



Worldview Orientations and Personal and Social Risk Perceptions for COVID-19 in a U.S. Population-Based Sample

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Abstract

Adoption of COVID-19 preventive behaviors involves considering personal risk and the risk to others. Consequently, many COVID-19 prevention measures are intended to protect both the individual engaging in the behavior and others in the population. Yet, the preponderance of research is focused on perceptions of an individual's personal risk, making risk perception for others a critical area for investigation. Two worldview orientations describing values regarding how society should be organized, hierarchy—beliefs prioritizing social hierarchy, and individualism—beliefs prioritizing personal autonomy, have been linked to a range of risk perceptions. This study objective is to examine the association of worldview orientations with COVID-19 risk perceptions for oneself and others in a United States context. Using a national sample of 410 U.S. adults, we examined the associations between worldview orientations and six facets of risk (absolute risk, risk certainty, comparative risk, risk severity, fear, feelings of risk) using demographics-adjusted multivariable regression models. We conducted separate analyses for each of the following referents: (1) personal risk, (2) risk for the average person within the United States, and (3) risk to people within specific social groups (e.g., family, co-workers). Results indicate that stronger hierarchical and individualistic orientations were associated with lower COVID-19 risk perceptions for all three referents. The results were particularly consistent for fear and feelings of risk. Individualism was related to higher risk perception certainty for personal risk and the risk to people within specific social groups. Hierarchy was related to lower perceived severity for all referents. Findings suggest that U.S. public health messaging sensitive to worldview orientations may be needed to optimize acceptance of recommendations for protective behaviors, including vaccination. The relationship of worldview orientations to health risk perceptions may help guide messaging for future infectious outbreaks where risk perceptions are drivers of protective behavior.

Extended author information available on the last page of the article

Keywords COVID-19 · Risk perception · Worldview orientations · Individualism · Hierarchy

Introduction

The global transmission of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) poses an ongoing significant threat to human health worldwide. COVID-19 has emerged as one of the most significant threats to people's health, livelihoods, and well-being in decades. This threat can be mitigated by individual protective behaviors that reduce human-to-human transmission, including getting vaccinated, wearing a face mask that covers mouth and nose, maintaining at least 6 feet of distance from people outside of one's household, and washing hands often with soap and water for at least 20 s (Centers for Disease Control and Prevention [CDC], 2022).

Perceptions of Risk

The role of personal risk perceptions for developing COVID-19 figures strongly in promoting COVID-19 protective behavior. In the United States, COVID-19 risk perceptions are positively related to enhanced protection behaviors, including vaccine uptake, in cross-sectional (e.g., Bruine de Bruin & Bennett, 2020; Franz & Dhani, 2021; Joslyn et al., 2021; Magnan et al., 2021; Nazione et al., 2021; Viswanath et al., 2021), and longitudinal studies (Hamilton et al., 2020; Li et al., 2022; Smail et al., 2021), and are largely consistent with studies conducted internationally (Schneider et al., 2021). These findings are consistent with theoretical models supporting the role of personal risk perceptions in protective behavior adoption (Conner & Norman, 1996) and empirical work establishing that personal risk perceptions promote the performance of a range of protective behaviors outside of the COVID-19 context (Sheeran et al., 2014). Perceptions of risk include both cognitions, such as perceived likelihood of risk and severity of illness, and affect, such as worry or feelings of risk about developing illness (Ferrer et al., 2016; Janssen et al., 2014; Weinstein et al., 2007). The central importance of affect in risk perception is consistent with theoretical work highlighting the key role of emotion in the rapid, automatic formulation of risk judgments (Loewenstein et al., 2001; Peters et al., 2006; Cameron & Leventhal, 2003; Slovic et al., 2005) and is important to consider in the context of risk perception for COVID-19.

The preponderance of the risk perception literature is focused on the individual, overlooking the perception of risk to others in the population. The emergence of COVID-19 has revealed the limitations of that perspective, as motivation for adoption of COVID-19 preventive behaviors involves consideration of cognition and affect regarding one's own personal risk as well as the risk to other people (Bauchner & Fontanarosa, 2020). This is especially true since many of the measures recommended for preventing the spread of COVID-19, such as mask wearing and vaccination (CDC, 2021), are intended to jointly protect the individual and prevent spread

at the family and/or community level. As such, in the absence of legal mandates, an individual's engagement in behaviors that prevent transmission are likely motivated by both personal risk perceptions, and one's perceptions of the risk to others. However, the vast majority of conceptual and empirical work on illness risk perception (Sheeran et al., 2014) focuses on one's own risk perception and motivations to reduce one's own risk (but see Shepperd et al., 2018); even when questions about others' risk perceptions are utilized they are often in the service of creating a variable indicating an indirect comparison for personal risk perception (e.g., Ranby et al., 2010). Importantly, there has been extensive examination, both international and in the US, of the role of journalistic analysis, and political polling, in understanding COVID-19 risk perceptions and adoption of protective behaviors (e.g., Reimer et al., 2022; Tarry et al., 2022). The current paper highlights the COVID-19 context that has emphasized the need to examine perception of risk to others as a key element of risk perceptions that may underlie behavioral motivation, and has relevance beyond the COVID-19 context, as well. This work will help inform future research across the fields of journalism and political psychology.

Worldview Orientations

Foundational work by Douglas and Wildavsky (1982) highlights that the perception of risk is a social process that is influenced by underlying personal identity-consistent worldview orientations. Expanding on this perspective, Kahan and colleagues (Kahan et al., 2005, 2007) argue for two independent dimensions to describe worldview orientations: "hierarchy-egalitarianism" (referred to hereafter as "hierarchy") and "individualism-communitarianism" (referred to hereafter as "individualism;" Kahan et al., 2005, 2007; Kahan, Jenkins-Smith, & Braman, 2011). A hierarchical worldview involves a tendency to interpret risk within values prioritizing belief in the legitimacy and need for social hierarchy and social stratification based on characteristics—such as social class—that perpetuate a sense of protection and continuity. In contrast, an egalitarian worldview involves prioritizing equal rights and opportunities for all individuals. An individualistic worldview comprises a perspective valuing independence, self-reliance, and self-determination; in contrast, a communitarian worldview values mutual interdependence and interactions with others across a range of activities (Kahan et al., 2011).

Worldview orientations can shape the prioritization of some risks and the minimization of others. For instance, hierarchical and individualistic worldviews are related to lower risk perceptions associated with climate change, because of beliefs that prioritizing climate change may inhibit financial free markets (Kahan et al., 2005; Xue et al., 2014). However, hierarchical and individualistic worldviews are related to *higher* perceived risks associated with HPV vaccination, because of a belief that vaccination may condone adolescent sexual behavior of young women that defies traditional gender norms (hierarchy) and, if mandatory, because it interferes with decisional agency (individualism; Kahan et al., 2010). This evidence illustrates how worldview orientations are not uniformly related to lower risk perception, but that risk appraisal is a process in which individuals selectively credit potential harms

as more or less risky based on alignment with personal preferences regarding how society should be organized. Complex demographic effects on risk perceptions, such as suppressed risk perception in men (compared to women) and White people (compared to Black people) can sometimes be partially driven by worldview orientations (Finucane et al., 2000), but demographics and worldview orientations by no means completely overlap. Furthermore, extensive research examining personality characteristics and cognitive worldviews reveals these constructs influence protective behaviors to mitigate infectious disease in tandem (Fincher et al., 2008; Murray et al., 2011), including in the context of the COVID-19 pandemic (see Bayeh et al., 2021 for review).

Worldview orientations may influence COVID-19 perceptions of risk in the United States (e.g., Bazzi et al., 2021; Han et al., 2021), but have not been directly examined. There are several reasons to expect that the perception of risk for COVID-19 may be minimized among those who have high hierarchical and individualist worldviews. People high in individualism may prioritize individual freedoms over group wellbeing, whereas people high in hierarchy may derive felt protection from stable social characteristics, such as social class, and a sense of security from harms granted by those in charge of the hierarchy (e.g., government; Kahan et al., 2007). In international settings, the importance of an individualistic worldview has been shown to shape COVID-19 personal risk perceptions, over and above trust in government or science, or political orientation (Schneider et al., 2021). In the United States, however, the communication environment may dictate that worldview orientations may be significantly more polarized than in other countries (Penneycook et al., 2021). As such, examining the contribution of worldview orientations and COVID-19 risk perceptions in the United States will help guide needed public health messaging regarding protective action. Accordingly, in this study we examine worldview orientations and COVID-19 cognitive and affective facets of risk perception, and risk to oneself and others.

Research Questions and Hypotheses

Our primary research question asked, what is the association between worldview orientations (hierarchy; individualism) and perceptions of risk for COVID-19 in a nationally representative U.S. sample? We hypothesized that stronger hierarchical and individualistic worldview orientations would be associated with lower COVID-19 personal and social risk perceptions. We considered cognitive (absolute risk, risk certainty, comparative risk, and risk severity) and affective (fear and feeling of risk) risk perceptions across three referents (personal risk for oneself, risk for the average person within the United States, and risk to people within specific social groups). Our examination of COVID-19 risk perceptions and worldview orientations in a nationally representative U.S. sample will inform COVID-19 prevention message development, given the ongoing pandemic, and the possibility of recurrent infections with COVID-19. The repeated pathogen transmission from animal reservoirs to human populations in recent decades (e.g., HIV, the 1918 influenza virus, the avian influenza virus; Baker et al., 2022), and the possibility and inevitability of

future outbreaks (Maxmen, 2021) make understanding factors that shape risk perceptions a pursuit of critical importance that can improve mitigative capacity, both today, and in responding to future outbreaks.

Method

Participants

From June 12 to June 18, 2020, we recruited a nationally representative sample of U.S. adults via the Ipsos KnowledgePanel (IPSOS, 2020). The Ipsos KnowledgePanel is the oldest and largest probability-based sampling online panel in the United States, consisting of non-institutionalized adults age 18 and above selected using address-based sampling that covers 97% of U.S. households. Of 682 panel members invited, 410 returned responses (completion rate of 60%). Participants completed the survey online and were compensated with points exchangeable for rewards from Ipsos.

Measures

Worldview Orientations

We assessed worldview orientations with a measure developed by Kahan and colleagues (2011), which assesses both “hierarchy-egalitarianism” (e.g., “We have gone too far in pushing equal rights in this country”) and “individualism-communitarianism” (e.g., “The government interferes far too much in our everyday lives”). Each scale contained six statements using a 4-point Likert scale ranging from 1 to 4 [strongly disagree, somewhat disagree, somewhat agree, strongly agree]. For hierarchy-egalitarianism, a higher mean score indicated a more hierarchical (less egalitarian) worldview. For individualism-communitarianism, a higher mean score indicated a more individualistic (less communitarian) worldview. The scores for both hierarchy-egalitarianism ($\alpha=0.87$) and individualism–communitarianism ($\alpha=0.84$) scales exhibited good internal consistency. Since these scales were developed and validated in the United States, they have been found to be most highly predictive of risk perceptions in U.S. samples (Xue et al., 2014).

Risk Perception

Most risk perception items were adapted from prior sources (Janssen et al., 2018). In the current study, we assessed six different facets of perceived risk. With one exception (comparative risk, which was evaluated for personal risk only), each facet of risk was assessed for each of three referents: (1) one’s own personal risk, (2) risk for the average person within the United States, and (3) the risk to people within specific social groups the participants thought was most important to protect from getting COVID-19. To assess risk for people within specific social groups, participants

were first shown a list of social groups that included: (1) immediate family (e.g., parents, children, spouse/partner), (2) extended family, close friends, (3) co-workers or classmates, (4) neighbors, (5) people you encounter when doing shopping or errands, (6) people of your race/ethnicity, (7) people with shared political values, (8) people in your city or community, (9) people in your state, (10) people who live in the United States, and (11) health care workers. Then, participants were asked to select the group they thought was most important to protect from getting COVID-19. Subsequently, they answered perceived risk questions for people within social groups with the specific referent on mind.

Perceived absolute risk was measured with a question asking how likely respondents thought each referent was to get COVID-19 in the next 6 months [1=very unlikely, 2=unlikely, 3=likely, 4=very likely]. *Certainty about absolute risk* was measured with an item asking how certain the respondents were about the level of perceived risk they indicated for the absolute risk question. [1=very uncertain, 2=uncertain, 3=certain, 4=very certain]. *Perceived comparative risk* was measured with a question asking how likely respondents thought they were to get COVID-19 in the next 6 months compared to other people their age [1=much less likely, 2=less likely, 3=about the same likelihood, 4=more likely, 5=much more likely]. *Severity* was measured with a question asking participants how serious COVID-19 infection would be for each referent, if they were to get it in the next 6 months [1=not at all serious, 2=a little bit serious, 3=serious, 4=extremely serious]. *Fear* was assessed with an item asking how afraid respondents were that each referent could get COVID-19 in the next 6-months [1=not at all afraid, 2=a little bit afraid, 3=afraid, 4=extremely afraid]. *Feelings of risk* was assessed by an item asking how easily participants felt each referent could get COVID-19 in the next 6 months [1=not at all easily, 2=a little bit easily, 3=very easily, 4=extremely easily].

Demographic Information

Demographic variables included gender, race, ethnicity, age, formal educational attainment, rurality, household income, and political party affiliation.

Statistical Approach

The IPSOS KnowledgePanel team calculated adjusted design weights to address potential survey non-response (IPSOS, 2020). These adjusted design weights were calculated using the distribution of U.S. adults from the most recent fielding of the Current Population Survey. Analyses included the weights and were conducted using SAS version 9.4. The significance level was set to $\alpha=0.05$.

Using multivariable linear regression models, we examined the relationships between worldview orientations (hierarchy and individualism) and the six facets of perceived risk (absolute risk, risk certainty, comparative risk, severity, fear, and feeling of risk). Analyses for all the facets of perceived risk were conducted separately for each of the three referents (personal risk, risk for the average person within the

United States, and risk to people within specific social groups). We entered both worldview orientations in each model as predictors, following Kahan's recommendation to include them together as they both influence risk perceptions (Kahan et al., 2011). We adjusted the models for gender, race/ethnicity, age, education, rurality, household income, and political party affiliation. The reported findings are from the adjusted models. Confidence intervals (CIs) were set to 95%. Additionally, we controlled for false discovery rate (FDR) using the Benjamini–Hochberg (1995) procedure with a detection threshold of $Q=0.10$; all findings remained significant ($p < 0.05$).

Results

Participant Characteristics

Weighted univariate analyses were performed for participant characteristics, which reflect the demographic distribution of the U.S. population. For details, see Table 1. With respect to risk perceptions, personal risk showed lowest scores for all facets of risk (i.e., absolute risk, severity, fear, and feelings of risk). Risk certainty was lowest for people within specific social groups. Comparative risk was measured for one referent only (self). For more information, see Table 2.

Worldview Orientations and Perceived Risk

Personal Risk Perceptions

Individualism was statistically significantly associated with all facets of personal risk perception (see top panel of Fig. 1). Specifically, respondents with more individualistic worldview had lower absolute risk ($b = -0.16$; $p = 0.028$; $CI [-0.30, -0.02]$), higher certainty about one's risk ($b = 0.32$; $p < 0.001$; $CI [0.13, 0.50]$), lower comparative risk ($b = -0.18$; $p = 0.036$; $CI [-0.36, -0.01]$), lower severity ($b = -0.17$; $p = 0.049$; $CI [-0.35, -0.01]$), lower fear ($b = -0.28$; $p < 0.001$; $CI [-0.43, -0.14]$) and lower feelings of risk ($b = -0.20$; $p = 0.006$; $CI [-0.34, -0.06]$). In contrast, hierarchy was associated with lower risk severity only ($b = -0.22$ $p = 0.007$; $CI [-0.38, -0.06]$).

Risk Perceptions for the Average Person in the United States

As shown in the middle panel of Fig. 1, with regard to risk perception for the average person in the United States, higher individualism was associated with statistically significantly lower risk severity ($b = -0.20$; $p = 0.004$; $CI [-0.34, -0.06]$), lower fear ($b = -0.30$; $p < 0.001$; $CI [-0.44, -0.17]$), and lower feeling of risk ($b = -0.16$; $p = 0.017$; $CI [-0.29, -0.03]$). Higher hierarchy was associated with lower absolute risk ($b = -0.22$; $p < 0.001$; $CI [-0.34, -0.09]$), lower severity ($b = -0.23$; $p < 0.001$; $CI [-0.36, -0.10]$), and lower feeling of risk ($b = -0.18$; $p = 0.004$; CI

Table 1 Participant Characteristics ($N=410$)

Demographic information	<i>N</i>	Weighted %*
Gender		
Women	211	51.59
Men	199	48.41
Race/Ethnicity		
Non-Hispanic White	291	63.14
Non-Hispanic Black or African American	36	11.82
Non-Hispanic, Asian, American Indian/Alaska Native, or Native Hawaiian/Pacific Islander	23	5.55
Non-Hispanic 2 + races	14	3.04
Hispanic	46	16.44
Age		
18–29	42	20.90
30–44	95	25.13
45–59	117	24.69
60+	156	29.28
Education		
Less than high school	28	10.60
High school	130	28.31
Some college	110	27.77
Bachelor's or higher	142	33.32
Rurality		
Non-metro area	60	13.34
Metro area	350	86.66
Household income		
Up to \$ 49,999	108	31.75
\$ 50,000 to \$ 99,999	132	30.95
\$ 100,000 to \$ 149,999	82	17.70
\$ 150,000 to \$ 199,999	52	11.54
\$ 200,000 to \$ 249,999	15	3.26
\$ 250,000 and more	21	4.81
Political orientation		
Republican	120	29.50
Democrat	132	32.40
Independent	99	24.30
Another party	10	2.50
No affiliation	46	11.30

Table 2 Risk perceptions by referent

Risk facet	Personal	Average person in the United States	People within specific social groups
	Weighted <i>M</i> (<i>SD</i>)	Weighted <i>M</i> (<i>SD</i>)	Weighted <i>M</i> (<i>SD</i>)
Absolute risk ^a	1.92 (0.73)	2.84 (0.84)	2.50 (0.84)
Certainty ^a	2.90 (0.91)	2.97 (0.76)	2.74 (0.78)
Comparative risk ^b	2.54 (0.89)	N/A	N/A
Severity ^a	2.55 (0.99)	2.82 (0.87)	3.06 (0.84)
Fear ^a	2.02 (0.94)	2.22 (0.90)	2.52 (0.95)
Feelings of risk ^a	1.87 (0.74)	2.48 (0.83)	2.30 (0.89)

^aThe scale ranges from 1 to 4; ^bThe scale ranges from 1 to 5

[−0.30, −0.06]). The associations between worldview orientations and the remaining risk facets did not reach statistical significance of $p < 0.05$.

Risk Perception for People within Specific Social Groups

As shown in the bottom panel of Fig. 1, with regard to risk perception for people within specific social groups, higher individualism was associated with lower absolute risk ($b = -0.32$; $p < 0.001$; $CI [-0.44, -0.21]$), higher certainty about risk ($b = 0.18$; $p = 0.032$; $CI [0.02, 0.34]$), lower fear ($b = -0.29$; $p < 0.001$; $CI [-0.36, -0.09]$), and lower feeling of risk ($b = -0.17$; $p = 0.037$; $CI [-0.32, -0.01]$). Higher hierarchy was associated with lower risk severity ($b = -0.28$; $p < 0.001$; $CI [-0.41, -0.16]$), and fear ($b = -0.23$; $p < 0.001$; $CI [-0.44, -0.15]$). The associations between either worldview and the remaining risk facets did not reach statistical significance ($p < 0.05$).

Discussion

Using a representative U.S. sample, we found robust and consistent support that people with higher hierarchical and individualistic worldviews believe that they and others are at a lower risk for COVID-19 than people with more egalitarian and communitarian worldviews. These results held even after adjusting for relevant demographic characteristics—including political affiliation—in all analyses. Although higher levels of both worldview orientations were linked to lower COVID-19 risk perception in several instances, individualism was linked to lower risk perceptions more consistently than hierarchy (associations between individualism and risk facets were observed in 13 out of 16 models, and for hierarchy in 6 out of 16 models). Furthermore, individualism was related to higher certainty about COVID-19 risk for personal risk and risk to people within specific social groups, suggesting that those who endorse individualism believe they are particularly insulated to threats of COVID-19, given their reduced risk perceptions and relative confidence in their

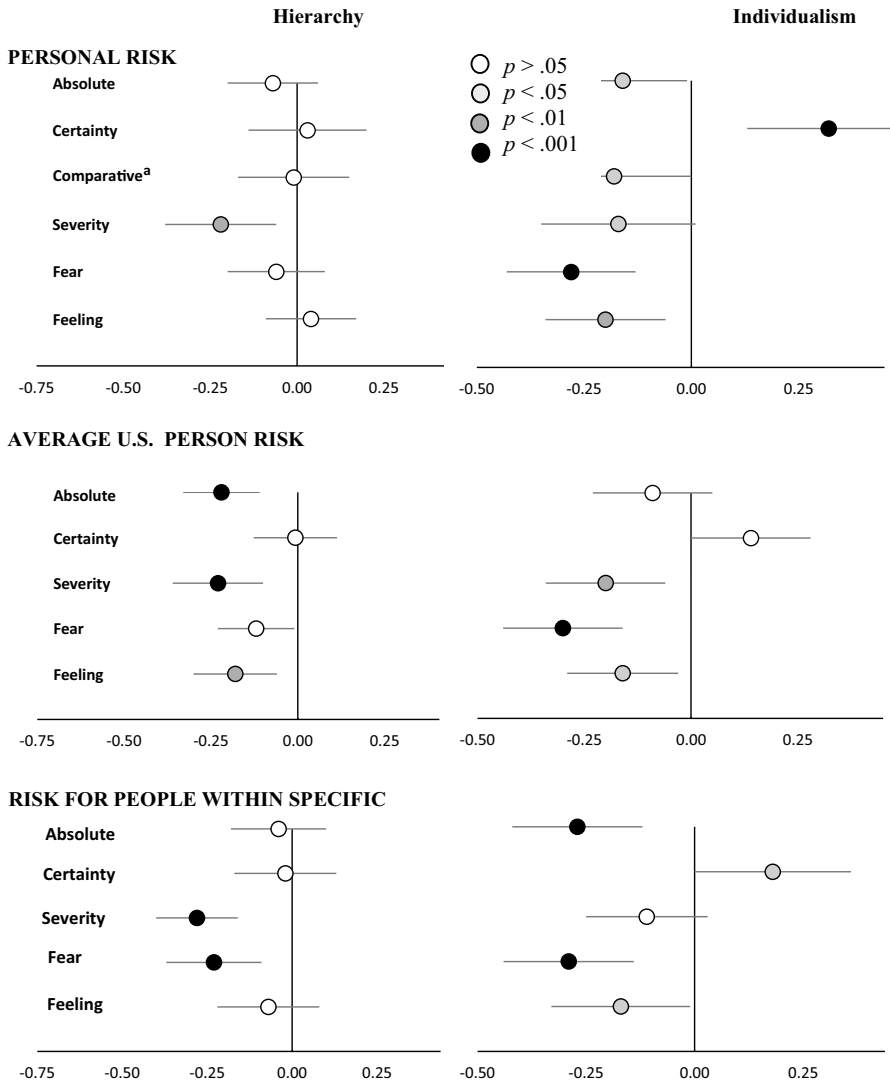


Fig. 1 Associations between worldview orientations and risk perception for: personal risk, the risk to the average person in the United States, and risk to people within specific social groups. Notes: ^a Comparative risk was measured using a scale from 1 to 5; all other risk outcomes were measured on a scale from 1 to 4. Each risk perception measure was regressed simultaneously on both hierarchical and individualistic worldviews; results from 16 models, adjusted with demographic variables, are depicted. CIs were set to 95%. Data points represent unstandardized regression coefficients. Dots on the left-hand side of the vertical bar indicate an inverse relationship between the risk facet/referent and the worldview; data on the right-hand side indicate a positive relationship. For example, higher hierarchy is associated with lower perceived severity for one’s own risk. Higher individualism is associated with higher certainty about one’s own risk estimate

assessments. Finally, hierarchy was consistently related to lower COVID-19 severity for personal and others’ risk. This highlights that those endorsing hierarchy may feel

their risk severity is lower, consistent with beliefs that those in charge will protect members of hierarchy from harms.

There were additional patterns of results with implications for message development. First, affective facets of risk, such as fear of developing COVID-19 and feelings of risk, were consistently related to worldview orientations. Indeed, individualism was uniformly associated with reduced affective risk (i.e., fear and feeling across all referents), communication that is designed to elicit stronger emotions may bolster message persuasiveness among individualists. Leveraging affect in risk communication messages is important given the documented need to address affective risk perceptions to maximize protective behaviors to mitigate COVID-19 (Harper et al., 2021; Savadori & Lauriola, 2022). Such approaches may be particularly effective when coupled with efficacy statements to promote the belief that the message recipients have the ability to counteract the threat (Tannenbaum et al., 2015). Second, *p* values for associations between worldview orientations and other's risk were generally smaller (i.e., showing stronger association evidence) than for worldview orientations and personal risk perceptions. This important and novel finding suggests that people with hierarchical and individualistic worldviews may be particularly inclined to disregard the negative consequences of COVID-19 for other people. Thus, risk communication focused primarily on protecting others from the virus may not be as persuasive as messaging focused on personal risk.

Given that those with the stronger hierarchical or individualistic worldviews may underappreciate their risk for COVID-19, or may be more resistant to the ongoing public health messaging regarding infection risks, intervention strategies to influence COVID-19 risk perceptions need to go beyond standard messaging (Hornsey & Fielding, 2017). Instead, they need to effectively increase perceived risk—and reduce certainty—among those with individualistic worldviews. There have been efforts in the U.S. to target entrenched beliefs underlying reduced COVID-19 risk perceptions that can have relevance for targeting worldviews (Han et al., 2021; Joslyn et al., 2021; Resnicow et al., 2021). For example, Resnicow et al. (2021) proposed that entrenched beliefs can be addressed using messages that empathize with certain aspects of the audience's views rather than challenging them (approach known as “rolling with resistance”), while also avoiding controlling language (e.g., you must/have to) in order to reduce reactance. Such approaches could possibly address lower risk perception related to worldviews but have not been tested specifically for those with strong hierarchy or individualism. As such, these and additional risk reduction approaches require testing. Messages that leverage decisional autonomy and choice could have persuasive appeal for individualists. Eliciting worry can be similarly worthwhile given links between individualism and lower affective risk. For example, messages to encourage vaccination may have more persuasive appeal for individualists if they acknowledge that vaccines are voluntary, while also reminding that they are crucial for minimizing serious health consequences from COVID-19, and death. To target lower perceived severity in those who endorsed hierarchy, highlighting the more severe health outcomes resulting from COVID-19 (e.g., difficulty breathing) may help elicit more appropriate concern. Persuasiveness of the communication could be bolstered if messages are delivered by trusted in-group models (Bavel et al., 2020). Inclusion of multi-level contexts such as

institutions or communities within which individuals operate that impact one's ability to take preventive action to mitigate risks is critical for more complete modeling and understanding of factors that shape risk perceptions and behavior change (e.g., Latkin et al., 2021). Finally, involving relevant stakeholders (i.e., people who endorse hierarchy or individualism) to inform message development may increase acceptability by the target audiences.

Study Limitations and Strengths

Policies in response to the COVID-19 pandemic varied vastly across U.S. geographical areas, which may have influenced how COVID-19 threat was perceived across localities. This, along with the fact that the risk of contracting COVID-19 fluctuated throughout the pandemic (Schneider et al., 2021), is a limitation to the external validity of our findings across geographic areas and different timepoints in the trajectory of the pandemic. Second, we assessed risk perceptions for people within specific social groups who participants believed were most important to protect from getting COVID-19, but in the analyses, we did not make distinctions between these different referents, and instead treated them as a uniform group (i.e., we examined perceived risk for people within social groups). Examining risk perception for specific social groups individually is an important future endeavor. The influences of political orientation on COVID-19 risk perception may be better explained by "Conservative" v. "Liberal" dimension rather than political party affiliation, which is an imperfect proxy for the degree of one's conservatism/liberalism. Finally, application of the findings of this work could more fully address worldviews and personality factors, as well as journalistic and media influences on worldviews and COVID-19 risk perceptions.

Although the associations of individualistic and hierarchical worldviews with COVID-19-related have been described in international research (Dryhurst et al., 2020; Savadori & Lauriola, 2022), as well as a U.S. literature (Liu & Yang, 2021), our study adds contribution. Specifically, by using a nationally representative sample of U.S. respondents, and controlling for political party affiliation and demographics, we examine cognitive and affective risk beliefs for self and others, and contribute a comprehensive assessment of links between worldviews and perceived COVID-19 risk. Also, to our knowledge this is the first study to include assessment of risk certainty.

Conclusions

The strong links associating hierarchical and individualistic worldviews with COVID-19 risk perception imply that worldviews play a role in appraisal of threats surrounding COVID-19. The use of sensitively designed, culturally consistent messaging may help optimize acceptance of recommendations for behavioral protection and vaccination—both in the context of COVID-19, and potential future outbreaks. Such messages may be optimal if they are consistent with, rather than in conflict

with, worldview orientations. Unique needs of those with different worldviews should be considered in message development.

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Data Availability Data are available upon request from the corresponding author.

Code availability Syntax is available upon request from the corresponding author.

Compliance With Ethical Standards

Conflict of interest None of the authors have conflicts of interest or competing interests that would influence reporting of study results.

Ethical Approval The study was approved by the University of Kentucky institutional review board.

Consent to Participate Participants were part of a standing IPSOS survey panel. IPSOS conducts an over-all consent process when participants join the panel.

References

- Baker, R. E., Mahmud, A. S., Miller, I. F., Rajeev, M., Rasambainarivo, F., Rice, B. L., Takahashi, S., Tatem, A. J., Wagner, C. E., Wang, L.-F., Wesolowski, A., & Metcalf, C. J. E. (2022). Infectious disease in an era of global change. *Nature Reviews Microbiology*, 20(4), 193–205. <https://doi.org/10.1038/s41579-021-00639-z>
- Bauchner, H., & Fontanarosa, P. (2020). Thinking of risk in the era of COVID-19. *JAMA*. <https://doi.org/10.1001/jama.2020.10242>
- Bavel, J. J. V., Baicker, K., Boggio, P. S., et al. (2020). Using social and behavioural science to support COVID-19 pandemic response. *Nature Human Behaviour*, 4, 460–471. <https://doi.org/10.1038/s41562-020-0884-z>
- Bayeh, R., Yampolsky, M. A., & Ryder, A. G. (2021). The social lives of infectious diseases: Why Culture Matters to COVID-19. *Frontiers in Psychology*, 23(12), 648086. <https://doi.org/10.3389/fpsyg.2021.648086>. PMID:34630195;PMCID:PMC8495420
- Bazzi, S., Fiszbein, M., & Gebresilasse, M. (2021). “Rugged individualism” and collective (in)action during the COVID-19 pandemic. *Journal of Public Economics*, 195, 104357. <https://doi.org/10.1016/j.jpubeco.2020.104357>
- Benjamini, Y., & Hochberg, Y. (1995). Controlling the False Discovery Rate: A Practical and Powerful Approach to Multiple Testing. *Journal of the Royal Statistical Society. Series B (Methodological)*, 57(1), 289–300. <http://www.jstor.org/stable/2346101>
- Bruine de Bruin, W., & Bennett, D. (2020). Relationships Between Initial COVID-19 Risk Perceptions and Protective Health Behaviors: A National Survey. *American Journal of Preventive Medicine*, 59(2), 157–167. <https://doi.org/10.1016/j.amepre.2020.05.001>

- Cameron, L., Leventhal, H. (2003) The self-regulation of health and illness behaviour. *New York*. Routledge.
- Centers for Disease Control and Prevention. (2021). *CDC COVID-19 study shows mRNA vaccines reduce risk of infection by 91 percent for fully vaccinated people*. <https://www.cdc.gov/media/releases/2021/p0607-mrna-reduce-risks.html>
- Centers for Disease Control and Prevention. (2022). *How to protect yourself and others*. <https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/prevention.html>
- Conner, M., & Norman, P. (1996). *Predicting health behaviour: Research and practice with social cognition models*. Open University Press.
- Dryhurst, S., Schneider, C. R., Kerr, J., Freeman, A. L. J., Recchia, G., van der Bles, A. M., Spiegelhalter, D., & van der Linden, S. (2020). Risk perceptions of COVID-19 around the world, *Journal of Risk Research*, 23(7–8), 994–1006. <https://doi.org/10.1080/13669877.2020.1758193>
- Ferrer, R. A., Klein, W. M., Persoskie, A., Avishai-Yitshak, A., & Sheeran, P. (2016). The Tripartite Model of Risk Perception (TRIRISK): Distinguishing Deliberative, Affective, and Experiential Components of Perceived Risk. *Annals of Behavioral Medicine*, 50(5), 653–663. <https://doi.org/10.1007/s12160-016-9790-z>
- Fincher, C. L., Thornhill, R., Murray, D. R., & Schaller, M. (2008). Pathogen prevalence predicts human cross-cultural variability in individualism/collectivism. *Proceedings of Royal Society B Biological Sciences*, 275, 1279–1285. <https://doi.org/10.1098/rspb.2008.0094>
- Finucane, M. L., Slovic, P., Mertz, C. K., Flynn, J., & Satterfield, T. A. (2000). Gender, race, and perceived risk: The “white male” effect. *Health, Risk & Society*, 2(2), 159–172. <https://doi.org/10.1080/713670162>
- Franz, B., & Dhanani, L. Y. (2021). Beyond political affiliation: An examination of the relationships between social factors and perceptions of and responses to COVID-19. *Journal of Behavioral Medicine*, 44(5), 641–652. <https://doi.org/10.1007/s10865-021-00226-w>
- Hamilton, K., Smith, S. R., Keech, J. J., Moyers, S. A., & Hagger, M. S. (2020). Application of the health action process approach to social distancing behavior during COVID-19. *Applied Psychology: Health and Well-Being*, 12(4), 1244–1269. <https://doi.org/10.1111/aphw.12231>
- Han, P. K. J., Scharnetzki, E., Scherer, A. M., Thorpe, A., Lary, C., Waterston, L. B., Fagerlin, A., & Dieckmann, N. F. (2021). Communicating scientific uncertainty about the COVID-19 pandemic: Online experimental study of an uncertainty-normalizing strategy. *Journal of Medical Internet Research*, 23(4), e27832–e27832. <https://doi.org/10.2196/27832>
- Harper, C. A., Satchell, L. P., Fido, D., & Latzman, R. D. (2021). Functional fear predicts public health compliance in the COVID-19 Pandemic. *The International Journal of Mental Health & Addiction*, 19(5), 1875–1888. <https://doi.org/10.1007/s11469-020-00281-5>
- Hornsey, M. J., & Fielding, K. S. (2017). Attitude roots and Jiu Jitsu persuasion: Understanding and overcoming the motivated rejection of science. *American Psychologist*, 72(5), 459–473. <https://doi.org/10.1037/a0040437>
- IPSOS. Knowledge Panel. (2020) <https://www.ipsos.com/en-us/solutions/public-affairs/knowledgepanel>.
- Janssen, E., Verduyn, P., & Waters, E. A. (2018). Don't know responses to cognitive and affective risk perception measures: Exploring prevalence and socio-demographic moderators. *British Journal of Health Psychology*, 23(2), 407–419. <https://doi.org/10.1111/bjhp.12296>
- Janssen, E., Waters, E. A., van Osch, L., Lechner, L., & de Vries, H. (2014). The importance of affectively-laden beliefs about health risks: The case of tobacco use and sun protection. *Journal of Behavioral Medicine*, 37(1), 11–21. <https://doi.org/10.1007/s10865-012-9462-9>
- Joslyn, S., Savelli, S., Duarte, H. A., Burgeno, J., Qin, C., Han, J. H., & Gulacsik, G. (2021). COVID-19: Risk perception, risk communication, and behavioral intentions. *Journal of Experimental Psychology: Applied*, 27(4), 599–620. <https://doi.org/10.1037/xap0000398>
- Kahan, D. M., Braman, D., Cohen, G. L., Gastil, J., & Slovic, P. (2010). Who fears the HPV vaccine, who doesn't, and why? an experimental study of the mechanisms of cultural cognition. *Law and Human Behavior*, 34(6), 501–516. <https://doi.org/10.1007/s10979-009-9201-0>.
- Kahan, D., Braman, D., Gastil, J., Slovic, P., & Mertz, C. (2005). Gender, race, and risk perception: The influence of cultural status anxiety. *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.723762>
- Kahan, D. M., Braman, D., Gastil, J., Slovic, P., & Mertz, C. K. (2007). Culture and identity-protective cognition: Explaining the white-male effect in risk perception. *Journal of Empirical Legal Studies*, 4(3), 465–505.
- Kahan, D. M., Jenkins-Smith, H., & Braman, D. (2011). Cultural cognition of scientific consensus. *Journal of Risk Research*, 14(2), 147–174.

- Latkin, C., Dayton, L. A., Yi, G., Konstantopoulos, A., Park, J., Maulsby, C., Kong, X. (2021). COVID-19 vaccine intentions in the United States, a social-ecological framework. *Vaccine*, 39(16), 2288–2294. <https://doi.org/10.1016/j.vaccine.2021.02.058>. Epub 2021 Mar 10. PMID: 33771392; PMCID: PMC7945864.
- Li, Y., Luan, S., Li, Y., Wu, J., Li, W., & Hertwig, R. (2022). Does risk perception motivate preventive behavior during a pandemic? A longitudinal study in the United States and China. *The American Psychologist*, 77(1), 111–123. <https://doi.org/10.1037/amp0000885>
- Liu, Z., & Yang, J. (2021). Public Support for COVID-19 Responses: Cultural Cognition, Risk Perception, and Emotions. *Health Communication*, 23, 1–11. <https://doi.org/10.1080/10410236.2021.1965710>
- Loewenstein, G. F., Weber, E. U., Hsee, C. K., & Welch, N. (2001). Risk as feelings. *Psychological Bulletin*, 127(2), 267–286. <https://doi.org/10.1037/0033-2909.127.2.267>
- Magnan, R. E., Gibson, L. P., & Bryan, A. D. (2021). Cognitive and affective risk beliefs and their association with protective health behavior in response to the novel health threat of COVID-19. *Journal of Behavioral Medicine*, 44(3), 285–295. <https://doi.org/10.1007/s10865-021-00202-4>
- Maxmen, A. (2021). Has COVID taught us anything about pandemic preparedness? *Nature*, 596(7872), 332–335. <https://doi.org/10.1038/d41586-021-02217-y>
- Murray, D. R., Trudeau, R., & Schaller, M. (2011). On the origins of cultural differences in conformity: four tests of the pathogen prevalence hypothesis. *Personality and Social Psychology Bulletin*, 37(3), 318–329. <https://doi.org/10.1177/0146167210394451>
- Nazione, S., Perrault, E., & Pace, K. (2021). Impact of information exposure on perceived risk, efficacy, and preventative behaviors at the beginning of the COVID-19 pandemic in the United States. *Health Communication*, 36(1), 23–31. <https://doi.org/10.1080/10410236.2020.1847446>
- Pennycook, G., McPhetres, J., Bago, B., & Rand, D. G. (2021). Beliefs About COVID-19 in Canada, the United Kingdom, and the United States: A novel test of political polarization and motivated reasoning. *Personality and Social Psychology Bulletin*, 48(5), 750–765. <https://doi.org/10.1177/01461672211023652>
- Peters, E., McCaul, K. D., Stefanek, M., & Nelson, W. (2006). A heuristics approach to understanding cancer risk perception: Contributions from judgment and decision-making research. *Annals of Behavioral Medicine*, 31(1), 45–52. https://doi.org/10.1207/s15324796abm3101_8
- Ranby, K. W., Aiken, L. S., Gerend, M. A., & Erchull, M. J. (2010). Perceived susceptibility measures are not interchangeable: Absolute, direct comparative, and indirect comparative risk. *Health Psychology*, 29(1), 20–28. <https://doi.org/10.1037/a0016623>
- Reimer, N. K., Atari, M., Karimi-Malekabadi, F., Trager, J., Kennedy, B., Graham, J., & Dehghani, M. (2022). Moral values predict county-level COVID-19 vaccination rates in the United States. *American Psychologist*, 77(6), 743–759. <https://doi.org/10.1037/amp0001020>
- Resnicow, K., Bacon, E., Yang, P., Hawley, S., Van Horn, M. L., & An, L. (2021). Novel predictors of COVID-19 protective behaviors Among US Adults: Cross-sectional survey. *Journal of Medical Internet Research*, 23(4), e23488. <https://doi.org/10.2196/23488>
- Savadori, L., & Lauriola, M. (2022). Risk perceptions and COVID-19 protective behaviors: A two-wave longitudinal study of epidemic and post-epidemic periods. *Social Science & Medicine*, 301, 114949. <https://doi.org/10.1016/j.socscimed.2022.114949>
- Schneider, C. R., Dryhurst, S., Kerr, J., Freeman, A. L. J., Recchia, G., Spiegelhalter, D., & van der Linden, S. (2021). COVID-19 risk perception: A longitudinal analysis of its predictors and associations with health protective behaviours in the United Kingdom. *Journal of Risk Research*, 24(3–4), 294–313. <https://doi.org/10.1080/13669877.2021.1890637>
- Sheeran, P., Harris, P. R., & Epton, T. (2014). Does heightening risk appraisals change people's intentions and behavior? A meta-analysis of experimental studies. *Psychological Bulletin*, 140(2), 511–543. <https://doi.org/10.1037/a0033065>
- Shepperd, J. A., Lipsey, N. P., Pachur, T., & Waters, E. A. (2018). Understanding the cognitive and affective mechanisms that underlie proxy risk perceptions among caregivers of asthmatic children. *Medical Decision Making*, 38(5), 562–572. <https://doi.org/10.1177/0272989x18759933>
- Slovic, P., Peters, E., Finucane, M. L., & Macgregor, D. G. (2005). Affect, risk, and decision making. *Health Psychology*, 24(4s), S35–40. <https://doi.org/10.1037/0278-6133.24.4.S35>
- Smail, E., Schneider, K. E., DeLong, S. M., Willis, K., Arrington-Sanders, R., Yang, C., Alexander, K. A., & Johnson, R. M. (2021). Health beliefs and preventive behaviors among adults during the early COVID-19 pandemic in the United States: A latent class analysis. *Prevention Science*, 22(8), 1013–1022. <https://doi.org/10.1007/s11211-021-01273-0>

- Tannenbaum, M. B., Hepler, J., Zimmerman, R. S., Saul, L., Jacobs, S., Wilson, K., & Albarracín, D. (2015). Appealing to fear: A meta-analysis of fear appeal effectiveness and theories. *Psychological Bulletin*, *141*(6), 1178–1204. <https://doi.org/10.1037/a0039729>
- Tarry, H., Vézina V, Bailey, J, & Lopes L. (2022). Political orientation, moral foundations, and COVID-19 social distancing. *PLoS ONE*, *17*(6), e0267136. <https://doi.org/10.1371/journal.pone.0267136>
- Viswanath, K., Bekalu, M., Dhawan, D., Pinnamaneni, R., Lang, J., & McLoud, R. (2021). Individual and social determinants of COVID-19 vaccine uptake. *BMC Public Health*, *21*(1), 818. <https://doi.org/10.1186/s12889-021-10862-1>
- Weinstein, N. D., Kwitel, A., McCaul, K. D., Magnan, R. E., Gerrard, M., & Gibbons, F. X. (2007). Risk perceptions: Assessment and relationship to influenza vaccination. *Health Psychology*, *26*(2), 146–151. <https://doi.org/10.1037/0278-6133.26.2.146>
- Xue, W., Hine, D. W., Loi, N. M., Thorsteinsson, E. B., & Phillips, W. J. (2014). Cultural worldviews and environmental risk perceptions: A meta-analysis. *Journal of Environmental Psychology*, *40*, 249–258. <https://doi.org/10.1016/j.jenvp.2014.07.002>

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