Comparing cultural theory and cultural cognition theory survey measures to each other and as explanations for judged risk

Abstract

Different approaches to operationalizing the cultural theory (CT) developed by Douglas, Thompson, Wildavsky, and others in survey research on risk perceptions are rarely compared, never for the same people. We compare for US respondents the construct validity of cultural worldview measures developed by Jenkins-Smith and colleagues—including both indices of items refining the Wildavsky and Dake approach, and short paragraphs (cultural "statements")—to those developed by Kahan and colleagues based on cultural cognition theory (CCT). Correlational analyses reveal moderate convergent and discriminant validity among these measures, and along with regression analyses controlling for demographic variables similarly moderate predictive validity across measures for judgments of personal risk for ten hazards. CT statements better discriminate between individualists and hierarchists, and CT indices explain more variance in judged risk (predictive validity) when controlling for demographic variables in regression analyses. We discuss theoretical and methodological implications of our findings to foster further scholarly comparisons of and improvements in these survey-based cultural approaches to explaining risk judgments.

Keywords: cultural theory, cultural cognition theory, culture, worldviews, risk perception

Introduction

National and within-country differences in risk perceptions are well-documented (Renn and Rohrmann 2000). Risk analysts using the cultural theory (CT) developed by Douglas, Wildavsky, and others (Douglas and Wildavsky 1982; Schwarz and Thompson 1990; Thompson 2008; Thompson, Ellis, and Wildavsky, 1990) claim that some variation in judged risk is of a particular cultural kind. For them, cultures are institutions or patterns of relations derived from

two relational dimensions that give rise to and are sustained by compatible values and beliefs called "cultural biases." Their concept of culture is not tied to a particular social or political unit of analysis, such as a country, political party, or interest or identity group, but instead they claim it can be used to analyze cultural variations in any such units.

Scholars using CT do not claim that its two dimensions (grid and group) are the *only* dimensions of cultural variation nor the only sources of cultural variation in risk perception. But these dimensions are among a few found to exist cross-nationally (Maleki and de Jong 2014; Maleki and Hendriks 2015) and CT has been used in comparative studies of cross-national cultural variation, including to explain risk perception, management, and regulation[1] (see, e.g., 6 2011; Cornia, Dressel, and Pfeil 2016; Grendstad 1999, 2003; Hendriks 1999; Heims 2016; Hood, James, Peters, and Scott 2004; Lockhart 1997, 1999, 2011; Lodge and Wegrich 2011a; Nakamura 2016; Olli 2012; Peters and Slovic 1996; Verweij 2000; Wildavsky 1986, 2001). Moreover, the cultural types generated by CT's dimensions in the US are similar to those generated inductively by the best-known approach to studying US political subcultures (Elazar 1984, 1994; compared to CT in Thompson, Ellis, and Wildavsky 1990) and have been validated in CT studies *within* the US for some elements of culture as conceived in CT both in the general population and across a variety of organizational settings, again including studies of risk perception, management, and regulation (see, e.g., Chai and Wildavsky 1998; Coyle 1994; Ellis 1998; Ellis and Wildavsky 1989; Ellis and Thompson 1997; Gastil, Braman, Kahan, and Slovic 2011; Jackson 2014; Jones 2011, 2013, 2014; Jones and Song 2013; Lockhart 1997, 2001; Moyer and Song 2016; Ripberger, Jenkins-Smith, and Herron 2011; Ripberger, Song, Nowlin, Jones, Jenkins-Smith 2012; Ripberger, Gupta, Silva, and Jenkins-Smith 2014; Swedlow 2012, 2017; Swedlow, Ripberger, Liu, Silva, and Jenkins-Smith 2016; Trousset, Gupta, Jenkins-Smith,

Silva, and Herron 2015; Tumlison, Moyer, and Song 2017; Wildavsky 1986). Elements of CT's cultures have also been found to exist *within* European and Asian countries, among others, both in the general population and across a similar variety of organizational settings, and have been used to explain risk perception, management, and regulation there as well (see, e.g., Bale 1997, 1999; Brenot, Bonnefous, and Marris 1998; Cornia et al. 2016; Grendstad 1999, 2003; Kiss, Montpetit, and Lachapelle 2016; Lachapelle, Montpetit, and Gauvin 2014; Liu 2018; Lodge and Wegrich 2011b; Lodge, Wegrich, and McElroy 2010; Matheson 2017; Olli 2012; Simmons 2016; Sotirov and Winkel 2015; Xue et al. 2014; Xue, Hine, Marks, Phillips, and Zhao 2016). Thus, while some scholars (e.g., Boholm 1996; van der Linden 2016) question whether the cross-national and within-country cultural variation posited by CT exists – and we agree and elsewhere argue (Johnson & Swedlow, 2019) that there is significant room to improve the validity of CT concepts, measures, and studies – our reading of existing CT studies is that there is a reasonable basis for a CT-based specification of cultural sources of risk perception both cross-nationally and *within* the US and a number of other countries.

This paper contributes to cultural studies of risk perception by comparing two conceptual variants and three approaches to measuring CT's cultures in surveys. No study has yet compared the variants and approaches within the same people. We fill this research gap by comparing in a panel of US respondents the construct validity of cultural worldview measures developed by Jenkins-Smith and colleagues (most recently Swedlow, Ripberger, Liu, Silva, and Jenkins-Smith 2016a, 2016b) to those developed by Kahan (2012) and colleagues based on a variant of CT they call cultural cognition theory (CCT). The Jenkins-Smith CT measures include both indices of cultural worldview items, refining the approach of Wildavsky and Dake (1990), and short paragraphs (cultural "statements").

Comparison of these approaches is much needed, particularly given Kahan's (2012) critiques of CT's conceptualization and operationalization; critiques of Kahan's conceptualization and operationalization of CT as CCT (Douglas 2003; Olli 2012; van der Linden 2016); and Kahan's (2012) argument that CCT is preferable for its greater scale reliability and predictive validity. The only (partial) comparison of predictive validity to date, a meta-analysis of 21 CT and CCT studies of environmental risk perceptions (Xue et al. 2014), found expected if modest cultural influences, with cultural effect sizes varying with hazard type, study location, and cultural measure used.

Thus, after further detailing CT and CCT differences in risk-perception survey implementation, we compare CT indices and statements to CCT indices. We use two-sided bivariate correlational analyses for a simple baseline for these multiple comparisons, supplemented by hierarchical regression analyses controlling for demographic variables to determine relative effects of these three operationalizations in explaining risk perceptions. We find moderate convergent and discriminant validity, and with regard to judged risk moderate predictive validity. CT statements better discriminate between individualists and hierarchists, and CT indices explain more variance in judged risk in regression analyses. We discuss theoretical and methodological implications of our findings and invite other scholars to join us in the effort to compare and improve upon these cultural approaches to explaining judged risk.

Background

Cultural theory (CT) and cultural cognition theory (CCT)

CT posits that two dimensions of social and political relations generate four basic ways life can be lived. "Grid" seeks to capture how much individual behavior is regulated, while "group" attempts to capture how much individuals act collectively. Crossing these dimensions

produces relational patterns or institutions that are hierarchical (high grid and group), individualist (low grid and group), egalitarian (low grid, high group), and fatalist (high grid, low group; Figure 1). CT further hypothesizes these four institutional patterns generate, and in turn are sustained by, compatible cultural biases consisting of political values, and beliefs about human nature, the environment, and the economy, among other things.

[Figure 1]

The initial CT operationalization in survey research, by Dake and Wildavsky (Dake 1990, 1991, 1992; Dake and Wildavsky 1991; Wildavsky and Dake 1990), adapting existing worldview measures, yielded four scales corresponding to the four cultural biases rather than two scales corresponding to the grid and group dimensions. Wildavsky and Dake (1990) found these cultural worldview measures better predicted risk perceptions than other available explanations, prompting much interest, translation of the measures into many European languages, and their administration in several European risk surveys (see bibliography in Wildavsky 2006; Xue et al. 2014). Results were at best mixed, causing considerable criticism and rejection of CT (e.g., Bellaby 1990; Boholm 1996; Johnson 1987; Marris, Langford, and O'Riordan 1998; Renn and Rohrmann 2000; Rippl 2002; Sjöberg 1997), despite others continuing to find it valuable (e.g., Ellis and Thompson 1997; Gastil et al. 2011; Kahan 2012; Kahan et al. 2007, 2010, 2012, 2016; Peters and Slovic 1996; Moyer and Song 2016; Ripberger et al. 2014; Ripberger, Jenkins-Smith, and Herron 2011; Tumlison, Moyer, and Song 2017; Xue et al. 2014).

Jenkins-Smith and collaborators are prominent among the latter group, refining Dake-Wildavsky worldview items for greater scale reliability but retaining one scale for each worldview (Herron and Jenkins-Smith 2006; Ripberger et al. 2012, 2014; Ripberger, Jenkins-Smith, and Herron 2011). They recently developed single statement measures mixing

worldviews with relational experiences and preferences, combining ratings and (partial) ranking (Swedlow et al. 2016a, 2016b; Tables 1-2).

[Tables 1–2]

Inspired by CT and the Dake-Wildavsky operationalization, Kahan and collaborators (Kahan 2012; Kahan et al. 2007, 2010, 2012, 2016) developed a conceptualization and measurement of worldviews and their dimensional arrangement in survey research that both builds upon and significantly departs from prior efforts. CCT seeks to operationalize "grid" as the extent of hierarchy versus egalitarianism, and "group" as the extent of individualism versus communitarianism (Figure 2; Table 3).

[Figure 2]

[Table 3]

Expected associations of cultural measures with judged risks

Scholars using CT and CCT predict risk perceptions will have a functional relationship with relational patterns corresponding to the four institutional types generated by grid and group. Wildavsky and Dake (1990), for example, give reasons deduced from CT why hierarchs will fear social deviance, egalitarians technological threats to the environment, and individualists economic disruption.

But it is unclear why cultural differences in risk perception develop for some risks and not others (Kahan et al. 2016). Douglas and Wildavsky saw institutional explanations as very important (Douglas 1986; Douglas and Wildavsky 1982; Wildavsky 1987). Wildavsky thought political parties, the major U.S. institutional vehicles for translating preferences into public policies, were culturally polarizing, with Democrats becoming more egalitarian and Republicans more hierarchical and individualistic (Wildavsky 1991; also Swedlow et al. 2016b), causing

related differences in risk perception.

This recognition drives a reasonable hypothesis about how culture generates risk perceptions, based on Zaller's (1992) argument that the public develops opposing views on political issues when 1) opinion leaders such as partisan politicians or interest group representatives have differences 2) which are communicated 3) to an attentive public. Kahan et al. (2016) effectively make the first two parts of this argument when they note how interest groups propagate "[c]ulturally antagonistic memes—highly suggestive, highly inflammatory argumentative tropes that fuse risks to contested understandings of the best way to live." Such interest group activity (Brady and Sniderman 1985) can convert otherwise broadly consensual issues such as the Zika virus' health threat into divergent risk perceptions (Kahan et al. 2016).

This hypothesis should apply to risks in our study because all besides airplane crashes[2] have been or could be culturally contentious in the U.S.: the Zika and Ebola viruses, gun control, nuclear power, GMOs, abortion, climate change, pesticides, and food additives. However, this hypothesis does not specify how closely coupled elite and public views are: How quickly does the public develop views mirroring elites', and how long after their last exposure to elite views does the public retain them?

However, the CT and CCT literature does generate some expectations for how culture relates to risk judgements. Table 4 summarizes these expectations only for hierarchism, individualism, and egalitarianism because fatalists' risk perceptions are difficult to predict.[3]

[Table 4]

Gun control, abortion, and environmental threats are all hazards fully or partially human-caused which have been publicly salient and culturally contentious for decades, exhibiting no discernible shifts in cultural fears among US political elites. "Persons of hierarchical and

individualistic orientations should be expected to worry more about [gun control than egalitarians] because of the association of guns with hierarchical social roles (hunter, protector, father) and with hierarchical and individualistic virtues (courage, honor, chivalry, self-reliance, prowess)" (Kahan et al. 2007, citing Kahan and Braman 2003; but see Douglas 2003 and response in Kahan 2012). Hierarchists, but not individualists and egalitarians, should be threatened by abortion protections for their undermining of patriarchic gender relations (Kahan et al. 2007; but see Stenvoll 2002).

Based on Douglas and Wildavsky (1982), individualists and hierarchists should see climate change and other threats to the environment as low risk, but egalitarians will see them as high risk. "[I]ndividualists tend to be dismissive of environmental and technological risks because giving credence to such risks would invite restrictions on commerce and industry, two aspects of modern society that they value" (Xue et al. 2014, p. 250). "Similarly, hierarchists also tend to discount environmental and technological risks, given that acknowledging such danger could be viewed as 'implicit indictments of competence and authority of societal elites' [citing Kahan 2012, p. 728]. Egalitarians view commerce and industry as important sources of social inequality and, as such, are more likely to view environmental and technological risks associated with these endeavours as unacceptable."

Yet interpretive ambiguities created by temporal change in technologies and associated risks should be acknowledged. Nuclear power, once embodying individualists' and hierarchists' technological optimism and consequently reviled by egalitarians (Robinson 2016), is now attractive to (some) egalitarians for not emitting greenhouse gases they fear drive climate change (Jones 2011). On the other hand, 55% of Americans in the 2016 General Social Survey rated "nuclear power stations" as extremely/very dangerous, a proportion that may be too large to

include only egalitarians and/or fatalists (National Science Board, 2018). So cultural differences in support for nuclear power may have blurred (Corner et al. 2011; Jones 2011; Robinson 2016). Pesticide use continues to be opposed by egalitarian environmentalists, but successful use reduction and increased availability of alternatives like organic foods may have ameliorated cultural contention about them. As agribusiness is responsible for most food additives, these might arouse concerns for egalitarians, but absent recent problems with additives people might lack motivation to feel threatened (Hirsch and Baxter 2011).

Some cultural convergence also might occur over genetically modified organisms (GMOs), condemned by environmentalists for their use in crops, and by political conservatives fearing humans are "playing God" (Finucane et al. 2000; Finucane and Holup 2005; Flynn, Slovic, and Mertz 1994; Sheehy, Legault, and Ireland 1996).

As natural hazards, the Ebola and Zika viruses might fail to trigger cultural contention as less clearly implicating desired or feared social arrangements than do more obviously human-caused hazards (Johnson 2017), despite experimentally-induced polarization over climate change and immigration claims over Zika (Kahan et al. 2016). Xue et al. (2014) found stronger effect sizes for hazards partly or wholly human-caused than for natural hazards, the risks of which individualists downplayed but other cultures amplified.

Research questions

We aim to assess whether these different cultural measures (1) converge (e.g., hierarchist measures are correlated regardless of method) or diverge (e.g., hierarchist and egalitarian measures are negatively correlated or uncorrelated[4]) as expected, and (2) predict risk judgments as expected.

Methods

Research design

The Decision Research online panel is a diverse, quota-recruited (gender, age, education) sample of American adults, most with job and/or family responsibilities. The study's four waves of longitudinal polling over six months—July 19-24, 2016 (Wave 1, n = 1047), August 1-13, 2016 (Wave 2, n = 989), January 25-February 6, 2017 (Wave 3, n = 805), and April 13-24, 2017 (Wave 4, n = 743)—would have been prohibitively costly with a nationally representative sample. This was a longitudinal design for reasons *other* than testing the associations between these different cultural measures; only the CCT measures were included in the original design, with the other CT measures added later as we realized the opportunity offered by this design. Respondents were paid at a prorated rate of $15 per hour, with a median time of 21.9, 19.8, and 19.6 minutes for the common respondents (n = 743) to Waves 1, 3, and 4, the subjects of this paper.

Cultural measures

CCT measures assessed in Wave 1 were the full sets of 13 items for Grid (hierarchism-egalitarianism) and 17 items for Group (individualism-communitarianism), while Wave 3 measures included three items each for the four CT worldviews (CT indices; Swedlow et al. 2016a) (Tables 3 and 1, respectively). Both CCT and CT items were answered on 6-point *strongly disagree-strongly agree* scales (Flynn, Slovic, and Mertz 1994). Wave 4 sought ratings of four CT "statements" (Swedlow et al. 2016a) on the degree to which they described the subject's outlook on life, who answered these questions on a 0 *not at all*-10 *completely* scale (Table 2)[5].

Dependent variables

To assess predictive validity, personal risk ratings were elicited in Wave 1. People rated

ten hazards—worded exactly as in Table 4 and later tables—on 6-point scales (1 = *no risk at all*, 6 = *very high risk*) for "risk to you and your family" (personal risk).Judgments of "risk to the U.S." also were collected, but with few exceptions—e.g., fatalists rating these lower than personal risks, perhaps reflecting the latter's greater relevance to them—results were similar, as reported in our online supplemental information.

Analysis

Two-sided bivariate correlations were used to assess inter-measure associations. Adjustment for multiple contrasts used the false discovery rate approach (FDR), which tests significance at the individual item level rather than Bonferroni's test of a universal null hypothesis against an omnibus alternative, while retaining sufficient power to minimize false positives (Glickman, Rao, and Schultz 2014). With FDR at $d = .01$ (recommended for empirical investigations), no more than 1% of significant differences identified by this method should be false positives. Hierarchical regression analyses, with gender, age and education as controls entered at the first step, probed the relative effect of separately adding each of the three operationalizations (CCT indices, CT indices, CT statements) at the second step.

To assess the substantive value of observed correlations, we utilized effect size thresholds proposed by Cohen (1988) of small ($r > .10$), medium ($r > .30$), and large ($r > .50$; Cohen 1988, pp. 79-80), supplemented by Rosenthal's suggestion of a very large ($r > .70$) effect size threshold (Rosenthal 1996). Effect sizes for change in R^2 in regression analyses were assessed using two sets of suggested criteria: the commonly used Cohen (1988) conventions—1% (small), 9% (medium), 25% (large)—and Ferguson's (2009) stricter criteria, given allegations that Cohen's prompt over-interpretation of small effects: 4% (minimum practical significance), 25% (moderate), 64% (strong). Despite dangers in arbitrary use of these or other criteria (e.g., Cohen

1988, pp. 12, 532; Glass, McGaw, and Smith 1981, p. 104), they help guide discussion of our results' potential meanings.

No adjustments (e.g., imputation or use of means) were made for missing data. In the main regression analyses reported later, each cultural measure's effect beyond that of the demographic controls was based on the sample for the wave in which that measure was collected: i.e., Waves 1 (CCT), 3, (CT indices), and 4 (CT statements), respectively. However, we also report the same results for those people who answered all three waves, as a partial control for wave effects.

Results

Sample

Respondents (n =705) were more female and better educated than the U.S. population: 60.3% women, with a mean age of 44.0 (SD = 13.7, median = 42); 48.8% completed at least a bachelor's degree. Some 37.8% were liberal, 29.1% conservative.

Correlations between cultural measures

Bivariate two-sided correlations were calculated among the four CT indices, the four CT statements, and the two CCT indices (Table 5). Practically all correlations were statistically significant, including by the false discovery rate criterion all those with $p < .05$, and several exhibited expected convergent or divergent validity (see shading in table; 27 of the non-fatalist correlations; 12 of the 45 total correlations). The three hierarchist measures were all positively associated, although the strength of this association was less with the CT hierarchist statement, and the three individualist measures were all positively associated, although with lower strength for the CT individualist statement. The two CT egalitarian measures were positively associated, suggesting convergent validity, and negatively associated with the HE and IC indices, evidencing

divergent validity. Most of these expected correlations exhibited medium effects by Cohen's criteria (large for the CT and CCT individualist indices).

However, some expectations were violated. Most prominently, despite prior positive correlations of hierarchist and individualist measures, we expected divergence because these are usually conceptualized as independent and orthogonal, representing high-grid/high-group versus low-grid/low-group, respectively. Yet all these cultural measures correlated with each other, sometimes weakly (CT statements .03), sometimes strongly (CCT indices .65; this correlation, plus that for the CT hierarchist and individualist indices, exhibited large effects by Cohen's criteria, and three of the 11 correlations exhibiting medium effects also included them). So with the exception of the CT statements we found convergence where we expected divergence.

Egalitarianism should be negatively associated with hierarchism and individualism, as the expected findings for CCT measures cited above indicate, yet we observed positive if small correlations among CT measures, both indices and statements. As discussed, associations between fatalism and other cultural measures were difficult to anticipate, but it was positively associated with all of them (including the IC index, thus negatively associated with communitarianism).

[Table 5]

Correlational analyses assessing predictive validity for personal risk judgments

These results appear in Table 6, with all results significant at $p < .01$ or higher meeting the FDR criterion, with none of those significant at $p < .05$ meeting the criterion (see Supplemental Information 1 for corresponding U.S. risk-rating correlations). Thus we excluded the latter from counting as meeting expectations, which we defined as statistical significance by the FDR criterion *and* the positive or negative sign predicted in Table 4. Nearly half (46.3%) of

correlations involving non-fatalist measures and more than a third (37) of the 100 correlations overall met expectations, due almost entirely to positive correlations: i.e., when we expected negative correlations (14 of the 30 predictions), only two panned out, involving the CCT measures for climate change. Only one of these correlations—ignoring expectations—met Cohen's criterion for a large effect (abortion, fatalists), with seven more (four of them fatalist) entailing medium effects; the remainder had small (66) or tiny (26) effects.

Hazards exhibiting the most consistency in predictive validity in these correlations, for five of the ten measures each, included gun control (working about equally well for CT and CCT indices, less well for CT statements, and not at all for egalitarianism), GM organisms[6] and Ebola virus (all expectations met for hierarchism and egalitarianism, none for individualism), and airplane crashes (all expectations met for CT indices, two of the three CT statements, and no CCT indices). Climate change (CT egalitarian measures correlated positively as expected, and CCT indices negatively as expected), and Zika virus (hierarchist and egalitarian expectations met for CT measures, not CCT), followed closely behind with four of 10 expectations met. Abortion met three expectations, all for hierarchist measures. The three non-climate change environmental hazards met two expectations each, all for egalitarian measures.[7] Given contrasting options for fatalists, we had no expectations, but all their correlations were positive.

[Table 6]

Regression analyses assessing predictive validity for personal risk judgments

Next, we hierarchically regressed risk judgments separately on CT indices, CT statements, and CCT indices at the second step, controlling for gender, age, and education entered at the first step. Our evaluative criteria again include whether the signs of standardized correlation coefficients are as expected, plus the relative and absolute magnitude of adjusted R^2

(given the different number of CCT versus CT measures) and change in R^2 (a primary effect size measure).

Some 12 of 30 (40%) CT index correlations, 11 of 30 (37%) CT statement correlations, and seven of 20 (35%) CCT index correlations with personal risk exhibited sign consistency (Table 7; see Supplemental Information 2 for equivalent U.S. risk-rating results). Adjusted R^2–reflecting the overall joint effect of controls and each operationalization, controlling for the number of items—was consistently largest for CT indices (M = .12, SD = .07, median = .09) and smallest for CCT indices (M = .03, SD = .03, median = .02), except for gun control and climate change where CCT indices exhibited the second largest adjusted R^2. The change in R^2 followed the same pattern.[8] Among significant CT-index associations fatalism was generally the strongest, with exceptions including a tie for gun control and being second strongest for pesticides; this pattern occurred only for abortion among CT statements.

[Table 7]

The effect of wave

The collection of responses to cultural measures across different waves—caused by us deciding to pursue the opportunity to compare CCT to CT measurement approaches after data collection had begun—offers both advantages and disadvantages. A strength is that the similarity, and sometimes identity, of items in different measures would make it difficult to avoid respondent confusion or frustration if they were all asked in a single instrument (e.g., compare the CT items and the statements which compile them). A potential weakness is that the temporal gap between the risk ratings and the CT measures, assuming random drift in people's responses to both kinds of items, may weaken their predictive effects relative to the CCT measures, which were asked in the same wave as the risk items.

A prior analysis (Johnson, 2018) showed no significant differences between Wave 3 (CT indices) and Wave 4 respondents (CT statements) in demographics or ideology, as well as in several other variables not salient to the current topic. We ran another analysis probing differences between Wave 4 respondents (n = 742), who completed all cultural measures used here, against all people who had dropped out earlier (n = 247). There were no significant differences for gender, education, political ideology, Democrat or Republican partisanship, the two CCT indices, or the CT indices of individualism and egalitarianism. There was an age difference (M = 43.72, SD = 13.66 Wave 4; M = 39.03, SD = 11.20 others; $p < .0005$). Compared to Wave 3 respondents who did not answer the last survey instrument (n = 102), Wave 4 respondents (n = 702) rated lower on both hierarchism (M = 3.97, SD = 1.24 Wave 4; M = 4.27, SD = 1.24 Wave 3; $p = .022$) and fatalism (M = 3.21, SD = 1.20 Wave 4; M = 3.56, SD = 1.39 Wave 3; $p = .018$).

Results for people who answered the Wave 4 survey, running the same analyses reported in Table 7, appear in Supplemental Information 3. The results for CT statements are identical in both locations, as Wave 4 is when the statement ratings reported in Table 7 were elicited. The CT-index results show no differences in significance of R^2 changes, no differences in the sign of the significant cultural-bias coefficients, and few differences in which cultural-bias coefficients were statistically significant (GM organisms featured fatalism and egalitarianism associated with higher perceived risks in Table 7, while fatalism and individualism were so associated in SI 3; Zika virus was marginally associated with higher perceived risk in SI 3 but not in Table 7; airplane crashes were high risk for all cultural biases in SI 3 but not for individualism in Table 7). For the CCT indices, there were no differences in significance of R^2 changes except for GM organisms, no differences in the sign of the significant cultural-bias coefficients, and few

differences in which cultural-bias coefficients were statistically significant (nuclear power, GM organisms, airplane crashes). These results did not change the relative effects of the three cultural measures.

Role of political variables and government

As noted earlier, questions have been raised (van der Linden 2016) about the degree to which cultural biases might simply replicate the effects of ideology, particularly if several of the items comprising CCT survey measures of those biases mention government, an ideological flashpoint in the contemporary U.S. We address this concern in two ways: summarizing analyses involving political variables in a separate paper (Swedlow & Johnson, 2019), and re-analyzing our data here based on removal of the government-associated items in CCT measures.

Separate political-variable analyses found that a 7-point measure of political ideology (1 *extremely liberal*, 7 *extremely conservative*) correlated more strongly with CCT indices (HE .59, IC .49) than with CT indices (H .41, I .38, E -.28, F .04) or CT statements (H .20, I .16, E -.15, F .02), with all correlations but the fatalism ones significant at $p = .001$. Two binary measures of political partisanship (whether the respondent reported being a Democrat or a Republican, the major U.S. political parties) exhibited a similar pattern—i.e., stronger associations with CCT than CT indices, and with CT indices than CT statements—but with weaker correlations than for political ideology.

Hierarchical linear regressions were used to predict personal risk perceptions for an environmental index (mean of nuclear power, genetically modified organisms, pesticides and food additives), climate change, abortion, gun control, and airplane crashes. We entered gender, age, education, political ideology, and the two partisan measures in the first step of each regression, then added one of the three cultural-bias measures in the second step, for four

regression analyses for each of the five dependent variables. Political ideology was at least marginally significant in all baseline regression analyses except for the environmental index, with less frequent statistical significance for the partisan measures, while adding each of the cultural bias measures added significantly ($p < .0005$ excluding CCT for environmental index: $p = .034$) to explained variance except for CCT on airplane crashes. The CT indices were the strongest cultural explanation with regard to change in R^2, although less so for U.S.-risk ratings, and less effective than CCT in terms of signs matching expected coefficients (Swedlow & Johnson, 2019).

For present purposes we will focus on the lower effect on explained variance of the CCT measures, which among other factors may include the mention of government in several IC items. We replicate some of our earlier analyses in the current paper after removing these "government" items, creating an $IC_{non\text{-}gov}$ index. This trims the items comprising the index from 17 to six (M = 4.12, SD = 0.86, α = .71, n = 698 listwise deletion). It correlates with the HE index at $r = .64$, with CT indices (H .44, I .54, E -.40, F .02) and CT statements (H .27, I .19, E -.14, F .08), political ideology (.45), Democratic partisanship (-.24), and Republican partisanship (.30). If we compare the cultural correlations to those in Table 5, overall there are few substantive differences. The same is true for correlations with political variables (r = -.29 Democrat, .33 Republican). This suggests that, whatever is the source of the relative power of CCT versus CT measures in explaining risk perceptions, it does not lie in the inclusion of items that mention government.

That still leaves the relative explanatory power of political variables and the CCT measures. Table 8 repeats the contrast of these in Swedlow & Johnson (2019), using the new $IC_{non\text{-}gov}$ index in place of the complete one used earlier. The results were nearly identical, again

suggesting that—whatever the merits of using references to "government" to measure the group dimension—this tendency does not alter the relationship of political variables and CCT measures in predicting risk perceptions.

[Table 8]

Discussion

Summary of Findings

- Correlations among cultural measures, whether within (e.g., comparing one CT measure to another) or across (CT correlations to CCT) categories, were often as expected (44% of non-fatalist and 27% of total correlations): e.g., any given hierarchism measure correlated positively with other hierarchism measures, suggesting convergent validity, and negatively with an egalitarian measure, suggesting divergent validity. But positive correlations for hierarchical and egalitarian CT measures, and between hierarchism and individualism as also reported in earlier studies, were among examples of lack of discriminant validity. CT statements exhibited the lowest correlations among themselves and hence the most internal discriminant validity.
- Almost half of non-fatalist (but only a third of total) correlations, primarily positive ones, between cultural measures and risk judgments were as expected. By hazard, consistency was greatest (but at most for half of the cultural measures) for gun control, GMOs, Ebola virus, and airplane crashes, followed closely by climate change and Zika virus, but no cultural or measurement approach was consistently more predictive. Effect sizes were generally small.
- Regression analyses controlling for demographic characteristics found that the three approaches were little distinguished by sign consistency (35-40% of coefficients), although CT indices were best and CCT indices worst in explaining variance in predicted risks.

Theoretical implications

We expected correlations among cultural survey measures purporting to tap the same theoretical source to hang together, and they mostly did,[9] which is reassuring. But it is less clear how to interpret the correlation of hierarchism and individualism in contemporary Europe and North America,[10] which was replicated in our CT and CCT indices but not in our CT statement measures.

One interpretation is that such correlations invalidate both CT and CCT if the underlying theory is deemed to claim that individuals will have only one cultural bias; many have so interpreted and thus rejected these approaches. Others have suggested that both institutions and individuals will be culturally pluralized (Rayner 1992; Verweij, Luan, and Nowacki 2011), with some claiming that cultural biases of individuals vary by domain, such as politics, work, or family (Olli 2012; Rayner 1992). Moreover, CT predicts formation of cultural coalitions (Douglas and Wildavsky 1982; Thompson, Ellis, and Wildavsky 1990), both along shared dimensions and in an "opposites attract" fashion (Wildavsky 1985), whose members may come to support each other's cultural biases. For example, in the U.S. it is argued that hierarchical individualists represent a fusion found in the contemporary Republican Party coalition of social and religious conservatives and libertarian business interests that Douglas and Wildavsky (1982) called "The Center" and Wildavsky "The Establishment" (2006, p. 93, fig. 4.1). And scholars using CT claim that shifting cultural coalitions explain many major developments in both US (Chai and Wildavsky 1998; Ellis and Wildavsky 1989, 1990; Lockhart 2001; Robinson 2014, 2016; Swedlow 2011; Swedlow et al. 2016b) and European politics (Bale 1997; Grendstad 2003; Lockhart 1997, 1999, 2011; Olli 2012), including policy advocacy coalitions (Coyle and Wildavsky 1987; Herron and Jenkins-Smith 2006; Jenkins-Smith et al. 2014; Kahan et al. 2007,

2010, 2012, 2016; Ripberger, Jenkins-Smith, and Herron 2011; Sotirov and Winkel 2015).

CT also claims that its cultures are conceptually distinct but will necessarily co-occur, which could lead to correlation in survey measures seeking to tap distinct cultures (Verweij, Luan, and Nowacki 2011). The somewhat greater discriminatory power of our cultural statement measures imply that correlative findings may at least partly be a measurement artifact and that it is possible to distinguish the cultural types in surveys. Moreover, the referenced research on institutions like political parties and groups like policy advocacy coalitions finds that these two cultures, while co-varying and coordinating activities, are conceptually and empirically distinct. Finally, diverse national, historical, and experimental studies cited above find that hierarchists and individualists are not always correlated or in coalition, but can come into conflict and will build coalitions with other cultural partners under conditions predicted by CT.

As for predictive validity defined by cultural measures' associations with risk judgments, our results also are subject to different interpretations. Almost half of the non-fatalist[11] correlations we expected were confirmed here, but no more than half of the measures per hazard produced results consistent with expectations. Although nearly half of our expectations were of negative associations (14 of 30), only two negative correlations were both significant and consistent, meaning that positive associations dominated. The main culprits were environmental issues, which Wildavsky (1991) particularly labeled as egalitarian concerns that hierarchists and individualists would dismiss, but which they also rated as risky here.[12] Although we noted earlier some possible reasons for convergence over such issues as nuclear power, GMOs, pesticides and food additives—and suggested that every cultural bias might be associated with judged risk of airplane crashes—further research is needed to test these hypotheses. Retrospective longitudinal designs that used existing data coded for cultural orientations and risk perceptions would be

needed to validate our hypotheses for historical change in the cultural status of these hazards (Lodge and Wegrich 2011; Lodge, Wegrich, and McElroy 2010; Robinson 2014, 2016). Longitudinal panel survey studies might examine temporal changes within individuals, and cross-sectional surveys differences across cultural orientations, in risk perceptions of varying hazards, allowing inferences about sources of cultural conflict and coalition (Ripberger, Jenkins-Smith, and Herron 2011; Swedlow et al. 2016a). Meanwhile, experimental studies could examine how susceptible those with varying cultural orientations are to different cultural framings and other cultural cues about these and other hazards (Kahan 2012; Kahan et al. 2007, 2010, 2012, 2016).

The relation of cultural to other explanations of risk perceptions is beyond our remit, but the low explained variance in personal risk judgments due to application of cultural bias measures here suggests more multiple-explanation arguments be pursued, rather than (e.g.) privileging psychometric or hazard-proximal explanations over cultural ones (Sjöberg 1997). That effect sizes here for cultural measures were rarely medium, much less large, allows us to neither trumpet their superiority nor dismiss them as useless. For example, more knowledgeable respondents—about specific risks and/or more numerate, scientifically, and/or politically knowledgeable or involved generally—exhibit more culturally coherent, biased, and predictable perceptions and preferences (Ellis and Thompson 1997; Gastil et al. 2011; Kahan et al. 2012; Ripberger et al. 2012). Incorporating these supplemental measures into future analyses comparing CT and CCT conceptualizations and approaches to measurement could be very important.

That said, our separate analysis of how these cultural measures add to explained variance when controlling for political ideology and partisanship (Swedlow & Johnson, 2019), and our

report here of similar findings when we omit from the CCT IC index those items which contain "government" in the statement, suggest that CT and CCT measures are not simply duplicates of those political variables. While the CCT items here and in the political-variable analyses added less to explained variance than did the CT measures, this does not appear to be due to the inclusion of "government" in the IC items, nor do the results suggest that this is due entirely to common variance with the political variables (e.g., compare climate change in Table 8, where this may be a plausible explanation, to the other results in that table). More research is warranted to test the associations between political and cultural variables, but the data reported here do not indicate that they reflect identical concepts.

Methodological implications

Flaws in operationalization and measurement also may underlie some of our more puzzling findings. Operationalizing a theory with two dimensions as four dimensions allows respondents to rate more than one dimension highly, as Kahan points out (2012). Yet his two-dimensional solution does not, as we have seen, prevent measures of hierarchy and individualism from being highly correlated (hierarchical individualists). Additionally, this approach obscures any cultural variation within the CCT scales, which is easier to observe using indices for each of the four cultures in turn (Olli 2012). The CT statements for hierarchy and individualism were the least correlated of these measures, suggesting that assessing cultural biases with four independent items does not necessarily lead respondents to rate both dimensions highly. Meanwhile, acquiescence bias may play a role in driving "agree" responses for these scales and positive correlations among cultural measures.[13] Additionally, the correlation of fatalistic measures with other cultural measures could be spurred by fatalists' don't-care attitude causing random responses (Verweij, Luan, and Nowacki 2011). One solution to these potential

measurement problems might be a forced-choices format requiring respondents to rank cultural biases against each other (see, e.g., Jacoby 2014; Swedlow and Wyckoff 2009). The current CT statements approach only elicits rankings when respondents give two or more statements the same rating; full rankings at minimum would need to be elicited to test this possibility. A related solution is to analyze not just patterns of cultural support but also their rejection, including the different combinations in which these occur (Olli 2012).

Despite being somewhat more discriminating across cultural biases than the CT indices, the CT statements exhibited slightly weaker associations with risk ratings overall. The latter finding might be explained by the statement format, which potentially generates confusion and hence measurement error when a respondent agrees with only some views in the statement whereas index items allow a clearer signal of agreement or disagreement. Moreover, a single measure of any concept will have more measurement error than a three-item measure, all else equal. But if the slightly weaker predictive validity of the statement measures is due to their erroneous measurement of cultural variation, why are they somewhat more discriminating across cultural biases? Moreover, the only other study to compare these measures found CT statements better predicted policy preferences than CT indices (Swedlow et al. 2016a). Further comparison of these measurement approaches is certainly warranted.

The more general question is whether our findings and the small body of related work comparing CT and CCT allow recommending one measurement approach over the other, with the answer depending in part on what kind(s) of construct validity are most important for particular researchers and research. Convergent and divergent validity data here suggest little distinction, except that CT statements did a better job discriminating between individualists and hierarchists. There was no pattern in which measure type produced bivariate correlations

consistent with expectations across hazards, although CT indices were slightly more consistent with those expectations, and explained more variance in judged risk (predictive validity) when controlling for demographic variables in regression analyses. Other construct validity approaches to comparing CT and CCT survey measures—e.g., face and content validity (Douglas 2003; Swedlow et al. 2016a), reliability (Kahan 2012; Xue et al. 2014), or factoring (Olli 2012; Xue et al. 2016)—are in their infancy. Pending further such comparisons, researchers will need to consider whether divergent validity, variance explained, or getting the sign right is most important in choosing a cultural survey approach.[14]

Limitations

Data came from a non-representative sample of Americans, so extrapolation to wider populations is limited. Although our data suggest otherwise (except for age, and two of the four CT indices between Wave 3 and Wave 4 respondents), the attrition pattern may be non-random; if so, parameter estimates may be influenced.

Conclusions

Our first-ever comparison of CT and CCT measures answered by the same survey respondents found moderate convergent and discriminant validity, and with regard to judged risk moderate predictive validity. Several unexpected findings underscored the potential benefits—and remaining theoretical and methodological challenges—of using such deductively-derived survey measures of culture to predict and explain risk perceptions. We have outlined some questions and paths for further research and hope other scholars join us to compare and improve upon these cultural approaches to predicting and explaining risk judgments.

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Notes

[1] What constitutes explanation of course varies across these studies, which use a variety of research methods, including case studies and survey research, which tend to have strengths that offset each other's weaknesses (Johnson & Swedlow, 2019). Studies relying on surveys generally report modest explanatory effects (Xue, Hine, Loi, Thorsteinsson, and Phillips 2014), which may be due to challenges operationalizing CT and CCT for survey research (Johnson & Swedlow, 2019).

[2] Hierarchists should be more willing than other cultural types to delegate responsibility to an expert, the pilot. Individualists might prefer people competing to work the controls or piloting their own airplanes. Egalitarians might like passengers to vote on the pilot's next action or take turns at the controls. But it is likely that the latter two cultural types will in practice (like fatalists) resign themselves to pilot control, a loss of control which may register as heightened fear in a survey response.

[3] Fatalists might expect risks to be randomly distributed, due to good and bad luck from diverse sources, so lack concern about any particular hazard, *or* see any hazard as threatening, and thus rate *all* as high risk (Verweij, Luan, and Nowacki 2011). The meta-analysis hypothesized fatalists as indifferent toward risk "given their generally high level of disengagement and external locus of control," but found fatalists tended to be afraid of natural hazards (Xue et al. 2014, pp. 250, 254–256).

[4] Some theoretical disagreement and empirical divergence about whether different cultures are

orthogonal leave open whether to expect negative, or no, correlations.

[5] The CCT-CT comparison was not envisioned during study design, otherwise data on all cultural measures probably would have been collected in the same wave, although as we note in the text this would pose problems given overlap in the content of different measures.

[6] Technically 4.5 expectations were met for GMOs, as by definition the positive correlation for the HE scale means a negative, therefore unexpected, correlation for egalitarianism.

[7] Analyses were re-run with Wave 3 responses (excluding only the fatalism statement, mistakenly omitted from that wave) by Wave 4 respondents. Correlations' signs did not differ, with small changes in magnitude and significance, suggesting the 3-month temporal gap in collecting different CT measures did not drive unexpected results there. The 5-month gap between CT data collection, and CCT and risk judgment data in Wave 1, cannot be assessed this way.

[8] All CT indices met Cohen's small-effects threshold, with the medium-effects threshold met for airplane crashes, Ebola virus, abortion and climate change; all met Ferguson's minimal-practical-effects criterion, and abortion's R^2 change almost met his medium-effects criterion (and Cohen's large-effects threshold). CT statements all met Cohen's small effects threshold, with airplane crashes and abortion meeting the medium threshold; all but gun control, pesticides and food additives met Ferguson's practical minimum significance threshold, with none meeting the medium effect threshold. CCT indices met Cohen's threshold for even small effects four times (airplane crashes, Ebola, gun control, abortion), and for medium effects once, an issue which met Ferguson's threshold for minimal practical significance (climate change).

[9] As fatalism has tended to be ignored in theoretical discussions, the largely positive correlations

between fatalist measures and others observed here are difficult to interpret. Kahan (2012) argues that fatalism is a psychological condition, not a way of life, and might argue that our results indicate a free-floating anxiety, anomie, and other worries shared across cultures.

[10] Kahan found early in his use of the two CCT measures with U.S. samples that correlations were r ~ .3, but in later studies correlations rose to r ~ .4 (Xue et al. 2014, p. 255) and could rise to r > .5 even when using the CCT short form survey (Kahan 2015). A study using the short form with Australians found a correlation of only .22 (Phillips, Hine, and Marks 2018), but a U.S. study using the long form with the same online panel as used here found a correlation of .74 (Finucane and Holup 2005). Other studies, using the four separate CT indices rather than CCT measures, also found separating hierarchy and individualism difficult (Dake and Wildavsky 1991; Grendstad 2003; Kiss, Montpetit, and Lachapelle 2016; Marris, Langford, and O'Riordan 1998).

[11] Fatalists' tendency to rate all risks as high suggests, as we speculated earlier, that fear of "everything" might shape their lives, but we need a better rationale for why fatalists might lack a specific set of issues that threaten them, and broader empirical data to test that hypothesis.

[12] Overall respondents on average rated seven of 10 hazards as posing less than "moderate" personal risk, with only food additives, climate change and pesticides featuring 52.4%-60.4% rating these as "moderate," "high" or "very high" risk.

[13] Acquiescence bias is measured here as the proportion agreeing minus those disagreeing for each item (for CT statements, 0-4 and 6-10 ratings on the 11-point scale) following Olli (2012, 331-338). Some 83.3% of CT items, 76.5% of IC items, and 75% of CT statements, versus 23.1% of HE items, featured more agreement than disagreement. Assuming zero as the ideal and

100 as the maximum imbalance in response (Olli 2012), “high” imbalance (defined here as > 30 percentage points difference) occurred for 38% (HE), 59% (IC), 58% (CT indices), and 75% (CT statements) of items.

[14] Researchers usually also need to consider practical survey administration issues, such as cost and response rates. One-item measures like the CT statements may be preferable on both grounds. But the time it takes to answer questions also influences response rates, perhaps making CT items or CCT “short form” measures more attractive.

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Table 1. CT Cultural Worldview Indices (Jenkins-Smith et al.)

Hierarchist
Society would be much better off if the people in charge imposed strict and swift punishment on those who break the rules.
Society is in trouble because people do not obey those in authority.
The best way to get ahead in life is to work hard to do what you are told to do.
Individualist
We are all better off when we compete as individuals.
Even the disadvantaged should have to make their own way in the world.
Even if some people are at a disadvantage, it is best for society to let people succeed or fail on their own.
Egalitarian
Society works best if power is shared equally.
What society needs is a fairness revolution to make the distribution of goods more equal.
It is our responsibility to reduce differences in income between the rich and the poor.
Fatalist
No matter how hard we try, the course of our lives is largely determined by forces beyond our control.
It would be pointless to make serious plans in such an uncertain world.
The most important things that take place in life happen by chance.

Table 2. CT Cultural Statements (Jenkins-Smith et al.)

Hierarchist
I am more comfortable when I know who is, and who is not, a part of my group, and loyalty to the group is important to me. I prefer to know who is in charge and to have clear rules and procedures; those who are in charge should punish those who break the rules. I like to have my responsibilities clearly defined, and I believe people should be rewarded based on the position they hold and their competence. Most of the time, I trust those with authority and expertise to do what is right for society.

Individualist
Groups are not all that important to me. I prefer to make my own way in life without having to follow other peoples' rules. Rewards in life should be based on initiative, skill, and hard work, even if that results in inequality. I respect people based on what they do, not the positions or titles they hold. I like relationships that are based on negotiated "give and take," rather than on status. Everyone benefits when individuals are allowed to compete.

Egalitarian
My most important contributions are made as a member of a group that promotes justice and equality. Within my group, everyone should play an equal role without differences in rank or authority. It is easy to lose track of what is important, so I have to keep a close eye on the actions of my group. It is not enough to provide equal opportunities; we also have to try to make outcomes more equal.

Fatalism
Life is unpredictable and I have very little control. I tend not to join groups, and I try not to get involved because I can't make much difference anyway. Most of the time other people determine my options in life. Getting along is largely a matter of doing the best I can with what comes my way, so I just try to take care of myself and the people closest to me. It's best to just go with the flow, because whatever will be will be.

Table 3 CCT Cultural Indices (Kahan et al.)

Hierarchist-egalitarian (HE)

People in our society often disagree about issues of equality and discrimination. How strongly do you agree or disagree with each of these statements?

We have gone too far in pushing equal rights in this country.
The women's rights movement has gone too far.
Our society would be better off if the distribution of wealth was more equal. (R)
A lot of problems in our society today come from the decline in the traditional family, where the man works and the woman stays home.
It's old-fashioned and wrong to think that one culture's set of values is better than any other culture's way of seeing the world. (R)
It seems like the criminals and welfare cheats get all the breaks, while the average citizen picks up the tab.
Nowadays it seems like there is just as much discrimination against whites as there is against blacks.
Society as a whole has become too soft and feminine.
We live in a sexist society that that is fundamentally set up to discriminate against women. (R)
Parents should encourage young boys to be more sensitive and less rough and tough. (R)
Discrimination against minorities is still a very serious problem in our society. (R)
We need to dramatically reduce inequalities between the rich and the poor, whites and people of color, and men and women. (R)
It seems like blacks, women, homosexuals and other groups don't want equal rights, they want special rights just for them.

Individualist-communitarian (IC)

People in our society often disagree about how far to let individuals go in making decisions for themselves. How strongly do you agree or disagree with each of these statements?

Government should put limits on the choices individuals can make so they don't get in the way of what's good for society. (R)
Private profit is the main motive for hard work.
It's not the government's business to try to protect people from themselves.
Free markets--not government programs--are the best way to supply people with the things they need.
People should be able to rely on the government for help when they need it. (R)
Our government tries to do too many things for too many people. We should just let people take care of themselves.
Sometimes government needs to make laws that keep people from hurting themselves. (R)
Too many people today expect society to do things for them that they should be doing for themselves.
Government regulations are almost always a waste of everyone's time and money.
It's society's responsibility to make sure everyone's basic needs are met. (R)

The government should do more to advance society's goals, even if that means limiting the freedom and choices of individuals. (R)
If the government spent less time trying to fix everyone's problems, we'd all be a lot better off.
The government interferes far too much in our everyday lives.
Society works best when it lets individuals take responsibility for their own lives without telling them what to do.
People who are successful in business have a right to enjoy their wealth as they see fit.
It's a mistake to ask society to help every person in need.
The government should stop telling people how to live their lives.

Table 4. Expected Associations of Cultural Measures with Judged Risks

	Gun control	Abortion	Climate change	Nuclear power	Pesticides	Food additives	GM organisms	Ebola virus	Zika virus	Airplane crashes
Hierarchists	high (+)	high (+)	low (-)	low (-)	low (-)	low (-)	high (+)	high (+)	high (+)	high (+)
Individualists	high (+)	low (-)	low (-)	low (-)	low (-)	low (-)	low (-)	low (-)	low (-)	high (+)
Egalitarians	low (-)	low (-)	high (+)	high (+)	high (+)	high (+)	high (+)	high (+)	high (+)	high (+)

Table 5. Correlations Among Cultural Measures

	Hierarchist	Individualist	Egalitarian	Fatalist	Hierarchist_st	Individualist_st	Egalitarian_st	Fatalist_st	HE
Individualist	.53***								
Egalitarian	-.04	-.13***							
Fatalist	.28***	.29***	.35***						
Hierarchist_st	.47***	.33***	.02	.19***					
Individualist_st	.14***	.22***	-.04	.05	.03				
Egalitarian_st	.08*	-.01	.43***	.24***	.33***	.07†			
Fatalist_st	.18***	.24***	.20***	.39***	.20***	.19***	.19***		
HE	.47***	.47***	-.48***	.06	.28***	.17***	-.21***	.12**	
IC	.34***	.53***	-.42***	.04	.15***	.18***	-.21***	.08*	.65***

Shading indicates expected results _st = statement, HE = CCT Hierarchist-Egalitarian, IC = CCT Individualist-Communitarian. Listwise deletion n = 697.

† $p < .10$ * $p < .05$ ** $p < .01$ *** $p < .001$

Table 6. Correlations Between Cultural Measures and Judged Risk to "You and Your Family"

	Gun Control	Abortion	Climate Change	Nuclear Power	Pesticides	Food Additives	GM Organisms	Ebola Virus	Zika Virus	Airplane Crashes
CT Hierarchist index	.24***	.26***	-.05	.21***	.12**	.15***	.20***	.23***	.22***	.23***
CT Individualist index	.21***	.32***	-.06	.15***	*.10**	.12**	.19***	.20***	.20***	.23***
CT Egalitarian index	-.02	.19***	.41***	.19***	.22**	.16***	.11**	.19***	.16***	.28***
CT Fatalist index	.21***	.50***	.18***	.28***	.21***	.24***	.26***	.38***	.30***	.42***
CT Hierarchist statement	.18***	.25***	.06†	.12**	.11**	.12**	.12***	.22***	.18***	.22***
CT Individualist statement	.02	*.09**	-.01	.07†	.10**	.13***	.14***	*.08**	*.08**	.05
CT Egalitarian statement	*.08**	.20***	.25***	.16***	.14***	.11**	.12***	.15***	.17***	.26***
CT Fatalist statement	.11**	.30***	*.09**	.14***	*.08**	.06	.11**	.22***	.15***	.22***
CCT Hierarchist-Egalitarian	.24***	.21***	-.30***	.04	.00	.07†	.12**	.11**	*.09**	*.07**
CCT Individualist-Communitarian	.23***	.13***	-.27***	.01	.01	.05	.12**	.04	.03	.02

Shading indicates expected results (Table 4 and text). Italics indicate correlations significant at $p < .05$ failing the FDR criterion for multiple comparisons (Method). n = 699 CT indices, 740 CT statements, 734 CCT indices. † $p < .10$ * $p < .05$ ** $p < .01$ *** $p < .001$

Table 7. Comparing Explanation of Personal Risk Judgments Across Alternative Cultural Measures, Controlling for Demographics

CT Indices	Gun Control	Abortion	Climate Change	Nuclear Power	Pesticides	Food Additives	GM Organisms	Ebola Virus	Zika Virus	Airplane Crashes
F	7.79***	40.10***	19.42***	11.98***	7.41***	7.69***	9.62***	19.52***	11.99***	27.69***
R^2	.06	.26	.15	.10	.06	.06	.08	.15	.10	.20
Adjusted R^2	.06	.26	.14	.09	.05	.06	.07	.14	.09	.19
Change in R^2	.063***	.232***	.131***	.082***	.049***	.047***	.068***	.137***	.089***	.174***
Hierarchist	.14**	.08*	-.05	.09*	.03	.05	.06	.13**	.12**	.09*
Individualist	.05	.12**	-.06	-.01	.00	-.01	.06	.00	.02	.06
Egalitarian	-.09*	.05	.34***	.11**	.16***	.08†	.07†	.09*	.08*	.17***
Fatalist	.14***	.37***	.03	.19***	.10*	.17***	.18***	.27***	.19***	.26***
CT Statements										
F	4.09***	19.42***	9.12***	7.40***	4.91***	4.94***	5.95***	11.14***	7.87***	16.14***
R^2	.04	.16	.08	.07	.05	.05	.05	.10	.07	.13
Adjusted R^2	.03	.15	.07	.06	.04	.04	.05	.09	.06	.13
Change in R^2	.037***	.129***	.058***	.047***	.035***	035***	.044***	.083***	.059***	.105***
Hierarchist	.16***	.18***	-.03	.06	.06	.09*	.09*	.17***	.13***	.13***
Individualist	.00	.04	-.02	.03	.08*	.12**	.11**	.05	.05	.01
Egalitarian	.01	.08*	.24***	.11**	.10**	.07†	.07†	.05	.10**	.17***
Fatalist	.08*	.23***	.04	.12**	.05	.02	.07†	.16***	.10**	.17***
CCT Indices										
F	9.87***	14.46***	25.93***	4.09**	4.45***	4.74***	4.99***	3.77**	1.87†	5.85***
R^2	.05	.07	.12	.02	.02	.02	.03	.02	.01	.03
Adjusted R^2	.04	.06	.11	.02	.02	.02	.02	.01	.00	.02
Change in R^2	.045***	.047***	.106***	.003	.003	.000	.005	.012**	.004	.010**
Hierarchy-Egalitarianism	.12**	.24***	-.24***	.07†	-.04	.01	.05	.14**	.08†	.13**
Individualism-Communitarianism	.12**	-.04	-.13**	-.03	-.02	-.00	.03	-.05	-.03	-.08*

Standardized correlation coefficients for indices/statements. Demographic variables entered at the first step were gender, age, and education. Degrees of freedom: CT indices (7,794 [n = 801], excluding airplane crashes and gun control 7,793 [n = 800), CT statements (7,733 [n = 740], excluding airplane crashes 7,732 [n = 739]), CCT indices (5,977 [n = 982], excluding gun control 5,976 [n = 981]). † $p < .10$ * $p < .05$ ** $p < .01$ *** $p < .001$

Table 8. Hierarchical Linear Regressions of Judged Personal Risk Contrasting Demographic/Political Against CCT Predictors with Non-Government IC Index

	Political Variables			CCT		Model Statistics				
	Ideology	Rep	Dem	HE	IC	F	R^2	Adjusted R^2	Change in R^2	*p*
Env index	.03	.03	.04			1.35	.01	.00		.233
	.07	.05	.03	-.00	-.11*	1.98*	.02	.01	.010	.022
Climate change	-.12**	-.05	.04			5.77***	.04	.04		<.0005
	.02	-.00	.00	-.23***	-.11**	11.62***	.11	.10	.063	<.0005
Abortion	.12**	.11**	.06			7.91***	.06	.05		<.0005
	.02	.08*	.09*	.23***	-.02	9.34***	.09	.08	.030	<.0005
Gun control	.19***	.02	.01			5.22***	.04	.03		<.0005
	.11**	-.01	.03	.14**	.06	6.34***	.06	.05	.022	<.0005
Airplane crashes	.11**	.04	.09*			4.93***	.04	.03		<.0005
	.09*	.03	.09*	.07	-.03	3.91***	.04	.03	.002	.425

All analyses also include gender, age and education as control variables along with the political variables in the first step. Degrees of freedom: baseline (6,792), CCT (8,790 [n = 798) except for gun control (6,791 [n = 797]; 8, 789 [n = 797]). † $p < .10$ * $p < .05$ ** $p < .01$ *** $p < .001$

Figure 1.

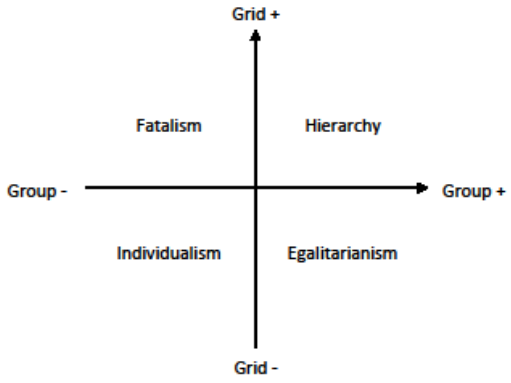

Figure 2.

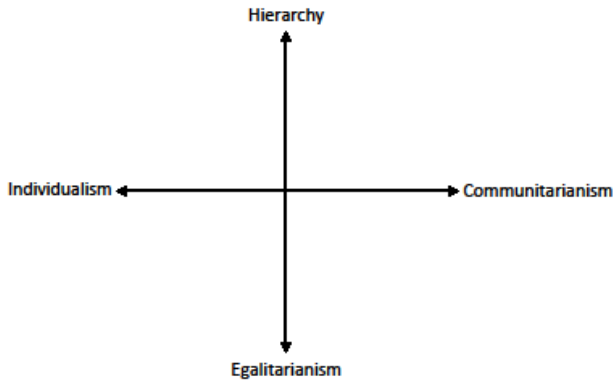

Figure Captions

Figure 1: Cultural Theory's (CT's) Grid and Group Dimensions of Social Relations and Resulting Cultural Types

Figure 2: Cultural Cognition Theory's (CCT's) Dimensions