I Think, Therefore I Act: The Influence of Critical Reasoning Ability on Trust and Behavior During the COVID-19 Pandemic

Alex Segrè Cohen 1, Lauren Lutzke 1, Caitlin Drummond Otten 2, and Joseph Árvai 1,3,∗

Actively open-minded thinking (AOT) operates in three dimensions: it serves as a norm accounting for how one should search for and use information in judgment and decision making; it is a thinking style that one may adopt in accordance with the norm; and it sets standards for evaluating the thinking of others, particularly the trustworthiness of sources that claim authority. With the first and third dimensions in mind, we explore how AOT influences trust in public health experts, risk perceptions, and compliance with recommended behaviors aimed at slowing the spread and severity of the COVID-19 pandemic. Using survey data from a nationally representative sample of Americans (N = 857), we tested whether AOT will lead people to place greater trust in public health experts (H1). Because these experts have been consistently messaging that COVID-19 is a real and serious threat to public health, we also hypothesized that trust in experts would be positively associated with high perceived risk (H2), which should have a positive influence on (self-reported) compliance with CDC recommendations (H3). And because AOT is a self-directed thinking style, we also expected it to directly influence risk perceptions and, by extension, compliance (H4). Our results support all four hypotheses. We discuss the implications of these results for how risk communication and risk management efforts are designed and practiced.

KEY WORDS: Behavior; COVID-19; critical reasoning; risk perception; trust

1. INTRODUCTION

Many countries continue to struggle with the COVID-19 pandemic. Between when the pandemic was declared by the World Health Organization in March 2020 and the time of this writing (in August 2021), there have been over 210 million reported infections worldwide, and nearly 4.5 million people have perished. Adding to the tragedy, the case count and numbers of fatalities remain high in many countries.1 And, though several different vaccines are either in development or have been granted emergency approval for use, their rollout in many countries—especially developing nations—has thus far been slow, inequitable, and clumsy.

Even though access to one of several COVID-19 vaccines is becoming more widespread, new variants of the SARS-CoV-2 virus remind us that managing the health risks associated with the pandemic still depends heavily upon widely agreed-upon behavioral measures that can be taken by individuals. These measures include avoiding spaces that are closed or

1For up-to-date data on COVID-19 infections and mortality, see: https://covid19.who.int
confined, crowded, or involve close contact with others; avoiding contact with people who are ill or symptomatic; and covering one’s mouth and nose with a fabric mask or face cover when in public spaces.

Despite the accessibility of these recommendations, we have observed a combination of obstinacy and misunderstanding regarding the transmission of the SARS-CoV-2 virus and the associated risks of COVID-19 (e.g., Chesser, Drassen Ham, & Keene Woods, 2020; Krause, Freiling, Beets, & Brossard, 2020). As a result, the adoption of behavioral measures has been limited in many areas leading to extraordinarily high infection and mortality rates. The United States is among the most high-profile examples; nearly 38 million Americans have been infected and over 600,000 have died. A broad range of experts and on-the-ground responders have argued that many of these infections and deaths across the United States (and elsewhere) could have been avoided through a better coordinated and science-based response across all levels of government (i.e., local, state, and federal), and—importantly—through higher levels of public compliance with the behavioral recommendations outlined above. A key aspect of such a response is the provision of clear and consistent risk messages that are delivered by trusted experts (Abrams & Greenhawt, 2020; Kim & Kreps, 2020; WHO 2020).

What leads to trust in technical experts and—ultimately—preventative behavior in the context of COVID-19 is the focus of the research reported here. Our research has its roots in a common, though largely anecdotal, observation from our prior work as facilitators of judgment and decision making in real-world contexts (e.g., Árvai & Gregory, 2020; Gregory, Arvai, & Gerber, 2013): that people asked to think critically about data and evidence as an input to judgments and decisions also tend to reason more critically about where the data and evidence came from (e.g., from reputable scientific bodies vs. sources of pseudo-science). These observations led us to suspect that critical reasoning ability may also be important when people make judgments about whom to trust during the COVID-19 pandemic.

Critical reasoning ability in the context of COVID-19 can be characterized according to the degree to which people understand (Drummond & Fischhoff, 2017; Drummond & Fischhoff, 2020) and, later, use (Árvai, 2014; Bessette, Wilson, & Árvai, 2020) scientific information when making judgments and decisions. One approach to formally measuring and studying critical reasoning ability is to assess the degree to which people identify with or exhibit the tenets of actively open-minded thinking (AOT) (Baron, 2019; Haran, Ritov, & Mellors, 2013; Stanovich & West, 2007).

AOT reflects the tendency to search for and evaluate information in a manner that is resistant to biases driven by prior beliefs or motivations (Mellors et al., 2015). Actively open-minded thinkers have been observed to make more accurate judgments about risks, and more evidence-based decisions under uncertainty, in a wide range of situations, such as climate change and politics (Baron, 2019; Haran et al., 2013; Stanovich & West, 1998). Individuals who score at the high end of the scales used to measure AOT (e.g., Stanovich & West, 1997; Svedholm-Häkkinen & Lindeman, 2018) tend also to be less reliant on motivated reasoning when forming opinions, regardless of their political ideology (Baron, 2019; Stanovich & Toplak, 2019; Stenhouse et al., 2018).

AOT draws on decision theory, specifically regarding setting standards for the conduct of objectives-directed thinking. Like “value-focused thinking” (Arvai, Gregory, & McDaniels, 2001; Gregory, Arvai, & McDaniels, 2001; Keeney, 1992), it involves the setting of parameters such as the attributes that are used to establish a judgment or to evaluate alternatives (Árvai & Gregory, 2020), the relative priority of different attributes (Bessette et al., 2020), level of confidence that is ascribed to judgments as they are being formulated (Baron, 2019), or amount of effort that ought be devoted to a judgment or decision before it is considered to be complete (Johnson & Payne, 1985).

Thus, AOT can be viewed from two different perspectives. On the one hand, AOT can be applied by individuals as a proactive thinking style; a series of step to follow when one makes a judgment or a decision. Here, the tenets of AOT—such as deploying a reflective (vs. reflexive) approach to judgment and decision making, taking into consideration information that goes against prior beliefs, and revising judgments or decisions in response to newly acquired evidence—characterize how information to support decision making is acquired and used (Haran et al., 2013). In this sense, decision-aiding tools such as decision analysis (Clemen, 2004) and structured decision making (Arvai et al., 2001; Gregory et al.,

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2See the final report of the Independent Panel for Pandemic Preparedness and Response: https://theindependentpanel.org/mainreport/
I think, therefore I act. 2012) are tools that require AOT. On the other hand, AOT can be thought of as a series of normative considerations that govern how information to support judgment and decision making should be sought and used. In this case, the tenets of AOT—such as being open to opposing arguments and viewing the willingness to change one’s mind as a strength instead of a weakness—characterize how the activity of judgment or decision making ought to unfold (Baron, Badgio, & Gaskins, 1986).

AOT consists of two related processes. One of these is the active search for counter-attitudinal information. The other is the active deployment of cognitive resources when information is acquired. Thus, AOT is active because people who engage in it take the initiative to identify credible information and, by extension, sources of it. And AOT is open-minded because those who engage in it are open to changing their opinions and judgments even if the information that first led to them seemed strong (Stenhouse et al., 2018). Overall, individuals who rate highly on AOT tend to invest more time and effort when searching for information upon which to base a judgment or decision. And people who score high AOT scores also tend to place a higher premium on considering the opinions and insights of others’ while forming their own (Haran et al., 2013).

It is this latter point that is at the heart of the research we report in this article. Prior work suggests that actively open-minded thinkers working in a domain where they lack in-depth knowledge or experience, may “outsource” the job of AOT to credible experts. Mechanistically, individuals who ascribe to the tenets of AOT may be more sensitive to—or may actively seek out—cues that are shared by people who are in a position to provide information that they too are actively open-minded thinkers (Baron, 2019). These cues may take the form of explanations or behaviors which suggest that attributes are being considered and prioritized, that sufficient time is being taken to draw conclusions, or that alternative conclusions have been considered.

In this sense, AOT is self-reinforcing: it serves as a norm accounting for how one should think; it is a cognitive process that is engaged in accordance with the norm; and it sets standards for evaluating the thinking of others, particularly the trustworthiness of sources that claim authority (Baron, 2019). It is for these reasons that actively open-minded thinkers are likely to gravitate toward respected or credentialed experts instead of commentators or pundits; in the context of COVID-19, this means relying on the insights of scientists and public health experts over the likes of commentators on media outlets such Fox News (because the normative tenets of AOT are generally not reflected in the behaviors or thinking styles of these media personalities).

Beyond AOT, we know that trust in the sources of risk information is a critical component of efforts aimed at keeping people safe during a pandemic. This is the case because, in the absence of more in-depth epidemiological knowledge, trust serves as a sort of heuristic that facilitates action based on the degree to which a trusted individual or organization recommends it. For example, during and after prior epidemics such as the H1N1 (swine flu) outbreak in 2009, trust in medical professionals and government risk managers predicted risk perceptions and an increase in preventative behavioral measures by members of the affected public (Siegrist, Luchsinger, & Bearth, 2021).

Prior research on the relationship between trust and risk perceptions has posited that an underlying driver is “salient value similarity” (Siegrist, Cvetkovich, & Roth, 2000). That is, people will judge an entity to be trustworthy if they perceive that it shares certain, situationally relevant (i.e., salient) values with them. This same path applies to judgments about the trustworthiness of individual actors. In this model, judgments about the similarity of salient values is more reflexive (Wilson & Arvai, 2006) than reflective; that is, these judgments are intuitive in nature, and are not the product of more active cognition during which people first account for the thinking styles (vs. values), such as AOT, of individuals and organizations.

In light of prior research on AOT, we hypothesize that higher levels of critical reasoning ability will also positively affect trust in experts; this, in turn, will positively affect (A) risk perceptions and (B) compliance with government recommendations aimed at protecting people from COVID-19. We draw these hypothesized connections—A and B—because public health agencies in the United States (e.g., the CDC) have been consistent in their messaging that the risks posed by COVID-19 are real and high (relative to other viral pathogens such as influenza B), and that people must take precautions (mask wearing, social distancing, etc.) to protect themselves.

With this as backdrop, the research reported here focused on the relationship between AOT, risk perceptions surrounding COVID-19, trust in experts,
and compliance with CDC guidelines to manage one’s personal risk (Fig. 1). In undertaking this research, we drew on evidence from prior pandemics (Rudisill, 2013), and during COVID-19 (Bavel et al., 2020; Motta Zanin, Gentile, Parisi, & Spasiano, 2020), which suggests that those who perceive health risks more acutely are more likely to take countermeasures to avoid infection. Specifically, we hypothesized that AOT will help people identify more credible sources of information about COVID-19 (i.e., from “experts”), and subsequently place greater trust in them (H1).

Because these experts have been consistently messaging that COVID-19 is a real and serious threat to public health, we also hypothesized that trust in experts would be positively associated with an increase of risk perceptions (H2). Experts have also noted how the public should adopt CDC-recommended guidelines to protect themselves from COVID-19, which should have a positive influence on (self-reported) compliance with CDC recommendations (H3). Because AOT is a self-directed thinking style in which people are thought to take their time to weigh multiple sources of evidence, we also expected it to directly influence risk perceptions and, by extension, compliance (H4). And we explore whether high levels of trust in experts also influence compliance with recommended behaviors aimed at protecting people and slowing the spread of COVID-19 (H5).

2. METHODS

2.1. Participants

Data collection occurred during the initial wave of the COVID-19 pandemic in the United States (May 7–13, 2020); data were collected using the YouGov survey platform and panel. The survey instrument (see Section 2.2) was sent to a nationally representative sample of United States residents aged 18 and older. Initially, 1,000 participants responded, of which 143 participants were removed because they failed an instructed-choice attention check. Within the final sample of 857 participants, the mean age was 49 years ($SD = 18$ years); the sample was 49% male, 72% white, and 33% possessed a bachelor’s degree. In terms of political ideology, 32% of the sample was liberal, 28% was moderate, and 30% was conservative. This sample was emblematic of the United States population (United States Census Bureau, 2017).

2.2. Design

The University of Michigan Institutional Review Board determined this study to be exempt from review. Prior to answering any questions related to our research, participants received background information about the intent of our study and were asked to provide informed consent. Participants were also asked if they had experienced any of the symptoms of COVID-19 (including fever; cough; shortness of breath or difficulty breathing; chills; repeated shaking with chills; muscle pain; headache; sore throat; and/or new loss of taste or smell) since February 2020; participants waiting for results from a COVID-19 test, and those who tested positive for SARS-CoV-2 were excluded from the sample. Individuals awaiting tests results were excluded because, at the time of our research, testing was not widespread and those getting tested were more likely to be doing so because they were either exposed to SARS-CoV-2 or because they were symptomatic; we were concerned that people who were awaiting test results would feel greater than average urgency, thereby inflating our compliance measure, when it came to taking preventative action. We had the opposite concern about people who had tested positive for SARS-CoV-2. The dependent variable in our research was

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3 The attention check question began with a preamble: A scientist wants to measure a hurricane’s impact on coastal plant life. Then, participants were instructed to read a statement and then told: Please select “False” from the answers below. The statement read: True or False? A scientist wants to study the migration patterns of birds. The possible responses were True and False. Participants who selected True (14.3%) failed the attention check and were excluded from the sample.
compliance with behaviors aimed at protecting oneself from COVID-19; we were concerned that people who had tested positive for the virus might conclude that they had immunity and would no longer feel compelled to take preventative action (independent of AOT, trust in experts, and risk perceptions); this, in turn, would artificially depress our compliance measure.

Prior to assessing participants’ level of compliance with CDC-recommended behaviors, we first offered them the opportunity to review these recommendations online. Participants were told: “The United States Centers for Disease Control and Prevention (CDC) has published a list of behaviors that people can take to slow the spread of COVID-19. We then provided respondents with an internet link to information about these behaviors.

Then, we listed each of the CDC’s recommended behaviors and then prompted respondents with the following instruction: For each of the CDC’s recommended behaviors listed below, please tell us the extent to which you personally take this behavior.” The list of behaviors included (1) washing your hands often, with soap and water and for at least 20 seconds; (2) avoiding touching your eyes, nose and mouth with unwashed hands; (3) staying home as much as possible, and only leaving to do essential errands; (4) covering your mouth and nose with a cloth mask or face cover when you are around others; (5) covering coughs and sneezes; (6) cleaning and disinfecting frequently touched surfaces daily; (7) avoiding close contact with people who are sick; and (8) keeping distance between myself and other people. Responses were collected on a slider ranging from 1 = I never do this to 100 = I always do this; the midpoint was not labeled. The average was taken to create a scale (\( \bar{X} = 79.20; SD = 16.43; \) Cronbach’s \( \alpha = 0.80 \)).

Trust in experts was then measured with the question, “How much do you trust United States public health experts to understand how to slow the spread of COVID-19?”. Responses were collected on a seven-point Likert scale ranging from 1 = “Not at all” to 7 = “Completely” (the midpoint was not labeled). The mean trust score was 4.67 (\( SD = 1.72 \)).

Next, we asked participants to report their level of perceived risk regarding COVID-19. Four risk perception variables were measured. We measured generalized concern with the question: “How concerned are you personally about contracting COVID-19?” Answers were provided on a seven-point Likert scale where 1 = not at all concerned and 7 = very concerned (the midpoint was not labeled). The chance of contracting COVID-19 was measured with the question: In your opinion, what is the percent chance that you will contract COVID-19 before June 31? Responses were collected on a slider ranging from 0% to 100%. Another risk perception variable measured judgment about the severity of a COVID-19 infection. The question posed to participants was: “Which of the following statements most accurately reflects your beliefs about what you think will happen to you if you become exposed to COVID-19?”. Answers ranged from 1 = I won’t be infected to 7 = I will be infected, hospitalized, and I will end up dying from the virus within 7–14 days. The midpoint, 4, was labeled I will be infected and I will feel like I have the seasonal flu (e.g. a mild fever; aches/pains; coughing) for 7–14 days. Probability of death was measured as follows: In your opinion, what is the percent chance that you will die from COVID-19 if you become infected? Answers ranged from 0% to 100%. Z-scores were computed for each measure, and then the average was taken to create a scale (Cronbach’s \( \alpha = 0.78 \)).

After reporting their risk perceptions, participants responded to the seven-item AOT scale (Haran et al., 2013). Participants responded to the following statements: (1) “Allowing oneself to be convinced by an opposing argument is a sign of good character”; (2) “People should take into consideration evidence that goes against their beliefs”; (3) “People should revise their beliefs in response to new information or evidence”; (4) “Changing your mind is a sign of weakness”; (5) “Intuition is the best guide when making decisions”; (6) “It is important to persevere in your beliefs even when evidence is brought to bear against them”; and (7) “One should disregard evidence that conflicts with one’s established beliefs.” Responses were collected using 7-point Likert scales where 1 = completely disagree, 4 = neutral, and 7 = completely agree. These variables’ z-scores were standardized and were made into the AOT scale (\( \bar{X} = 5.03; SD = 0.99; \) Cronbach’s \( \alpha = 0.72 \)).

Finally, we collected demographic information, including age, sex, race, education, income, and political ideology. Participants indicated their age and binary sex (male or female). Options for race included those found on the U.S. Census, namely, white, black, Hispanic, Asian, Native American, mixed,
other, or Middle Eastern. Education was measured on a six-point scale (1 = No high school, 2 = High school graduate, 3 = Some college, 4 = 2-year degree, 5 = 4-year degree, and 6 = postgraduate degree). Income was measured on a 16-point scale: 1 = Less than $10,000, 2 = $10,000 - $19,999, 3 = $20,000 - $29,999, 4 = $30,000 - $39,999, 5 = $40,000 - $49,999, 6 = $50,000 - $59,999, 7 = $60,000 - $69,999, 8 = $70,000 - $79,999, 9 = $80,000 - $99,999, 10 = $100,000 - $119,999, 11 = $120,000 - $149,999, 12 = $150,000 - $199,999, 13 = $200,000 - $249,999, 14 = $250,000 - $349,999, 15 = $350,000 - $499,999, and 16 = $500,000 or more; a “prefer not to say” option was also. Political ideology was measured on a five-point scale (1 = very liberal, 2 = liberal, 3 = moderate, 4 = conservative, and 5 = very conservative).

2.3. Analysis

We constructed a structural equation model (in STATA) to study the relationships between AOT, COVID-19 risk perceptions, trust in experts, and compliance with recommendations from the CDC (Fig. 1). The model controlled for demographic characteristics in each step.

3. RESULTS

Descriptive statistics: Descriptive statistics for AOT scores, the risk perception variable, trust in experts, and CDC compliance are shown in Table I. The correlation matrix for these variables can be found in Table II.

Trust in experts (H1): Participants who self-reported greater levels of actively open-minded thinking also had, on average, higher levels of trust in experts, though the effect size was small (β = 0.20, p < 0.01, h² = 0.01).

Perceived risk (H2 and H4): Both trust in experts (H2: β = 0.11, p < 0.001, h² = 0.05) and AOT (H2: β = 0.06, p < 0.05, h² = 0.01) were positively associated with perceived COVID-19 risk (Fig. 2 and Table III); the effect sizes were medium and small, respectively. In addition, AOT was both directly and indirectly (through trust in experts) related to risk perceptions.

Compliance with CDC recommendations (H3 and H5): Both perceived risk (H3: β = 4.92, p < 0.001, h² = 0.06) and trust in experts (H5: β = 2.16, p < 0.001, h² = 0.06) were positively associated with self-reported measures of compliance with CDC recommendations (both with medium effect sizes).

Other significant predictors: In addition to relationships outlined above, we found that political
ideology was also associated with trust in experts. Specifically, conservatives exhibited lower levels of trust than their more liberal counterparts with a medium effect size ($\beta = -0.32, p < 0.001, h^2 = 0.05$). The same was true of sex; females reported higher levels of trust than males ($\beta = -0.33, p < 0.01, h^2 = 0.01$).

Age, sex, and political orientation were also significant predictors of perceived COVID-19 risk (Table 3). Specifically, older participants ($\beta = 0.06, p < 0.001, h^2 = 0.02$) perceived greater risks from COVID-19, though the effect size was small; the same was true of liberals ($\beta = -0.12, p < 0.05, h^2 = 0.03$) and females ($\beta = -0.16, p < 0.01, h^2 = 0.01$).

Finally, age and sex were significant predictors of self-reported compliance with CDC recommendations. Older adults reported higher levels of compliance with recommendations ($\beta = 0.07, p < 0.05, h^2 = 0.01$) as did females ($\beta = -7.44, p < 0.001, h^2 = 0.07$).

4. DISCUSSION

How people perceive and then respond (e.g., via measures of acceptability or behavior) to all manner of risks—for example, climate change (Shi, Visschers, Siegrist, & Árvai, 2016), food (Segrè Cohen, Love, Nace, & Árvai, 2020), geoengineering (Visschers, Shi, Siegrist, & Árvai, 2017), nuclear power (de Groot et al. 2020), novel technologies (Lutzke & Árvai, 2021), and so on—has been studied extensively. However, it has been exceedingly rare that researchers are presented with an opportunity to study risk perceptions and behaviors in a context that is not only significant and salient, but one that affects virtually every living human at the same point in time. COVID-19, for all its tragedy and loss, reflects one such opportunity.

Yet, despite COVID-19 being so well-known and widespread, misunderstandings about the causes and consequences of COVID-19, as well as countermeasures for addressing it, have been equally commonplace (Bruine de Bruin, Carman, & Parker, 2021; Chesser et al., 2020). These observations are understandable given how quickly SARS-CoV-2 is evolving (Chu et al., 2020; Madewell, Yang, Longini, Halloran, & Dean, 2020; McDonald, Murray, Reynolds, Altmann, & Boyton, 2021; Tabatabaeizadeh, 2021). Compounding the challenges posed by this uncertainty is the plethora of incorrect information and deliberate misinformation about what COVID-19 is, how it spreads, what it does, and how it can be treated and managed. The end result is akin to a layer cake of risks: the risk of transmission and infection, epidemiological misunderstandings, and social factors have interacted to compound the dangers of the pandemic for the general public (Krause et al., 2020).

Under these circumstances, it is unreasonable to expect the public to both understand the range of evolving epidemiological details surrounding COVID-19, and then to separate pandemic facts from fictions. Thus, timely and deliberative risk communications which emphasize the exchange of risk information and provision of decision-support such that people may make up their own minds (Árvai, 2014) is—in our view—unrealistic and unlikely to be effective. Instead, what is needed during a public health crisis are consistent and more directive risk messages (Abrams & Greenhawt, 2020; WHO 2020); that is, messages that strongly recommend specific behaviors. In addition, it is crucial that these risk messages be delivered by people (or by recognizable institutions) who—because of their domain-specific technical expertise and experience—warrant a high degree of public trust (NASEM 2020).

In industrialized countries with modern public health infrastructure, these messengers tend to be individuals (e.g., doctors, researchers, senior administrators, spokespersons, etc.) who represent public or government health agencies like the CDC, regional hospitals and healthcare networks, research-intensive universities, and the like; alternatively, the messengers may be the entirety of institutions themselves (e.g., when recommendations come directly from the CDC). Trust in experts (Siegrist, 2021), which accounts for the degree to which people trust public-facing officials and institutions, is therefore a crucial element of risk communication—and, by extension, behavior change—initiatives. As we note in
### Table II. Correlation Matrix for AOT, Trust in Experts, Compliance with CDC Guidelines, and the Four Risk Variables (*p ≤ 0.05*)

|                  | AOT   | Compliance | Trust in experts | Severity | % Chance: Death | % Chance: Contraction | Personal concern |
|------------------|-------|------------|------------------|----------|-----------------|-----------------------|------------------|
| AOT              | 1     |            |                  |          |                 |                       |                  |
| Compliance       | 0.067*| 1          |                  |          |                 |                       |                  |
| Trust in experts | 0.228*| 0.371*     | 1                |          |                 |                       |                  |
| Severity         | 0.342*| 0.214*     | 0.203*           | 1        |                 |                       |                  |
| % Chance: Death  | 0.019 | 0.233*     | 0.184*           | 0.521*   | 1               |                       |                  |
| % Chance: Contraction | 0.077*| 0.210*     | 0.244*           | 0.303*   | 0.475*          | 1                     | 0.590*           |
| Personal concern | 0.124*| 0.439*     | 0.383*           | 0.426*   | 0.506*          | 1                     | 1                |

### Table III. Variables Related to Perceived Risk, Trust in Experts, and Compliance with CDC Recommendations. The Measures used for AOT and Perceived Risk were Standardized (see Section 2.2)

|                  | Trust in Experts | Perceived Risk | Compliance |
|------------------|------------------|----------------|------------|
| β                | 95% CI           | h²             | β          | 95% CI           | h²             | β          | 95% CI           | h²             |
| Constant         | 4.39***           | 3.45, 5.33     | -0.66**    | -1.10, -0.21     | 71.23          | 65.14, 77.31 |
| Trust in Experts |                  |                | 0.11***    | 0.07, 0.14       | 2.16***        | 1.49, 2.82   | 0.06       |
| AOT              | 0.20***           | 0.06, 0.34     | 0.06*      | 0.00, 0.13       | 4.92***        | 3.46, 6.37   | 0.06       |
| Age              | 0.01             | -0.00, 0.01    | 0.06***    | 0.00, 0.01       |               | 0.07*       | 0.01, 0.13   |
| Sex (Male)       | -0.33***          | -0.58, -0.08   | -0.16***   | -0.27, -0.05     | -7.44***       | -9.54, -5.32 | 0.07       |
| Race (white)     | -0.08            | -0.36, 0.20    | -0.00      | -0.13, 0.12      | -1.55          | -3.91, 0.82  | 0.00       |
| Education        | 0.06             | -0.04, 0.15    | -0.00      | -0.04, 0.04      | 0.27           | -0.51, 1.04  | 0.00       |
| Income           | -0.01            | -0.05, 0.03    | 0.01       | -0.03, 0.05      | -0.09          | -0.42, 0.24  | 0.00       |
| Political Ideology (Conservativism) | -0.32***          | -0.43, -0.21   | -0.12*     | -0.17, -0.07     | -0.46          | -1.38, 0.47  | 0.00       |
| Adjusted $R^2$   | 0.10             | 0.17           |            |                 |                | 0.26        |            |
| $F$              | 12.06***          | 18.06***       |            |                 |                | 30.32***    |            |
| (df1, df2)       | (7, 670)          | (8, 669)       |            |                 |                | (8, 669)     |            |

**Note:** n = 857; * p < 0.05, ** p < 0.01, *** p < 0.001
the introduction, trust serves as a heuristic that helps to facilitate behaviors based on the degree to which a trusted individual or organization recommends them (Siegrist et al., 2000).

It is for this reason that our research focuses on the role of AOT in promoting trust in experts. Specifically, we hypothesized that critical thinking ability (AOT) would be positively associated with trust in experts; we believed this to be the case because people who score highly on AOT would seek out the most credible sources of information about COVID-19 (i.e., public health agencies or experts who work in them) which, in turn, would be manifest in higher levels of trust (H1). And because AOT is a self-directed thinking style in which people are thought to take their time to weigh multiple sources of evidence, we also expected it to directly influence risk perceptions (H4). Our results support both hypotheses (Fig. 2).

Researchers who have studied AOT suggest that its positive effects are the result of the ground-rules it sets for the formulation of judgments and decisions (Baron, 2019; Pennycook, Cheyne, Koehler, & Fugelsang, 2020). As a result, people who score highly on the scales that measure AOT have a better understanding of the attributes that define a problem or solution and, therefore, can engage more readily (and more deliberatively) in priority setting and evidence-based evaluation (Baron, 2019). And, importantly, people who score more highly for AOT are more likely to consider the opinions and insights of others with relevant knowledge or experience during judgment and decision making (Haran et al., 2013).

It is for these reasons that we believe AOT positively affects trust in experts. Mechanistically, we speculate that because critical thinkers seek a better understanding of the component attributes of a risk (e.g., the different exposure pathways for SARS-CoV-2), they will look to experts and organizations who they believe can provide the most accurate information about it (Fig. 2). Roozenbeek et al. (2020) propose a similar mechanism for how critical thinking ability may help people to be less susceptible to misinformation about COVID-19. In a cross-national study, they found that higher levels of numeracy (which they used as a proxy for critical thinking ability) were strongly associated with trust in scientists, both of which were associated with lower susceptibility to misinformation about COVID-19. The findings of Roozenbeek et al. (2020) also suggest that critical thinking ability leads people to be more discerning about whom they look to for information about COVID-19; this, in turn, leads people to gravitate toward trusted sources of information—scientists—who, in turn, offer insights that contradict misinformation.

We also hypothesized that trust in experts would be positively associated with heightened risk perceptions (H2). We also hypothesized that these heightened risk perceptions would be positively associated with higher levels of self-reported compliance with guidelines (from the CDC) aimed at preventing people from contracting COVID-19 (H3). The data we collected supports both hypotheses (Fig. 2).

Our findings in support of H2 (Fig. 2) are in line with other research carried out during the pandemic. For example, in a study of people in Switzerland, Siegrist et al. (2021, 2021) similarly found that high levels of trust in experts predict heightened risk perceptions. Dryhurst et al. (2020) corroborate these findings in studies conducted in 10 countries across Europe, North America, and Asia. The mechanism underlying this connection is elementary: To our knowledge, every legitimate public health agency around the world has emphasized that COVID-19 is dangerous and, at the extreme, deadly. If one has a high degree of trust in experts, it stands to reason that they too would adopt this perspective, which would manifest in terms of perceived risk.

To this end, we also speculated that a high degree of trust in experts would lead to higher levels of self-reported compliance with guidelines (from the CDC) aimed at preventing people from contracting COVID-19 (H5). Here too, we find a significant, positive relationship. However, our research also supports our hypothesis that this relationship is mediated by perceived risk (H3; Fig. 2). Once again, the mechanism underlying this connection is relatively straightforward: across a wide range of hazards, higher levels of perceived risk have been shown to heighten personal concern and promote changes in preferences (e.g., about risk management policies) and behaviors that lead to lower levels of exposure (Siegrist & Árvai, 2020).

As above, our findings with respect to COVID-19 risk perceptions and compliance with recommended behaviors are in line with other research conducted during the pandemic (e.g., Bruine de Bruin et al., 2021). A noteworthy exception, however, is research conducted by Siegrist et al. (2021) who did not observe a direct link between trust in experts and recommended behaviors aimed at reducing the risk of a COVID-19 infection. (Siegrist et al. did, however, observe an indirect link; they
found significant and positive relationship between trust in experts and perceived risk, and perceived risk and behavior.) We speculate that the differences between our findings and those of Siegrist et al. (2021) are methodological in nature. Specifically, Siegrist et al. (2021) created two indices of behavior; one for “physical distancing” and another for “hygienic behaviors.” Physical distancing was measured using six highly specific items (e.g., that asked about whether people hosted friends or neighbors, relatives, a housekeeper, or personal service providers at their home). Hygienic behaviors were measured using seven different and specific items such as whether people regularly disinfected items such as food packaging and their mail. Our behavioral measures were fewer in number and represented more common behavior derived directly from the CDC’s recommendations (see Section 2.2); moreover, all of our behavioral items were combined to create a single scale. Thus, the significant differences between our behavioral measures and those used by Siegrist et al. (2021) are likely behind our divergent conclusions.

We also hypothesized that AOT would be positively associated with risk perceptions (H4); our findings support this hypothesis (Fig. 2). Prior research has shown that people who score high for AOT tend to make more accurate judgments and predictions (Baron, 2019; Haran et al., 2013; Stanovich & West, 1998). The “accuracy” of a risk perception is a tricky question because these judgments tend to vary on an individual level. However, much of the information from credible scientists suggests that the risks from COVID-19 are much greater than those for other coronaviruses such as Influenza A and B (Pormohammad et al., 2021). In addition, people who score high on AOT tend to be more resistant to prejudicial biases or motivations when formulating their judgments (Stenhouse et al., 2018). Thus, it is logical to conclude that people who score high on AOT will also judge the risks associated with COVID-19 as high.

Beyond our hypothesized relationships (Fig. 1), we found that—in addition to AOT—a small set of other variables also influenced trust in experts, perceived risk, and compliance in predictable ways (Table 3). For example, a conservative political ideology was associated with low levels of trust in experts and low perceived risk; this matches concurrent research from Pew which shows Republicans more than Democrats do not agree with government agencies’—such as the CDC’s—conclusion that COVID-19 poses a significant public health threat.6

In a similar vein, prior research has shown that AOT is relatively lower in conservatives than it is in liberals (Kahan & Corbin, 2016, Stenhouse et al., 2018). Thus, it is tempting to consider testing for an interaction between AOT and political ideology. However, including an interaction term between ideology and AOT in studies like ours would test the hypothesis that AOT is being used to defend “favored positions,” which is inconsistent with the theoretical definition of AOT (also see Baron, 2017). Our choice to control for political ideology in our models, and by doing so, to test whether AOT predicts social trust and risk perceptions above and beyond politics, was motivated by the theoretical definition of AOT as the tendency to seek out and evaluate evidence in a critical and balanced manner (Stanovich & West, 1998, Haran et al., 2013, Mellers et al., 2015, Baron, 2019).

In the end, we agree that political polarization has played an important role in the public response to the pandemic, and we currently have a paper in preparation that focuses specifically on this topic. We also hope others will take up the thorny issue of how to decouple partisanship from risk perceptions as well as personal and policy responses to risk.

Our research also demonstrates that older adults perceived higher COVID-19 risk and demonstrated higher levels of compliance with CDC recommendations; these findings are in line with research and epidemiological data which shows that older adults are more concerned because they are much more vulnerable if they become infected with COVID-19 (Bruine de Bruin, 2021). Finally, our research suggests that males more than females report lower levels of trust in experts, lower COVID-19 risk perceptions, and lower compliance with CDC recommendations aimed at addressing the pandemic. These findings are also in line with other studies of COVID-19 (Bruine de Bruin & Bennett, 2020; Siegrist et al., 2021) as well as a long line of research on sex7 differences in risk perceptions (Finucane, Slovic, Mertz, Flynn, & Satterfield, 2000; Rivers, Arvai, & Slovic, 2010, Siegrist & Árvai, 2020).

In terms of limitations, our research relied—as does other research on AOT—on self-reported

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6See: https://www.pewresearch.org/2021/03/05/a-year-of-u-s-public-opinion-on-the-coronavirus-pandemic/

7We acknowledge that there are more than two genders. However, at this time, YouGov provides demographic data based on sex.
measures of AOT. It is possible, if not likely, that many people will overreport that they are in-fact critical thinkers. Future studies of this type may benefit from methods that more objectively assess critical thinking styles. For example, future research might find it fruitful to measure decision-making competence (Parker, de Bruin, & Fischhoff, 2007) or the degree to which intuitive judgments are calibrated with the same judgments based on a more formal multicriteria assessment (Bessette et al., 2020).

In addition, our research relied upon a single item measure for trust. We made this decision out of concern about instrument length. The instrument used in this study was part of a larger national survey during the start of the COVID-19 pandemic and we wished to not overburden participants. We are confident that our chosen measure accurately reflects the degree to which participants trust experts’ ability to understand how to slow the spread of COVID-19; indeed, this wording was chosen because our dependent variable focused on steps people could take to slow the spread of COVID-19. However, we acknowledge that single-item measures are more likely to be misinterpreted than multiple items presented in a scale. We, therefore, suggest that future studies of this type adopt a scale-based measure of trust (e.g., see Siegrist et al., 2021) when possible.

In the end, much has been written about risk communication that emphasizes the importance of providing people with not just a framework within which to share information about risks, but also tools that help them to both formulate evidence-based judgments about risks and more internally consistent decisions about how to manage them. In much of our past work (e.g., Árvai & Gregory, 2020; Bessette, Campbell-Arvai, & Arvai, 2016; Bessette et al., 2020;) we have advocated for more elaborate decision-support tools that help people to explore their values, determine how these values align with the different attributes of a problem or alternative, and then make more internally consistent choices. However, in the case of AOT, different avenues for facilitating higher quality risk judgments and management decisions become apparent.

On the one hand, prior research suggests that critical reasoning can be prized in the moments before judgments or decisions need to be made; simply priming people to consider the credibility of evidence and their sources may be a powerful tool for promoting more science-based judgments and decisions (Drummond & Fischhoff, 2019; Lutzke, Drummond, Slovic, & Árvai, 2019). On the other, critical thinking styles may be taught in formal or informal education settings (Baron, 2019; Gregory, 1991). For example, Baron and colleagues (Baron et al., 1986, 1993) have developed courses aimed at teaching critical reasoning skills that can be deployed by people during the evaluation of information and arguments, and to motivate the search for information before making judgments and decisions. Helping people develop these skills—either as a series of steps to follow or norms to abide by—during formal and informal education may serve as an important complement to risk communication efforts that focus solely on providing risk information or recommended risk management actions.

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