. However, for independent-

[2] Admittedly, deviation from *phi* is not a measure of causal judgment because contingency does not directly imply causation (Cheng, 1997). However, given the lack of agreement on the "correct" model of human causal judgment (Hattori & Oaksford, 2007; Perales & Shanks, 2007), and the high correspondence between many indices of causation and phi (McKenzie, 1994), we chose *phi* as our measure of objective contingency. We calculated *phi* as:

$$\phi = \frac{(A*D)-(B*C)}{\sqrt{(A+B)*(C+D)*(A+C)*(B+D)}}$$

where, A, B, C, and D refer to cell frequencies corresponding to the labels in Table 1.

[3] This same pattern of effects obtained when we assessed the correspondence between participants' causal judgments and power (Cheng, 1997)—a normative index of causal effectiveness.

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Table 4
Mean cell weights in Experiment 1 as a function of cell, prime and cover story. 95% confidence intervals in parentheses. If causal judgments matched the contingencies, then the cell weights would all be 0.63 (Fisher's z).

Priming	Cover story	A	B	C	D	Mean
Interdependent	Car accident	0.56 (0.50, 0.62)	0.48 (0.42, 0.54)	0.35 (0.29, 0.41)	0.31 (0.24, 0.37)	0.42 (0.39, 0.46)
	Skin rash	0.65 (0.59, 0.71)	0.47 (0.41, 0.53)	0.49 (0.43, 0.55)	0.34 (0.29, 0.40)	0.49 (0.46, 0.52)
Independent	Car accident	0.61 (0.55, 0.66)	0.47 (0.41, 0.52)	0.44 (0.38, 0.50)	0.36 (0.30, 0.42)	0.47 (0.43, 0.50)
	Skin rash	0.57 (0.51, 0.62)	0.49 (0.43, 0.55)	0.44 (0.38, 0.50)	0.35 (0.30, 0.41)	0.46 (0.43, 0.49)
Overall mean		0.59 (0.57, 0.63)	0.48 (0.45, 0.51)	0.43 (0.40, 0.46)	0.34 (0.31, 0.37)	

primed participants there was no effect of cover story, $F(1,164) = 1.56$, $p = .213$, $d = 0.13$.

2.3. Discussion

We hypothesized that interdependent-primed participants would give more weight to information that illuminates hidden or background causes (i.e., Cell C)—potential contextual information when making causal judgments from contingency. The results were inconsistent with our hypothesis: Although we observed that both interdependents and independents approximated the typically-observed cell weight inequality, weighting A > B = C > D[4] (Levin et al., 1993; Mandel & Lehman, 1998), we also observed that interdependents gave less weight to the data overall for the car accident cover story. And, in direct contrast to our hypothesis, they gave less weight to Cell C for car accidents when compared to their own weighting of that information for skin rashes and when compared to the independents' weighting of Cell C—which did not vary with cover story. This difference in the weighting of the data for the skin rash and car accident cover stories translated into differences in correspondence with the objective contingencies: Interdependents demonstrated less sensitivity to *phi* for the car accident than skin rash cover story, whereas the sensitivity of independents was not modulated by cover story.

Thus, our results revealed two surprising findings: 1) Interdependents were less reliant on Cell C data for the car accident cover story, which is not consistent with the expectation that they would be more sensitive to information about unobserved background causes. 2) Sensitivity of the interdependent, but not independent, participants to the cover stories suggests that causal judgments of the interdependent-primed participants were sensitive to the context, but not in the way predicted.

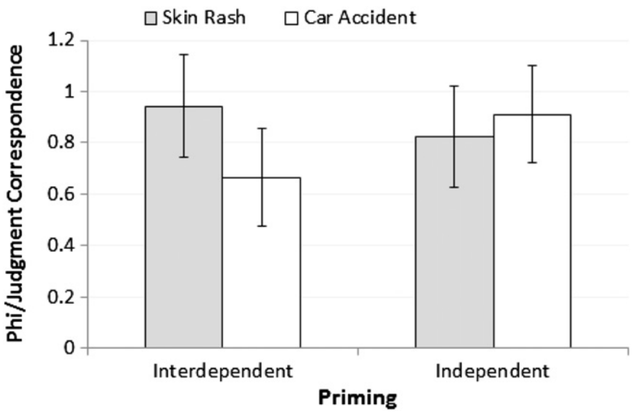

Fig. 1. Average correspondence between judgments and *phi* (measured as absolute value of Fisher's *z* transformed *r*) in Experiment 1. Error bars are 95% confidence intervals.

[4] One potentially odd effect that we observed in the present study was a rather large weighting of Cell D information (see Table 4). Cell D, which indicates the number of times the candidate cause and the outcome were jointly absent, is often-times given a cell weight at or close to zero (see Hattori & Oaksford, 2007, for a review). Some normative models of causal inference from contingency suggest that the cells should be weighted equally (e.g., Allan, 1980; Cheng & Novick, 1990). However, several authors have argued that participants come into the laboratory with the expectation (based on their extra-laboratory experience) that the occurrence of events is rare and the absence of events is common (Anderson, 1990; McKenzie & Mikkelsen, 2007). By this view, giving Cell D a weight at or near zero is normative because more information is obtained by observing the occurrence of events (the presence of the cause or outcome) rather than by observing the non-occurrence of events. McKenzie and Mikkelsen (2007) demonstrated that when judging causal relations among events whose absence – rather than presence – is rare, participants placed greater weight on Cell D information. In the current experiment, Cell D varied between one and five across trials (see Table 2). It may be that in the course of the current experiment participants learned that the joint absence of events was indeed sometimes rare, leading them to give Cell D more weight than is typical.

3. Experiment 2

We performed Experiment 2 to determine whether we could replicate the surprising effects of Experiment 1 and to discern between two competing explanations for the effect of cover story: The first is that interdependents, but not independents, are more sensitive to data from situations involving effects on people. We observed that when reasoning about children getting skin rashes, interdependents more heavily weighted the data and produced causal judgments in greater alignment with the objective contingencies. However, when reasoning about causal effects on cars, interdependents gave less weight to the data and the alignment between their causal judgments and the contingencies was worse than that of independents.

However, the cover stories of Experiment 1 differed not only with regards to whether they dealt with people, but also with regards to the number of alternative causes that the outcomes support. Participants can generate more potential causes of car accidents than of skin rashes (Goedert, Ellefson, & Rehder, 2013). Given that participants' causal judgments may vary with the number of alternative causes that they consider (e.g., Einhorn & Hogarth, 1986), one explanation for the effect of cover story is that independents are more sensitive to the number of alternative causes and place less weight on the observable data for outcomes with more possible causes. We designed Experiment 2 to discriminate between these two possible explanations for the effect of cover story.

Experiment 2 was the same as Experiment 1, but with four cover stories instead of two. We retained the car accident and skin rash cover stories from Experiment 1 and added two cover stories such that the four stories varied both with regards to whether the outcome dealt with people or not (plant growth and car accidents = not people; stress and skin rash = people) and with regards to the number of causes they supported (plant growth and skin rashes supporting fewer causes; car accidents and stress supporting more causes). We chose these cover stories based on pilot work in which 107 participants listed all of the causes they could think of for a variety of outcomes (see Goedert, et al., 2013, Appendix C). In the pilot study, participants listed a similar number of causes for car accidents and stress ($M = 7.01$, $SD = 4.06$ and $M = 7.07$, $SD = 3.70$, respectively), both of which were significantly higher than the number of causes listed for plant growth and skin rashes, which did not differ from each other ($M = 4.33$, $SD = 1.98$ and $M = 4.04$, $SD = 2.04$, respectively). Thus, using these four cover stories we were able to test whether what mattered about the cover stories of Experiment 1 was that they dealt with people or that they differed in the number of causes they support. To preview, our results indicate that what matters is the latter:

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Table 5
Mean cell weights in Experiment 2 as a function of cell, prime and cover story. 95% confidence intervals in parentheses. If causal judgments matched the contingencies, then the cell weights would all be 0.63 (Fisher's z). Stories in italics were also used in Experiment 1.

Priming	Cover story	Causes supported	People story?	A	B	C	D	Mean
Interdependent	Stress	More	Yes	.70 (.65, .76)	.51 (.45, .56)	.37 (.31, .43)	.30 (.24, .36)	.51 (.47, .54)
	Car accidents	More	No	.79 (.73, .85)	.46 (.41, .52)	.37 (.31, .43)	.29 (.23, .35)	.48 (.45, .51)
	Skin rash	Fewer	Yes	.78 (.72, .84)	.49 (.43, .55)	.45 (.40, .51)	.29 (.23, .35)	.47 (.44, .50)
	Plant growth	Fewer	No	.75 (.69, .81)	.55 (.49, .61)	.45 (.39, .51)	.35 (.29, .41)	.53 (.50, .56)
			Mean	.76 (.73, .79)	.50 (.47, .53)	.41 (.38, .44)	.31 (.28, .34)	
Independent	Stress	More	Yes	.74 (.68, .80)	.50 (.44, .56)	.74 (.41, .53)	.34 (.28, .39)	.49 (.46, .52)
	Car accidents	More	No	.72 (.66, .77)	.44 (.38, .50)	.51 (.45, .57)	.29 (.24, .35)	.51 (.48, .54)
	Skin rash	Fewer	Yes	.72 (.66, .77)	.44 (.38, .50)	.51 (.45, .57)	.29 (.23, .35)	.51 (.48, .54)
	Plant growth	Fewer	No	.68 (.62, .74)	.58 (.52, .63)	.43 (.38, .49)	.39 (.33, .45)	.52 (.49, .55)
			Mean	.73 (.70, .76)	.49 (.46, .52)	.47 (.44, .50)	.34 (.31, .37)	
Overall mean				.74 (.72, .76)	.50 (.48, .52)	.44 (.42, .46)	.32 (.30, .34)	

interdependents place less weight on the data and are less accurate for outcomes that support more alternative causes.

3.1. Methods

3.1.1. Participants

Participants were 137 college students (121 female) aged 18 to 29 years ($M = 19.5$, $SD = 1.6$) enrolled at The College of New Jersey, meeting the same exclusion criteria set for Experiment 1. They participated in partial completion of a course requirement.

3.1.2. Procedure

The procedure was identical to that of Experiment 1, with the exceptions of additional cover stories and an additional dependent variable. First, all participants performed the causal judgment task with the four cover stories provided in Appendix A (order of presentation randomized) and were re-primed with a different paragraph of the same priming condition just prior to each cover story, and again after the last cover story. In addition to the car accident and skin rash cover stories of Experiment 1, participants learned about plant growth and stress. For the plant growth cover story, participants imagined that they were a botanist attempting to determine whether fertilizer led to healthy plant growth for plants in 12 different greenhouses across the state. For the stress cover story, participants imagined that they were a clinical psychologist attempting to determine whether having lots of school deadlines leads to complaints of stress among students visiting a school's counseling center (in 12 different counseling centers).

Second, after completing the causal judgment task, participants were given a four-page packet in which they listed all possible causes they could think of for each of the four outcomes presented in the experiment. Each outcome appeared at the top of one of the blank pages (order counterbalanced across participants). Participants were instructed to write down as many causes as they could think of for each outcome, putting each new cause on a separate line.

3.1.3. Design and data analysis

The experiment had a 2 (priming: independent, interdependent) × 2 (people story: yes, no) × 2 (causes supported: more, fewer) × 4 (cell: a, b, c, d) design with priming as the sole between-groups manipulation. These four factors served as the model for the fixed effects in the MLM analysis. As in Experiment 1, we analyzed participants' cell weights and the correspondence between their causal judgments and *phi*. We performed both overall analyses and planned comparisons: We tested the competing hypotheses that the difference between cover stories for interdependents in Experiment 1 was a result of differences in the number of alternative causes that the outcome supported versus differences in whether the cover story dealt with effects on people by separately assessing the causes supported and people story factors for the independent and interdependent-primed participants.

3.2. Results and discussion

Two participants gave causal judgments outside the range of the scale and were excluded from the analyses, leaving 135 participants (68 independents and 67 interdependents).

3.2.1. Cell weighting

3.2.1.1. Overall analysis. Overall, we observed the typical cell weight inequality, with participants weighting A > B > C > D (see bottom row of Table 5). Bonferroni post hoc tests on this main effect of cell, $F(3,1987) = 33.59$, $p < .001$, revealed all cell weights to be significantly different from one another.[5]

Of particular relevance to the goals of Experiment 2, however, are the two potential interactions: priming by causes supported and priming by people story (depicted in Table 6). Overall, neither interaction was significant: priming by causes supported interaction, $F(1, 1987) = 3.07$, $p = .080$ (marginally significant); priming by people story interaction, $F(1, 1987) = 1.11$, $p = .292$. However, to test the competing hypotheses, we performed simple main effects tests for each interaction.

Tests of the number of causes supported at each level of priming were consistent with the effects of cover story in Experiment 1: The number of causes supported did not matter for the independents, who placed similar weight on the data for cover stories supporting more and fewer causes, $F < 1$, $d = 0.00$ (see Table 6). However, the interdependent-primed participants placed less weight on the data for outcomes supporting more versus fewer causes, $F(1, 1987) = 7.97$, $p = .005$, $d = .16$. Tests of the effect people story failed to yield an effect for either the independents, $F < 1$, $d = .04$, or the interdependents, $F(1, 1987) = 1.21$, $p = .271$, $d = .03$. No other effects involving priming reached significance, $Fs < 1$. Overall, this pattern of results is consistent with the hypothesis that it is the number of alternative causes the outcome supports, and not whether the stories involved effects on people that was driving the effects of cover story in Experiment 1.

As a final observation, in the overall analysis we also observed a significant 3-way (cell by people story by causes supported) interaction, $F(3,1987) = 4.47$, $p = .005$. This interaction appeared to be driven by differences in Cells A and B. When there were more causal alternatives, participants gave greater weight to Cell A for the story not involving

[5] Looking at the overall means of the cell weights for Experiments 1 and 2 (bottom rows of Tables 4 and 5), it appears that participants in Experiment 2 placed more weight on Cell A than did those in Experiment 1. It is not immediately clear why this is the case. We speculated that participants may have adopted a less sophisticated judgment strategy when faced with a greater number of cover stories—i.e., a longer task. While overall we failed to find main effects or interactions with block, consistent with the idea that participants might adopt less sophisticated judgment strategies over time, we observed that participants weighted Cell A more heavily for the cover story presented last ($M = .77$, CI [.74, .81]) than for that presented first ($M = .70$, CI [.66, .74]). However, this does not explain why even in the first block, participants appeared to be placing more weight on Cell A in Experiment 2 than in Experiment 1.

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Table 6
Mean cell weights in Experiment 2 corresponding to the marginal means from Table 5 for the priming by causes supported interaction and priming by people story interaction. 95% confidence intervals in parentheses.

Priming	Causes supported		People story?	
	More	Fewer	Yes	No
Interdependent	.47 (.45, .50)	.52 (.49, .54)	.49 (.46, .51)	.50 (.48, .53)
Independent	.51 (.49, .53)	.51 (.48, .53)	.50 (.48, .52)	.51 (.49, .54)

people (M = .77; CI [.74, .82]) vs. that involving people (M = .72, CI [.68, .77]); conversely, they gave less weight to Cell B for the story not involving people (M = .46; CI [.42, .51]) vs. that involving people (M = .50, CI [.46, .54]). When there were fewer alternative causes, we observed the opposite pattern, with Cell A more heavily weighted for the story involving people (M = .75, CI [.71, .79]) vs. not (M = .72, CI [.68, .76]); and Cell B weighted less for the story involving people (M = .47, CI [.52, .51]) vs. not (M = .56, CI [.52, .61]). Given, however, that our primary concern was the effect of the priming (this 3-way interaction did not further interact with priming, $F < 1$) and that the cells in this interaction each rely on a single cover story, we hesitated to over-interpret the interaction.

3.2.1.2. Planned comparisons testing differential weighting of cell C. To compare with Experiment 1, we also analyzed the effects of priming, alternative causes, and people story on the Cell C weights. The analyses were similar to and consistent with Experiment 1: There was a small main effect of priming, such that interdependents (M = .41, CI [.37, .45]) weighted Cell C less than independents (M = .47, CI [.44, .52]), $F(1, 133)$, = 5.69, p = .017, d = 0.19. Although the priming by people story and priming by causes supported interactions did not reach significance, $Fs < 1$, we performed planned comparisons testing the effects of causes supported and people story at each level of priming. Consistent with the overall analysis, independents weighted Cell C similarly for outcomes supporting both more (M = .47, CI [.43, .52]) and fewer causes (M = .47, CI [.43, .52]), $F < 1$, d = 0.00, while interdependents gave less weight to Cell C for outcomes supporting more (M = .37,CI [.32, .42]) as opposed to fewer causes (M = .45, CI [.40, .50]), $F(1, 397)$ = 8.72, p = .003, d = 0.31. The people story factor failed to reach significance for either the interdependents, p = .183, or the independents, $F < 1$.

3.2.2. Correspondence between cell weighting and objective contingency

Consistent with the cell weighting analyses, overall, independents showed a greater correspondence between causal judgments and *phi* (M = 1.11, CI [0.99, 1.23]) than interdependents (M = 0.87, CI [.76, .99]) [main effect of priming, $F(1, 133)$ = 3.99, p = .049, d = .36]; see Fig. 2. While the interaction between priming and causes supported failed to reach significance, $F < 1$, planned comparisons testing the effect of causes supported at each level of priming revealed a significant difference for interdependents, $F(1, 397)$ = 20.90, $p < .001$, d = .42, but not for independents, $F < 1$, d = .06. Commensurate with their pattern of cell-weighting, interdependents demonstrated a greater correspondence between their causal judgments and *phi* for cover stories supporting fewer (M = 1.01, CI [0.88, 1.14]) as opposed to more causes (M = .74, CI [0.61, 0.87]), while independents showed similar sensitivity for both types of cover stories (M = 1.09, CI [0.96, 1.22] and M = 1.13, CI [1.00, 1.26] for more and fewer causes, respectively). The difference between the independents and interdependents for the stories supporting more causes was of moderate size (d = .56).

Unlike in the analyses of the cell weights, we observed a priming by people story interaction, $F(1, 397)$ = 4.66, p = .031. However, this interaction was due to the independents having greater sensitivity to *phi* when the cover story did not deal with people (M = 1.19, CI [1.06, 1.32]) than when it did (M = 1.03, CI [0.90, 1.16]), $F(1, 397)$ = 6.97, p = .009, d = .24, while the sensitivity of interdependents was similar

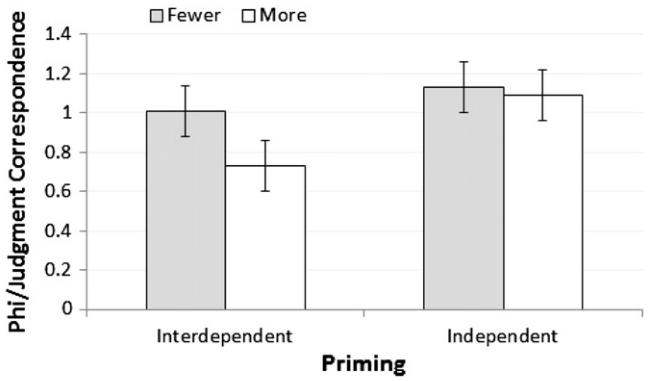

Fig. 2. Average correspondence between judgments and *phi* (measured as absolute value of Fisher's z transformed r) in Experiment 2. Error bars are 95% confidence intervals.

regardless of whether the cover stories dealt with people (M = .86, CI [0.73, 0.99]) or not (M = .89, CI [0.76, 1.02]), $F < 1$, d = .03. We observed no other effects, $ps > .13$.

3.2.3. Number of causes listed

Participants in our sample did list more causes for car accidents and stress than for skin rashes and plant growth. Modeling the priming by cover story factorial as fixed effects, we found results consistent with the pilot data: There was a main effect of story, $F(1,392)$ = 49.13, $p < .001$ and no other effects, $Fs < 1$, including no effect of prime. Bonferroni comparisons revealed that participants listed a similar number of causes for car accidents (M = 9.22, CI [8.57, 9.87]) and stress (M = 9.74, CI [9.10, 10.39]); and a similar number for plant growth (M = 5.77, CI [5.12, 6.41]) and skin rashes (M = 5.73, CI [5.09, 6.37]). All other pairwise comparisons reached significance.

3.3. Discussion

Experiment 2 replicated the unexpected effect of the interdependent prime on cell weighting – and in particular, the weighting of Cell C – as observed in Experiment 1. Overall, interdependents in Experiment 2 gave less weight to Cell C than did independents. Like Experiment 1, this reduction in cell-weighting corresponded to a reduced sensitivity to the contingencies.

As in Experiment 1, the content of the causal cover story consistently mattered for the interdependent, but not independent, participants. Furthermore, the results of Experiment 2 suggest that the cover story effects observed in Experiment 1 resulted from interdependents placing less weight on the data and thereby being less sensitive to the contingencies for cover stories that supported more as opposed to fewer causes. This difference was not however, driven by the ability of interdependents and independents to generate alternative causes of the outcome, as there was no effect of the prime on the number of causes listed.

4. General discussion

Our results suggest that interdependents are indeed more sensitive than independents to alternative causes of outcomes, just not in the way we predicted. We predicted that interdependents would be more sensitive than independents to observable data indicative of unobserved background causes—i.e., Cell C. Instead we found that interdependents were less sensitive to the overall data and to the Cell C frequency when the cover stories supported more alternative causes. Of key importance is that these differences in the weighting of the cell frequency information translated to differences in the sensitivity of participants to the objective contingencies, with interdependents demonstrating less sensitivity to the contingencies, particularly for outcomes supporting more causes.

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Why did we observe this effect? A post hoc explanation for the observed effect may rely on emphasizing a different aspect of the holistic/contextual vs. analytic/de-contextual distinction previously made for interdependence and independence in the introduction. The relative insensitivity of independents to the holistic context may have better-enabled their ability to tease apart the focal candidate cause from the background causes, much in the same way it has been shown to improve selective listening performance in a dichotic listening task (Oyserman et al., 2009). In a way, our results may be similar to those of the cultural differences in emotion judgment (Masuda et al., 2008): East Asian's judgments of the emotion on a target face were influenced by the emotions of surrounding faces. Analogously, interdependent participants in our study may have been more influenced by their knowledge of background causes and this knowledge may have been integrated with the data, leading to less reliance on the data explicitly presented to them. We assumed that greater attention to background causes would result in greater weighting of observable data indicative of those causes. However, it may have led to an integration of the focal experimentally-presented information and a priori knowledge of background causes.

In a scenario involving two explicitly-presented causes of a common effect, in which the effects of both causes were revealed, Kim et al. (2007) observed that interdependents reduced their judgments of a moderately effective cause in the presence of a strong alternative more so than did independents. Kim et al. used a plant growth cover story like the one in our Experiment 2. Thus, our results cannot help explain their result: We did not find differences in the weighting of data between the independents and interdependents for the plant growth cover story—one of the outcomes for which participants listed fewer causes. Thus, additional factors must come into play when alternative causes are explicitly presented.

4.1. Size of the observed priming effects

Although data-weighting was related to the correspondence between participants' judgments and *phi*, we observed larger effects of priming in the judgment/*phi* correspondence than in the cell-weighting. Overall, we observed small to very small main effects of the prime. It was only when we looked at moderators of the priming effect that we began to see larger effect sizes (e.g., the difference in judgment/*phi* correspondence between the interdependents and independents for the stories supporting more alternatives was $d = .56$). This moderate-sized effect is consistent with the sizes of effects observed on cognitive tasks in a meta-analysis of cultural priming, in which an average effect size of 0.50 was observed across social and non-social cognitive tasks (Oyserman et al., 2002). However, our results also suggest the importance of moderators of these priming effects. A challenge for future research will be identifying when, and on which tasks, these cultural differences emerge.

4.2. Culture as repetitive priming

Situational primes may be more or less effective in overcoming chronic differences in cultural mindset. Thus, we may expect to see larger effects if we were to compare the performance of individuals of East Asian and North American cultures who have chronic differences in their cultural mindset (but see Oyserman et al., 2009). Nonetheless, the findings from the priming studies hint that people may be constantly primed by the environment and that these subtle nudges in our mindset influence how we attend to and use information from the environment even for what appear to be relatively basic cognitive tasks. Together, small effects from benign environmental primes (e.g., being in a large group that one identifies with rather than being alone) could potentially accumulate and have larger effects on behavior than observed when manipulating any prime in isolation.

Indeed, culture may be the result of a repetitive environmental prime (e.g., Miyamoto, Nisbett & Masuda, 2006; Oyserman, 2011). A number of studies demonstrate that primes can be used to "push around" the performance of individuals from North America and East Asia such that those who are culturally individualistic look more collectivist and vice versa (e.g., Gardner et al., 1999; Oyserman, Sorensen, Reber, & Chen, 2009). However, caution must be exercised, as some studies demonstrate that, at least for some tasks, the effects of a prime depend on one's chronic culture (see Miyamoto & Wilken, 2013).

4.3. Conclusion

Our studies, along with other studies demonstrating effects of motivational differences on cognition, suggest that there is a greater need for the study of individual and motivational differences (Henrich et al., 2010; Markman, Baldwin, & Maddox, 2005; Schaller, 1992). "Basic" cognitive processes cannot be stripped away from the larger motivational and contextual factors. Often, we may be at risk of detecting a default information processing style reflective of the chronic motivational states of our participants rather than something fundamental about the nature of cognitive processing. Furthermore, the influence that motivational factors have on cognitive processing may help to explain failures of effects to replicate across studies. Thus, as we begin to understand these individual differences in motivation, we must strive in our research to create experimental conditions that control for potential motivational differences.

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Appendix A. Cover stories

A.1. Skin rash cover story

For this problem imagine that you are a doctor trying to determine whether there is a relation between hiking in the woods and developing a skin rash. In order to test this theory, you collect information from 12 different doctor's offices. For each office, you record information about children who were or were not hiking in the woods and whether they subsequently experienced a skin rash. Each of the following screens indicates the results of a SINGLE study from a SINGLE doctor's office. For each office you will be asked to rate how effective hiking in the woods is in either causing or preventing a skin rash. You should evaluate each office independently of the results of all the other offices. You will make your causal judgment on a scale that goes from −100 to +100. −100 means that hiking in the woods completely prevents skin rashes. +100 means that hiking in the woods completely causes skin rashes. 0 means that hiking in the woods is not related to the development of a skin rash in any way. You may use any number in between −100 and +100 to indicate how effective hiking in the woods is in preventing or causing a skin rash.

A.2. Car accident cover story

For this problem imagine that you are a U.S. police officer trying to determine whether there is a relation between car accidents and severed brake lines. In order to test this theory, you have police detectives collect information from 12 different counties within the

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states of New Jersey and New York. For each county, they record accident information about cars that had severed brake lines and those that did not. Each of the following screens indicates the results of a SINGLE study from a SINGLE county. For each county you will be asked to rate how effective severed brake lines are in either causing or preventing car accidents. You should evaluate each county independently of the results of all the other counties. You will make your causal judgment on a scale that goes from −100 to +100. −100 means that severed brake lines completely prevents car accidents. +100 means that severed brake lines completely causes car accidents. 0 means that severed brake lines are not related to the car accidents in any way. You may use any number in between −100 and +100 to indicate how effective severed brake lines are in causing or preventing car accidents.

A.3. Plant growth cover story

For this problem imagine that you are a botanist trying to determine whether there is a relation between fertilizer use and plant growth. In order to test this theory, you collect information from 16 different greenhouses across the state of New Jersey. For each greenhouse, you record information about plants that were or were not given fertilizer and whether those plants subsequently experienced healthy growth. Each of the following screens indicates the results of a SINGLE study from a SINGLE greenhouse. For each study you will be asked to rate how effective fertilizer is in either causing or preventing healthy plant growth. You should evaluate each greenhouse independently of the results of all the other greenhouses. You will make your causal judgment on a scale that goes from −100 to +100.

−100 means that fertilizer use prevents healthy plant growth. +100 means that fertilizer use causes healthy plant growth. 0 means that fertilizer use is not related to the plant growth in any way. You may use any number in between −100 and +100 to indicate how effective fertilizer use is in causing or preventing healthy plant growth.

A.4. Stress cover story

For this problem imagine that you are a clinical psychologist trying to determine whether there is a relation between stress and having lots of deadlines for schoolwork. In order to test this theory, you collect information from 16 different college counseling centers across the country. For each counseling center, you record information about patients who were and were not experiencing stress and whether those patients were experience lots of deadlines for schoolwork. Each of the following screens indicates the results of a SINGLE study from a SINGLE counseling center (labeled with an alphanumeric code). For each counseling center you will be asked to rate how effective schoolwork deadlines are in either causing or preventing stress. You should evaluate each counseling center independently of the results of all the other counseling centers. You will make your causal judgment on a scale that goes from −100 to +100. −100 means that schoolwork deadlines prevent stress. +100 means that schoolwork deadlines cause stress. 0 means that schoolwork deadlines are not related to stress in any way. You may use any number in between −100 and +100 to indicate how effective schoolwork deadlines are in causing or preventing stress.

Appendix B. Random effect results

B.1. Experiment 1

B.1.1. Cell-weighting

The intraclass correlation coefficient (ICC) for participants' cell weights was 0.00, indicating that little to no variability in cell weights was due to between-participant differences. Given this small ICC, we failed to observe a significant random effect of participants' intercepts, $\sigma_0^2 = 0.000$, $SE = 0.000$, $z = 0.00$, $p = .999$.

B.1.2. Correspondence between judgments and objective contingency

The ICC was 0.485, indicating that 48.5% of the variability was due to between-participant differences. Commensurate with this ICC, we observed a significant random effect of participants' intercepts, $\sigma_0^2 = 0.217$, $SE = 0.038$, $z = 5.66$, $p < .001$.

B.2. Experiment 2

B.2.1. Cell-weighting

The ICC was 0.0043. Consistent with this small ICC, and with Experiment 1, the effect of participants' random intercepts did not approach significance, $\sigma_0^2 = 0.0004$, $SE = 0.0007$, $z = 0.512$, $p = .308$.

B.2.2. Correspondence between judgments and objective contingency

We observed a moderate ICC of 0.55, and a significant effect of participants' random intercepts, $\sigma_0^2 = 0.2487$, $SE = 0.0318$, $z = 7.81$, $p < .001$.

Appendix C. Means of causal judgments in experiments 1 and 2

Means of causal judgments as a function of *phi*, prime, and cover story in experiments 1 and 2. Standard deviations in parentheses.

		Experiment 1		Experiment 2	
		Priming			
Cover story	Objective *phi*	Independent	Interdependent	Independent	Interdependent
Skin rash	−.36	−21.29 (46.70)	−12.90 (43.44)	−26.46 (38.96)	−25.84 (40.34)
	−.05	−2.17 (43.00)	4.77 (40.18)	−7.69 (40.07)	−2.75 (35.53)
	.05	4.32 (43.39)	18.77 (35.78)	12.98 (38.66)	13.76 (40.28)
	.36	30.44 (49.86)	39.37 (40.02)	40.48 (38.90)	39.56 (41.77)
Accidents	−.36	−13.58 (44.28)	−6.20 (52.15)	−24.88 (38.11)	−16.74 (45.84)
	−.05	10.51 (35.35)	15.97 (46.38)	2.97 (36.98)	−0.74 (41.77)
	.05	15.96 (38.28)	17.33 (43.08)	15.39 (42.44)	9.41 (46.67)
	.36	41.08 (36.05)	35.71 (50.32)	48.95 (34.08)	33.41 (48.94)
Plant growth	−.36			−34.30 (43.86)	−33.82 (41.76)
	−.05			−2.45 (37.93)	−5.48 (37.55)
	.05			14.82 (38.63)	15.57 (36.77)
	.36			50.48 (35.90)	48.17 (36.28)
Stress	−.36			−29.14 (38.81)	−26.11 (42.50)
	−.05			−8.02 (39.78)	−4.94 (42.83)
	.05			10.12 (40.11)	13.07 (45.39)
	.36			42.94 (40.14)	38.23 (45.04)

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