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Scientists, speak up!

Source impacts trust in health advice across five countries

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Abstract

We examined how different types of communication influence people's responses to health advice. We tested whether presenting Covid-19 prevention advice (e.g., washing hands/distancing) as either originating from a government or scientific source would affect people's trust in and intentions to comply with the advice. We also manipulated uncertainty in communicating the advice effectiveness. To achieve this, we conducted an experiment using large samples of participants (N= 4,561) from the UK, US, Canada, Malaysia, and Taiwan. Across countries, participants found messages more trustworthy when the purported source was science rather than the government. This effect was moderated by political orientation in all countries except for Canada, while religiosity moderated the source effect in the US. Although source did not directly affect intentions to act upon the advice, we found an indirect effect via trust, such that a more trusted source (i.e., science) was predictive of higher intentions to comply. However, the uncertainty manipulation was not effective. Together, our findings suggest that despite prominence of science scepticism in public discourse, people trust scientists more than governments when it comes to practical health advice. It is therefore beneficial to communicate health messages by stressing their scientific bases.

Keywords: Science communication, source credibility, uncertainty, political orientation, religiosity

Public Significance Statement

- Informing the general public that health advice originates from a scientific versus governmental source increases trust in the advice.
- Presenting health advice as originating from a scientific (versus governmental) source was indirectly related to increased intentions to follow the advice. This was explained by high trust in the scientific source.
- The findings were consistent across three Western (UK, US, Canada) and two Eastern countries (Malaysia, Taiwan).

Since the beginning of the Covid-19 pandemic, people worldwide have been advised to engage in prevention behaviours to limit further spread of the virus. Such advice has been communicated by two primary sources: Scientists and governments' leaders. A large body of evidence suggests that people trust information more if they perceive its source to be credible (Briñol & Petty, 2009; Petty & Cacioppo, 1986; Smith et al., 2013). In the current article, we investigate how two different sources (government versus science) and communication language impact people's trust in and intentions to comply with Covid-19 prevention advice across five countries.

Currently, the unwarranted and systematic rejection of scientific evidence has become a prominent problem in public discourse (Hornsey, 2020; Rutjens et al., 2021). Specifically, reduced societal trust in and compliance with scientific health advice represents a major health concern (Wellcome Trust, 2019). During the Covid-19 pandemic, lack of adherence to Covid-19 prevention measures has been a crucial factor in increasing the virus infection rate (Shallcross et al., 2021). In addition to science perceptions (Stosic et al., 2021), trust in and compliance with health measures may be impacted by the extent to which people find their governments as credible and have confidence in them (IPSOS, 2020). Overall, trust and compliance with health advice may be impacted by factors such as how public health advice is communicated and characteristics of the message source or recipient. In this paper, we examine the effect of source (scientific versus governmental) and uncertainty framing (whether advice effectiveness is certain or uncertain) in health advice communication, to understand their impact on advice trust (i.e., credibility) and intentions to comply with the advice across culturally diverse countries. We further examine whether the effects of source and uncertainty framing are moderated by individual differences in political orientation and religiosity. This is important because matching appropriate health messaging to recipients' characteristics increases compliance with the message (Murphy et al., 2021).

Source and Message Acceptance

Decades of research has shown that different aspects of message communication influence message acceptance. In general, people are more likely to agree with messages that come from credible sources, with highly credible sources being more persuasive than sources low in credibility (Maio et al., 2018; Smith et al., 2013). Source credibility can be signalled through three dimensions: trustworthiness – indicating whether the message communicator is truthful and honest; expertise – judging whether the communicator is an expert; and bias – the extent to which the communicator is motivated to hold a particular viewpoint (see Wallace et al., 2020). Scientists were judged to be among the most credible (in terms of trustworthiness) professions worldwide at the beginning of the pandemic (Bromme et al., 2022; Entradas, 2022; IPSOS, 2020; 2022). This is reflected in recent evidence on source credibility effects: Across 24 countries, people trusted nonsense messages more when the message source was a scientist, as opposed to a spiritual leader (Hoogeveen et al., 2022). As credibility of science sources has been examined in terms of trustworthiness, we focused on that aspect of credibility. More specifically, we investigated whether presenting health advice as originating from a scientific source, as opposed to the government, would increase people's trust in Covid-19 health advice.

Although scientists are generally perceived as credible sources of information, it is also possible, however, that in times of increased health threat associated with the Covid-19 pandemic, people turn to and trust external sources of control, like governments, to oversee such threats for them (Kay et al., 2008). Yet, statistical reports at the beginning of the Covid-19 pandemic demonstrated that although perceived health threat was high across many countries, people's confidence in governments in general was low (IPSOS, 2020). Indeed, trustworthiness is a predictor of intention to implement advice (Feng & MacGeorge, 2010).

Overall, in the current research we examined whether people would find health advice more trustworthy when it originated from scientific versus governmental sources.

Uncertainty and Message Acceptance

Of course, variables aside from the message source are likely to impact people's trust in scientific health advice. For example, uncertainty (i.e., stating that a measure will either *reduce* or *may potentially reduce* virus spread) is a characteristic of scientific knowledge and a key challenge for science communicators. On one hand, uncertainty in science communication might signal honesty and lead to more credibility than communicating certainty, specifically in a medical setting (Jensen et al., 2011). On the other hand, it has been demonstrated that uncertainty might be perceived to indicate the presence of conflict between scientists (Smithson, 1999) or a lack of confidence (Jerez-Fernandez et al., 2014), which in turn might reduce credibility. The same concerns and mixed evidence on the effects of uncertainty on credibility apply to governmental or institutional communication (Johnson, 2003; Johnson & Slovic, 1998). As such, clear boundary conditions to beneficial effects of uncertainty in communication are yet to be established ([see van der Bles et al., 2019, for a review](#)).

Matching Effects of Source and Uncertainty

However, as scientists are considered credible sources of information (Hoogeveen et al., 2022), we examine whether uncertainty versus certainty framed communication can further boost trust in messages communicated by scientists. This is because previous research has found that uncertainty communication had beneficial effects on trust communicating medical information, by signalling honesty (Jensen et al., 2011). On the other hand, as people have low trust and decreasing confidence in governments (IPSOS, 2020) and certain communication signals confidence (Jerez-Fernandez et al., 2014), communicating advice with certainty might be particularly beneficial for trust in messages coming from a

government. As such, it is possible that matching uncertainty communication with appropriate sources, depending on their default credibility perceptions, might have beneficial outcomes for trust (see [Teeny et al., 2021, for a review on matching effects](#)). Specifically, trust could be enhanced by matching uncertainty with sources perceived as credible by default (science), whilst certainty with sources that people have low confidence in (government).

Finally, we also examined whether the beneficial effects of source moderated by uncertainty communication on trust would extend to intentions to comply with the communicated advice. This is important because information that impacts attitudes or attitude-relevant variables (such as trust) might not necessarily impact intentions or behaviour (see [Itzhakov et al., 2018](#); [Maio et al., 2018](#)).

Political Orientation

In considering how source and credibility impact trust and intentions, we also explore the potential role of individual differences in political orientation and religious beliefs. In the US, political ideology is associated with scepticism surrounding Covid-19, with conservatives more likely than liberals to (a) believe in Covid-19 conspiracies, (b) underestimate the virus' impact, and (c) perceive themselves as less vulnerable to the virus ([Calvillo et al., 2020](#); [Rutjens et al., 2021](#)). Further, a study comprising of North American and European participants showed that high conservatism and religious orthodoxy predicted low intentions to comply with Covid-19 prevention measures, due to low trust in science ([Plohl & Musil, 2021](#)). In the context of source effects, [Hanel et al. \(2018\)](#) found that political supporters showed greater agreement with a series of quotes when the source of the quotes was attributed to a member of the party that the recipient supported. This is consistent with evidence regarding the role of source trust on message acceptance ([Maio et al., 2018](#)), suggesting that political orientation may interact with source effects on trust.

Religiosity

Regarding religiosity, highly religious individuals are less trusting of science (especially in the US, see McPhetres et al., 2020) and are generally more sceptical about evolution (Rutjens et al., 2018). Regarding the Covid-19 pandemic, some evidence indicates that highly religious individuals in the US tended to engage in more unreasonable behaviours (i.e., hoarding toilet paper) than non-religious participants, but there were no differences between religious and non-religious participants in engaging in Covid-19 prevention behaviours (Kranz et al., 2020).

Taken together, we argue that ideology, such as political orientation and religiosity, might be related to trust in Covid-19 prevention measures. Importantly, we suggest that such trust might be enhanced or reduced, depending on the communications styles adapted when delivering health messages and their source (Elsdon-Baker, 2015; van der Bles et al., 2019). It is important to note that although religiosity and political orientation are often associated, these variables should be treated as separate because they involve different effects on perceptions of science. For example, political orientation predicts climate change rejection, whilst religiosity predicts evolution rejection (Hornsey et al., 2016; Rutjens et al., 2018).

Hypotheses

Source

Based on the source credibility literature (Briñol & Petty, 2009; Hanel et al., 2018; Wallace et al., 2020), we predicted a main effect of message source on trustworthiness of Covid-19 advice and intentions to comply with the advice. Reports indicate that people consider scientists as highly reliable and trustworthy (Hoogeveen et al., 2022; Ipsos Mori, 2020; Krause et al., 2019), while the public's trust towards governments was low at the beginning of the pandemic (IPSOS Mori, 2020). We therefore hypothesised that overall,

participants would trust and intend to comply more with Covid-19 health advice when the source was scientific versus governmental, across countries.

Uncertainty

We predicted that uncertainty (versus certainty) in message communication could enhance trust and intentions to comply with the advice when it was communicated by scientists, whilst certainty (versus uncertainty) communication would benefit trust and intentions when the source was the government (Jerez-Fernandez et al., 2014; van der Bles et al., 2019). This is because uncertainty might boost perceptions of honesty when the source is considered credible (i.e., science; Hoogeveen et al., 2022; Jensen et al., 2011), whilst certainty might boost people's confidence in the source that they are—by default—less confident about (i.e., government; Jerez-Fernandez et al., 2014).

Political Orientation

Based on the source attribution literature, which has demonstrated that people more likely to agree with messages that come from sources they support (Hanel et al., 2018; Tamarin, 1966), we expected that across countries, participants who did not share political views with their government's ideology (left-wingers in the UK and US, liberals in Malaysia, right-wingers in Canada, and KMT supporters in Taiwan) would have lower trust in and intentions to comply with the advice coming from the government compared to participants who shared their government's ideology.

Religiosity

Finally, based on previous research suggesting that religious people have less positive attitudes towards *science* in the US (McPhetres et al., 2020), we predicted that highly versus less religious Americans would trust the advice less and intend to comply with it to a lower extent when the advice was from the scientific journal.

Present Research

To test the hypotheses, we designed an experiment where we manipulated different communication frames – in terms of source and uncertainty – of Covid-19 prevention advice. We measured whether such frames affected people’s trust in and intentions to comply with the advice; and whether the effectiveness of these different communication frames would vary depending on participants’ political orientation and religiosity. Further, as discussed below, we collected data from largely representative samples (we sought to recruit samples that were representative for the population in each country based on age and gender quotas) in five countries to examine the generality of observed effects (see Table 1).

We presented participants with advice regarding Covid-19 prevention measures (e.g., handwashing, distancing). We communicated its source as either coming from the government (report/briefing) or from scientific research, that is, an article published in the *Journal of Medicine* (a less well-known journal with an informative title). We also manipulated uncertainty frames by stating that the measures either *reduce* or *may potentially reduce* virus spread (van der Bles et al., 2020). Participants were randomly allocated to one of four conditions (government-certain, government-uncertain, scientific-certain, science-uncertain). We measured participants’ trust in the advice and intentions to comply with each Covid-19 prevention measure.

As most of the research reviewed above was conducted in Western countries, which are not necessarily representative for the whole world (Apicella et al., 2020), we collected data in the UK, US, Canada, Malaysia, and Taiwan. We selected these countries on the basis of their variability in terms of social, religious, and political contexts, as well as lockdown stringency.¹ At the time of data collection, the UK and US had conservative governments,

¹ According to the lockdown stringency index from mid-August 2020, (<https://www.bsg.ox.ac.uk/research/research-projects/coronavirus-government-response-tracker>; from 0 [not strict at all] – 100 – [very strict]), the US had the largest rate of coronavirus infections with slightly stricter

Canada had a centrist/left-leaning government, Malaysia had a conservative government, and Taiwan had a nationalist, centre-left/liberal government. In terms of the levels and types of religious affiliation, the populations in the UK, US, Canada are primarily Christian with increasing levels of secularity; Malaysia is largely a religious country dominated by Islam, whilst Taiwan is mainly Buddhist, with a significant proportion of non-religious individuals.

Pilot Study

As a starting point for our work, we ran an exploratory pilot experiment. In June 2020, we presented British participants ($N = 335$) with scientific evidence concerning the estimated impact of the Covid-19 pandemic. The source of the information was presented as either the UK government or a scientific journal and framed as either uncertain or certain (using numbers, such as confidence intervals versus a single estimate). Consistent with evidence presented above, participants evaluated the evidence as more trustworthy when the source was the scientific with journal rather than the government. This was moderated by political views, such that politically left-leaning participants trusted the scientific source more than the government, whereas right-leaning participants trusted the data equally regardless of the source, even when controlling for religiosity. Similarly, less religious individuals trusted the evidence more when they believed the source was the scientific journal rather than the government, whereas highly religious participants instead trusted the data equally regardless of the source, while controlling for political orientation (see Supplemental Materials for details). The uncertainty manipulation was ineffective, and for that reason, in the main study, instead of presenting confidence intervals versus precise estimates, we used language frames associated with uncertainty.

lockdown measures (67) than Canada (65) and the UK (65), with the UK having more infections than Canada. Finally, Taiwan had the least infections and the least strict lockdown measures (19.44), with Malaysia being in the middle in terms of infections and lockdown stringency (57.41).

Main Study: Method

Participants

We recruited 4,620 participants online, but excluded 59 from data analysis, as they failed an attention check included in the survey (“This is a test item. Please indicate three”). The final sample size was 4,561 participants. We established the sample size by conducting a power analysis ($\alpha = .05$, power = .95) based on the effect size for the source effect ($d = 0.33$) detected in our pilot study for a between-subjects t-test (see Supplemental Materials). The analysis estimated 200 participants per cell. To compensate for potential data loss, we recruited 225 participants per condition. A sensitivity power analysis suggested that the minimum detectable effect for the lowest sample size we obtained (i.e., in Canada) was $d = .22$.

British, American, and Canadian participants were recruited via Prolific, whilst Malaysian and Taiwanese samples were recruited via Qualtrics (as this recruitment platform had better access to samples in those countries). Except for representativeness for the population in each country based on gender and age quotas, in addition, we aimed to have a balanced sample in terms of religiosity. However, it should be noted that participants from Canada were on average younger than participants in other countries. Participants in the UK, US, and Canada received the equivalent of £0.75 for their participation, whilst participants in Malaysia and Taiwan were paid based on Qualtrics rates and received \$1US. Demographic and individual difference characteristics of the samples are presented in Table 1. Our study received university ethics approval (2020-SP-12665).

Table 1*Sample Characteristics.*

	UK (N=925)	US (N=904)	Canada (N=891)	Malaysia (N =911)	Taiwan (N =930)
Gender %	Women: 50.8 Men: 49.2	Women: 51.1 Men: 48.9	Women: 49.3 Men: 50.7	Women: 51.6 Men: 48.4	Women: 50.2 Men: 49.8
Age (years)	<i>M</i> = 46.51 <i>SD</i> = 17.26 18 – 44: 44% 45 – 64: 33% >65: 23%	<i>M</i> =44.45 <i>SD</i> =16.75 18 – 44: 44% 45 – 64: 40% >65: 16%	<i>M</i> = 30.31 <i>SD</i> =10.33 18 – 44: 91% 45 – 64: 8% >65: 1%	<i>M</i> = 42.60 <i>SD</i> =14.64 18 – 44: 52% 45 – 64: 42% >65: 4%	<i>M</i> = 43.90 <i>SD</i> = 14.22 18 – 44: 49% 45 – 64: 44% >65: 7%
Education (years)	<i>M</i> = 15.69 <i>SD</i> =3.42	<i>M</i> =16.50 <i>SD</i> =3.54	<i>M</i> = 17.19 <i>SD</i> =3.39	<i>M</i> = 16.53 <i>SD</i> =6.68	<i>M</i> = 16.16 <i>SD</i> = 3.33
Subjective social-economic status	<i>M</i> = 5.51 <i>SD</i> = 1.58	<i>M</i> = 5.39 <i>SD</i> = 1.78	<i>M</i> = 5.83 <i>SD</i> =1.51	<i>M</i> = 6.00 <i>SD</i> =1.59	<i>M</i> = 5.83 <i>SD</i> =1.72
Covid-19 knowledge	<i>M</i> = 2.46 <i>SD</i> =.91	<i>M</i> = 2.27 <i>SD</i> =.89	<i>M</i> = 2.06 <i>SD</i> =.91	<i>M</i> = 2.31 <i>SD</i> =.86	<i>M</i> = 2.09 <i>SD</i> =. 88
Political orientation	<i>Left/right wing</i> <i>M</i> = 4.64 <i>SD</i> = 2.01	<i>Left/right wing</i> <i>M</i> = 4.04 <i>SD</i> =2.54	<i>Left/right wing</i> <i>M</i> = 3.96 <i>SD</i> =2.02	<i>Conservatism</i> <i>M</i> = 5.25 <i>SD</i> =2.32	<i>Political party %</i> KMT: 20.1 DPP: 18.8 TPP: 4.7 NPP: 2.9 PFP: 1.2 TSP: 2.5 Not sure: 39.0 Prefer not to say: 10.8

Religiosity (mean)	<i>M</i> = 2.43 <i>SD</i> = 1.81	<i>M</i> = 2.77 <i>SD</i> = 2.12	<i>M</i> = 2.55 <i>SD</i> = 1.82	<i>M</i> = 4.27 <i>SD</i> = 1.76	<i>M</i> = 3.90 <i>SD</i> = 1.89
Religious? (binary yes/no) %	NA	NA	NA	Yes: 47.9 No: 52.1	Yes: 49.5 No: 50.5
Religious affiliation	Protestant: 14.7 Catholic: 8.7 Orthodox: 15.0 Buddhist: .9 Jewish: 1.0 Muslim: 4.9 Hindu: 1.1 Agnostic: 12.9 Atheist: 32.0 Other: 8.9	Protestant: 18.3 Catholic: 15.7 Orthodox: 5.2 Buddhist: 1.2 Jewish: 2.8 Muslim: .7 Hindu: .3 Agnostic: 23.5 Atheist: 22.3 Other: 10.1	Protestant: 8.7 Catholic: 19.3 Orthodox: 5.3 Buddhist: 2.9 Jewish: 1.9 Muslim: 3.5 Hindu: 1.1 Agnostic: 21.3 Atheist: 24.6 Other: 11.4	Protestant: 7.3 Catholic: 7.9 Orthodox: 3.6 Buddhist: 28.6 Jewish: .1 Muslim: 41.0 Hindu: 4.3 Agnostic: 1.1 Atheist: 2.5 Other: 3.5	Protestant: 6.6 Catholic: 2.6 Orthodox: .1 Buddhist: 17.6 Muslim: .3 Hindu: .1 Agnostic: 1.0 Atheist: 3.0 Taoism: 14.2 I-Kuan Tao: 1.8 Folk Religion: 15.9 No religion: 32.4 Prefer not to say: 3.0 Other: 1.4
Spirituality	<i>M</i> = 2.73 <i>SD</i> = 1.67	<i>M</i> = 3.28 <i>SD</i> = 2.03	<i>M</i> = 2.79 <i>SD</i> = 1.67	<i>M</i> = 4.10 <i>SD</i> = 1.60	<i>M</i> = 4.37 <i>SD</i> = 1.34
Faith in Science	<i>M</i> = 0.93 <i>SD</i> = 1.24	<i>M</i> = 5.10 <i>SD</i> = 1.39	<i>M</i> = 5.11 <i>SD</i> = 1.19	<i>M</i> = 4.83 <i>SD</i> = 1.00	<i>M</i> = 4.75 <i>SD</i> = .94
Government trust	<i>M</i> = 3.80 <i>SD</i> = 1.75	<i>M</i> = 3.50 <i>SD</i> = 1.64	<i>M</i> = 5.31 <i>SD</i> = 1.21	<i>M</i> = 5.03 <i>SD</i> = 1.68	<i>M</i> = 5.06 <i>SD</i> = 1.58

Measures and Design

The study was presented online via Qualtrics software. All participants were presented with health advice to prevent the spread of Covid-19. The advice content was standardised based on the official guidance at the time of data collection (which was from the end of October to December 2020; see below for details). The advice content included WHO guidance concerning Covid-19 prevention measures (<https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public>). In addition, we also acknowledged some differences in the advice given in different countries. Specifically, in Malaysia, travelling abroad was banned at the time of data collection and the mandated advice was to self-isolate after travelling from red zones area.² In contrast, in all of the other studied countries, people were advised to self-isolate after travelling abroad (see all the materials on OSF: <https://osf.io/m8zhk/>).

To manipulate framing of the advice, we used a 2 x 2 between-subjects design, with participants randomly allocated to condition. We informed half of our participants that the source of the advice was the government led by [national leader] (e.g., the UK government led by Boris Johnson), whilst the other half were told that the source was a scientific article from the *Journal of Medicine*. Regarding uncertainty, we informed participants in the certainty condition that following the advice “*will* prevent the spread of the virus, reduce the risk of catching or passing the virus on and prevent the spread of droplets carrying the virus,” whilst in the uncertain condition, we informed participants that the advice “*may* prevent the

² Ministry of Foreign Affairs, 2020: https://www.kln.gov.my/web/usa_washington/news-from-mission/-/blogs/travel-advisory-entry-restrictions-on-foreign-travelers-to-malaysia-4-september-2020

spread of the virus, *may potentially* reduce the risk of catching or passing the virus on and *potentially prevent* the spread of droplets carrying the virus” (van der Bles et al., 2020).

Main Dependent Variables

Trust in the Advice. To measure whether participants trusted the presented advice, we asked two questions: “How trustworthy are the government's reports/scientific findings about the Covid-19 prevention measures in your opinion?” and “How likely it is that the information about the effectiveness of the Covid-19 preventive measures presented earlier reflects reality?” on a scale from 1 (*not at all trustworthy/very unlikely*, respectively) to 7 (*very trustworthy/very likely*, respectively; $r = .92$). In addition, we asked participants to what extent they felt confident about their responses to the questions about the advice (1 = *not at all confident*; 7 = *very confident*).

Intentions to Comply with Covid-19 Prevention Advice. We asked participants how likely they intended to engage in the activities to prevent the Covid-19 spread on a scale from 1 (*very unlikely*) to 5 (*very likely*). We selected several relevant items from Pfattheicher et al. (2020). These items reflected measures that were communicated to the public at the time we conducted our experiment: “I will wear a face covering in enclosed spaces (e.g., supermarket, public transport),” “I will regularly wash my hands thoroughly,” “I will socially distance from strangers on the street,” “I will be at places where other people will also be (e.g., restaurant, pub, church, café)” (this item was reverse scored). We also asked participants to what extent they intended to work from home, and self-isolate after travelling. Participants could also select a *not applicable* option. As the majority of participants selected the option of *not applicable* (working from home: $n = 4224$; self-isolating: $n = 3014$), we did not use these items in the analyses. The reliability of the remaining items (wearing a face mask, social distancing, avoiding public spaces, and washing hands) was $\alpha = .59$. Despite this somewhat low value, we collapsed across these items in analyses presented the main text (we

also report individual analyses for each intention variable in Online Supplemental Materials). Note that low internal consistencies are expected if broad constructs are measured (Graham et al., 2011): We were interested to capture a broad range of relevant behaviours rather than to measure several similar ones, which would have resulted in a higher internal consistency.

Manipulation Checks

We asked participants how certain it was that complying with the Covid-19 measures prevented its spread (1 = *not at all certain*; 7 = *very certain*). Participants also indicated the source of the presented advice (e.g., in the UK: The BBC, the UK government, Sky News, or the scientific journal from the *Journal of Medicine*). The source choices were modified in each country to reflect the country context.

Individual Differences Measures

The measures below (except for political orientation and religiosity) were used mainly for descriptive purposes (see Table 1). However, as an additional aim, we were interested to explore whether the effects of our manipulation held when controlling for individual differences in worldviews and demographics. We therefore conducted an exploratory multiple regression analysis on source effects when controlling for worldviews and demographics. This is because acceptance of scientific messages is often related to such variables (e.g., see Rutjens et al., 2022).

Trust in the Government. We asked participants to indicate on the scale from 1 (*strongly disagree*) to 7 (*strongly agree*) to what extent they trusted the current government in their country.

Faith in Science. All participants responded to five items on a scale from 1 (*strongly disagree*) to 7 (*strongly agree*). The items were adapted from Farias et al. (2013) and Rutjens et al. (2018). The items were: “The scientific method is the only reliable path to knowledge”, “We believe too often in science, and not enough in feelings and faith” (reverse scored),

“Science tells us everything there is to know about what reality consists of”, “The only real kind of knowledge we can have is scientific knowledge”, “Science is the most efficient means of attaining truth.” As there was high internal consistency ($\alpha = .79$), these items were combined.

Covid-19 Knowledge Test. We asked participants to complete a short multiple-choice test concerning facts about Covid-19. We adapted four items from Calvillo et al. (2020). A sample item was “According to the World Health Organization, what is the most common incubation period for COVID-19?” with response options: “1 day”, “2 days”, “3-4 days”, “5-6 days”, and “I don’t know”. We calculated participants’ mean scores of correct answers across all questions.

Political Orientation. We measured political orientation with two items in the UK, US, and Canada, which were combined into one score ($r = .80$). We asked participants the extent to which they considered themselves left-/right-wing in terms of social (item 1) and economic issues (item 2) on a scale from 1 (*left-wing*) to 10 (*right-wing*). In Malaysia, we asked participants to what extent they considered themselves as liberal or conservative on a scale from 1 (*liberal*) to 10 (*conservative*). Finally, in Taiwan, participants reported which party they supported, as the dimension of conservatism is not widely used in Taiwan.

Religiosity. All participants indicated their religiosity on a scale from 1 (*not religious at all*) to 7 (*very religious*). In addition, in Malaysia and Taiwan, participants reported whether they were religious or not. This binary variable was mainly included for recruitment purposes.

Spirituality. Participants indicated their self-identified spirituality based on two items ($r = .87$; Rutjens et al., 2018). They were asked to indicate on a scale from 1 (*not at all*) to 7 (*very much*) whether they considered themselves (i.e., “To what extent do you consider

yourself to be a spiritual person?") as spiritual and whether other people considered them as spiritual.

Perceived General and Personal Threat of Covid-19. We asked participants to indicate to what extent they agreed with the statements adapted from [Foad et al., \(2021\)](#), for example, "I think the number of deaths directly caused by Covid-19 is a massive threat to this country" (general threat) and "I think it is likely that I, a friend, or close family member will die from Covid-19 at some point in the future" (personal threat) on a scale from 1 (*strongly disagree*) to 7 (*strongly agree*).

Demographics. Participants reported their gender, age, religious denomination, years of formal education, subjective social-economic status, and their local area (not used in the current analysis).

Procedure

Data collection took place from the end of October to December 2020. We conducted the study in the US just before the November 2020 election. The studies in the UK and Canada were run at the end of November 2020. Data collection in Taiwan and Malaysia began at the end of November and ended in December. The materials for the surveys conducted in Taiwan and Malaysia were translated into Mandarin and Malay, respectively. The translation was done by native speakers employed by Qualtrics and further adapted by the co-authors of the current paper.

Results

We summarise the results as follows. First, we present manipulation check analyses for the source and uncertainty manipulations. Second, given the failure of the uncertainty manipulation (see below), we examine the effect of the source manipulation on trust and intentions to comply with the prevention advice across countries. Third, we report analyses

testing whether political orientation and religiosity moderated source effects within each country.

Manipulation Checks

Source

First, we examined whether participants correctly identified the source of the presented advice.³ We conducted a multilevel logistic regression with *country* as random intercepts, accuracy in identifying the source (0 – incorrect, 1 - correct) as the outcome, source as a predictor, and uncertainty as a control variable. We found that the average accuracy score (i.e., predicted probability) was 72% in the scientific source condition and 87% in the government condition, this difference was significant $p < .001$. Excluding participants who failed this manipulation check did not impact on the results, thus we included the responses of all participants.

Uncertainty

We estimated a multilevel model (with *country* as random intercepts, and source as a control variable) to test participants thought that complying with Covid-19 measures would prevent its spread more in the certain versus uncertain condition. Contrary to our expectations, the effect of the uncertainty manipulation was not significant, $F(4, 4552) = 0.41, p = .531$ (certain: $M = 5.79, SD = 1.23$; uncertain: $M = 5.81, SD = 1.19$). For this reason, subsequent analyses do not include uncertainty as an independent variable. Instead, we controlled for this variable in the analyses.

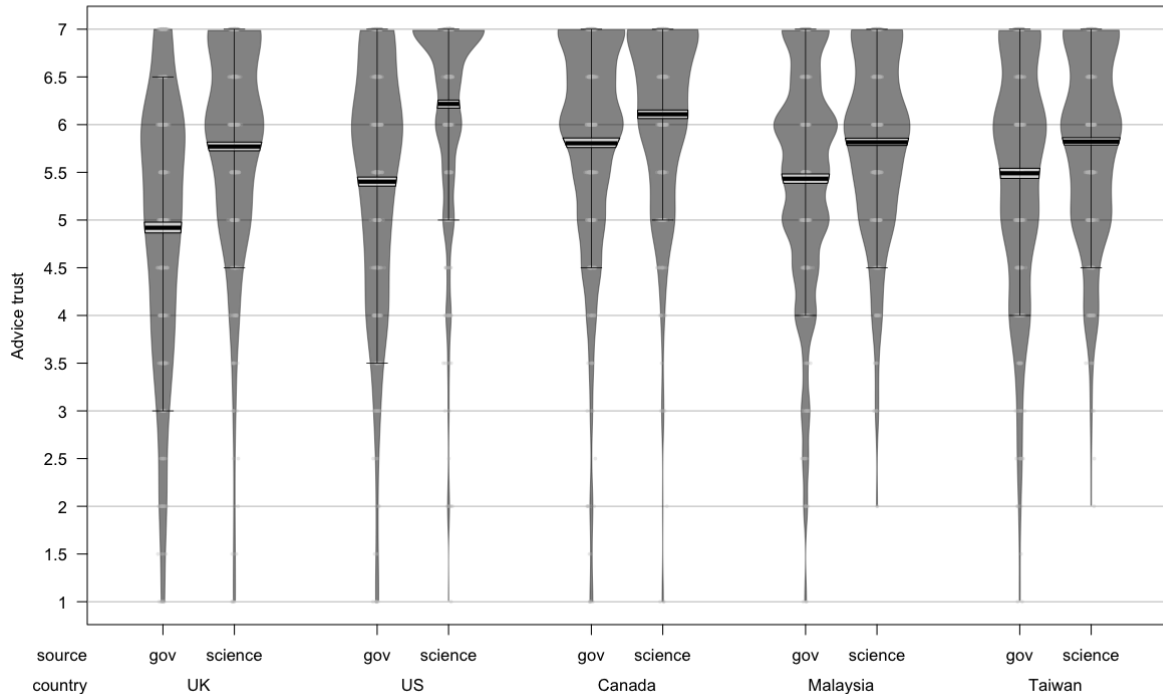
³ The majority of participants across the UK (87%), US (90%), and Canada (88%) correctly indicated the source of the presented advice. The proportion of correct answers was lower in Malaysia (57%) and Taiwan (62%). It is possible that in Malaysia and Taiwan the Covid-19 prevention measures were communicated more frequently by both the government and scientists, and hence participants might not have perceived the difference in the advice source in our study conditions.

Trust in the Advice

To test whether participants differentially trusted the advice depending on its source, we estimated a multilevel model with *country* as random intercepts. We also included *country* as a moderator, and we controlled for the message uncertainty. We found a significant main effect of source, such that across all five countries participants trusted the advice more when its source was the scientific journal as opposed to the government, $F(4, 4550) = 243.31, p < .001, d = 0.45, 95\% \text{ CI } [0.39, 0.51]$. This difference was the largest in the US ($d = 0.68, 95\% \text{ CI } [0.55, 0.81]$) and the UK ($d = 0.66, 95\% \text{ CI } [0.52, 0.79]$), followed by Malaysia ($d = 0.35, 95\% \text{ CI } [0.22, 0.48]$), Taiwan ($d = 0.30, 95\% \text{ CI } [0.17, 0.43]$), and Canada ($d = 0.28, 95\% \text{ CI } [0.15, 0.41]$; Figure 1).

Figure 1

Trust in the Advice as a Function of Source and Country (1 = Low Trust, 7 = High Trust).



Intentions to Comply with the Advice

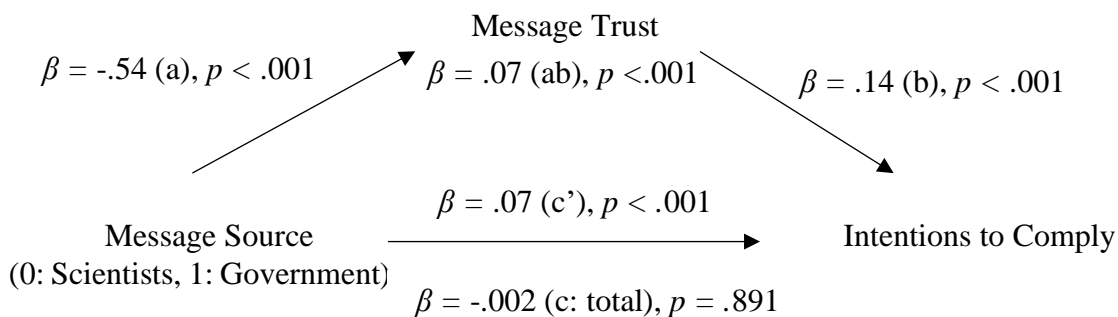
We subsequently tested whether intentions to comply with the advice depended on the advice source by estimating a multilevel model with *country* as random intercepts. As in the previous model, *country* was included as a moderator as well as message uncertainty was introduced as a control variable. The analysis revealed that the main effect of source was not significant, $F(4, 4550) = .01, p = .975$ (journal source: $M = 4.39, SD = 0.59$; government source: $M = 4.39, SD = 0.59$; see Supplemental Online Materials for individual analyses of each intention variable).

However, message trust was correlated with intentions to comply ($r = .27$), suggesting a potential suppressor effect concerned with trust in the journal source. As such, we conducted a follow-up analysis where we explored whether the relationship between source and intention to comply was indirect and explained by higher trust in the message

source (following a recommendation on testing indirect effects, see Rucker, Preacher, Tormala, & Petty, 2011). Indeed, we found that this was the case (see Figure 2). These results demonstrate that although the message source does not directly impact on intentions to comply with the advice, it appears that the extent to which source is trusted, it will lead to increased compliance. Moreover, when controlling for trust, the government source had a small significant direct effect on increased intentions to comply with the advice. It is possible that people intend to comply with the government advice in general, as the government, in contrast to scientists, has the authority to enforce laws and fines for failure to comply with the advice. Future research should further examine which variables can enhance the effect of source trustworthiness on intentions to comply with health measures.

Figure 2

The Indirect Effect of Source on Intentions to Comply.



Moderators of Source on Trust in the Advice

We subsequently assessed whether the effect of source was moderated by political orientation and religiosity. As noted in the method section, we recruited participants from diverse countries in terms of political and religious profiles. Hence, we conducted the moderation analysis for each country separately. Across all analyses, we entered trust as the

dependent variable, an interaction between source and political orientation (and religiosity in a separate model), and uncertainty as a covariate.⁴ The results are presented in Table 2.

Political Orientation

Across all countries, except for Canada, political orientation moderated the effect of source on trust in the advice. As predicted, in the UK (where the government was right-wing at the time), right-wingers trusted the advice more than left-wingers when the source was the government. The opposite was true for the scientific source: left-wingers trusted the advice more than right-wingers. Further supporting our predictions, Malaysian conservatives trusted the advice more than liberals when the source was the government (the Malaysian government was conservative). Further, in Taiwan, the ruling party supporters (DPP) trusted the advice more than the opposition party supporters (KMT). In both Malaysia and Taiwan there were no differences in trust when the advice source was the scientific journal among different political supporters.

Finally, contrary to our predictions, in the US (with a right-wing government), left-wingers trusted the advice more than right-wingers in both conditions. Yet, the magnitude of that difference was smaller when the source was the government as opposed to the scientific journal. All the results held when we controlled for religiosity.

Religiosity

As predicted, the more religious the US participants were, the less they trusted the advice when the source was the scientific journal. Further, there were no differences between highly and less religious participants when the source was the government. Religiosity did not moderate the effect of source on trust in other countries. These results replicated when we controlled for political orientation.

⁴ We found no interaction effects between source and political orientation, and source and religiosity on intentions to comply with the advice.

Table 2*Political Orientation and Religiosity as Moderators of the Effect of Source on Trust in the Advice*

Moderator	UK	US	Canada	Malaysia	Taiwan
Political Orientation	<p>Source x political orientation: $t(920) = 2.85, p = .004$.</p> <p>All participants trusted the advice more when the source came from the scientific source versus the government, however, when the source was:</p> <p>Scientific Journal Left-wingers ($M = 5.90, SE = .09$) trusted the advice more than right-wingers ($M = 5.66, SE = .08, p = .038, d = 0.19$ 95% CI [0.01, 0.37])</p> <p>Government Left-wingers ($M = 4.80, SE = .08$) trusted the advice less than right-wingers ($M = 5.05, SE = .09, p = .048, d = 0.19$ CI [0.001, 0.38])</p>	<p>Source x political orientation: $t(899) = 5.37, p < .001$.</p> <p>All participants trusted the advice more when the source came from the scientific source versus the government, however, when the source was:</p> <p>Scientific Journal Left-wingers ($M = 6.72, SE = .07$) trusted the advice more than right-wingers ($M = 5.65, SE = .08, p < .001, d = 0.94$ 95% CI [0.75, 1.12]).</p> <p>Government Left-wingers ($M = 5.53, SE = .08$) trusted the advice more than right-wingers ($M = 5.29, SE = .07, p = .024, d = 0.22$ CI [0.03, 0.41]).</p>	<p>Source x political orientation: $t(886) = 1.17, p = .242$.</p>	<p>Source x political orientation: $t(896) = 2.64, p = .008$.</p> <p>Scientific Journal No significant differences between left- and right-wingers, $p > .523$</p> <p>Government Conservatives ($M = 5.65, SE = .07$) trusted the advice more than liberals ($M = 5.20, SE = .07, p < .001, d = 0.41, 95\% CI [0.24, 0.60]$).</p>	<p>Source x political affiliation: $F(7, 910) = 3.96, p < .001$.</p> <p>Scientific Journal No differences between different party supporters, $ps > .999$.</p> <p>Government Focusing on the largest political parties, we found that KMT supporters ($M = 5.20, SE = .11$) trusted the advice less than DPP supporters ($M = 6.19, SE = .11, p < .001, d = 0.92, 95\% CI [0.63, 1.21]$).</p>

		Source x religiosity: $t(899) = 1.99, p = .047.$			
		Scientific Journal			
		Less religious participants ($M = 6.45, SE = .08$)			
Religiosity	Source x religiosity: $t(920) = 0.78, p = .438.$	trusted the advice more than highly religious ($M = 5.98, SE = .08, p < .001, d = 0.41$ 95% CI [0.21, 0.61])	Source x religiosity: $t(885) = 1.22, p = .223.$	Source x religiosity: $t(904) = 0.41, p = .134.$	Source x religiosity: $t(925) = 0.21, p = .827.$
		Government			
		No significant differences between less and highly religious participants, $p > .155.$			

Discussion

People worldwide have been advised to engage in prevention behaviours to quash the spread of the Covid-19 virus. Such advice has been communicated by two main sources: scientists and government leaders. Strong evidence suggests that people accept messages more when their source is considered highly trustworthy (Smith et al., 2013). Using large samples of participants across five countries, we tested whether differently framed (in terms of source and uncertainty) behavioural advice aimed at reducing the risk of Covid-19 infections, would impact people's trust in the message and their intentions to comply. As hypothesised, participants found the message more trustworthy when it originated from scientific research (i.e., a journal), as opposed to a report issued by the government. Further, although source did not directly impact on intentions to comply with the advice, we found that this was likely explained by greater trust in the message. That is, higher intentions to comply with the advice were related to the extent to which participants considered the source to be trustworthy. Finally, the manipulation of uncertainty was ineffective in changing participants' perceptions of message uncertainty.

In terms of moderation analyses, as expected, the effect of source on trust was moderated by political orientation, such that political supporters who did not endorse their government's ideology in the UK, Malaysia, and Taiwan found the message coming from the government less trustworthy than those who shared their ideology with the government. This pattern was not found in the US – American left-wingers found the message more trustworthy than right-wingers regardless of the source. This suggests that right-wing participants in the US were largely sceptical about Covid-19 measures, and potentially this is due to their low perceptions of Covid-19 threat (Conway et al., 2021). We found no such moderation effects in Canada, indicating that political orientation was not an important variable associate with governmental or scientific advice in this country.

Further, as predicted, religiosity moderated the effect of source on the message trust in the US. Highly religious versus less religious Americans showed less trust in the Covid-19 health advice when the advice originated from a scientific source. This is in line with literature demonstrating that highly religious Americans show more negative general attitudes towards science (McPhetres et al., 2020).

Overall, our primary findings are consistent with and extend previously identified source effects in science communication. Recent research suggested that nonsensical messages from scientists were considered more credible than the same messages originating from spiritual leaders (Hoogeveen et al., 2022; Smith et al., 2013). Building upon this literature, we show that this effect extends to a real-life message about health advice presented during a global health crisis, and when the comparison group to scientific sources was the government. Further, a recent review suggests that Covid-19 communicators should strive to increase credibility by presenting themselves as unbiased, in order to optimize persuasion (Susmann et al., 2022). As applied to our findings, it is possible that left-wing participants in the UK, Taiwan, and Malaysia perceived their country's government to be biased, and hence trusted the advice that originated from the government less than those whose ideology aligned with the government. Yet, these effects may depend on a particular context: Evidence shows that when a biased source switches their viewpoint based on high quality information, participants are persuaded by such a biased source (as people expect that biased sources would continue to hold the same position; [Wallace et al., 2020](#)). Hence, future research should investigate the effect of health advice source on the other aspects of message credibility, including bias. Additionally, based on advice response theory (Feng & MacGeorge, 2010; MacGeorge et al., 2016), we suggest that effectiveness of a message can be further enhanced if it is built on specific message features such as politeness.

Finally, we did not identify a direct effect of source on intentions to comply with the advice. However, there was a significant indirect effect, such that source was related to higher intentions to comply via increased trust in the scientific sources. These findings suggest that perceptions of health message sources per se are not sufficient to increase people's intentions to comply with the message. Instead, health messages should be communicated in ways that highlight trustworthiness of the source: For example, explicitly pointing out that scientists are highly trusted sources of information rather than expertise before presenting the main content of the health message (cf. Feng & MacGeorge, 2010). The lack of main effect of source on intentions, however, is also convergent with evidence that changing attitudes or attitude-relevant variables does not necessarily impact intentions or behaviours (see e.g., Itzhakov et al., 2018). Future research should investigate whether repeated exposure to messages is more effective in altering people's intentions and ultimately behaviour (see Maio et al., 2018). Altogether, our findings indicate that health advice messages should be more often communicated by scientific sources rather than governments to increase trustworthiness primarily. Further, to increase intentions to comply with health advice, such advice should be also communicated by scientific sources with an explicit statement regarding the trustworthiness of scientists.

Limitations

The manipulation of uncertainty was ineffective in changing people's perceptions of the certainty with which the presented advice would prevent the spread of Covid-19. The uncertainty manipulation we used focused on linguistic framing presenting the advice as either potentially or certainly effective. Such subtle framing was likely less salient than the source manipulation. Further, our messages comprised of advice to contain the spread of Covid-19, because this was relevant at the time of data collection. This could have limited the effect on intentions, because participants were already likely to be familiar with the advice.

This implies that their prior attitudes and existing habits likely had an impact on the trust and intention ratings than if the advice was about a less familiar topic (Verplanken, 2018).

Further, communicating uncertainty may be associated with other effects that we did not control for in the current study. Research suggests that uncertainty communication does not only reflect levels of uncertainty but may also lead to attributing specific intentions to the communicator. For example, uncertain language may indicate that the communicator is being cautious about the communicated content, potentially to avoid being blamed for providing incorrect information. At the same time, presenting certainty may lead to seeing the communicator as attempting to be persuasive (Juanchich et al., 2012; Sirota & Juanchich, 2015). Finally, given that we did not identify a direct effect of source on intentions to comply, it is possible that our brief manipulation was not strong enough to affect behavioural intentions. Future research should directly test variables that could enhance such manipulations.

Conclusion

Across five culturally diverse countries, we show that Covid-19 prevention advice is perceived as more trustworthy when it is communicated as originating from a scientific as opposed to a government source. This effect was moderated by political orientation and religiosity in some of the investigated countries. We also identified a significant indirect effect of scientific source on higher intentions to comply with the advice via increased trust. Overall, our findings provide strong evidence that health messages from scientists are considered as more truthful and honest. We suggest that it is beneficial to present health advice as originating from scientific sources to increase people's trust in the message and highlighting scientific sources trustworthiness to increase intentions to comply.

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