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A brief forewarning intervention overcomes negative effects of salient changes in COVID-19 guidance

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Abstract

During the COVID-19 pandemic, public health guidance (e.g., regarding the use of non-medical masks) changed over time. Although many revisions were a result of gains in scientific understanding, we nonetheless hypothesized that making changes in guidance salient would negatively affect evaluations of experts and health-protective intentions. In Study 1 (N = 300), we demonstrate that describing COVID-19 guidance in terms of inconsistency (versus consistency) leads people to perceive scientists and public health authorities less favorably (e.g., as less expert). For participants in Canada (n = 190), though not the U.S. (n = 110), making guidance change salient also reduced intentions to download a contact tracing app. In Study 2 (N = 1399), we show that a brief forewarning intervention mitigates detrimental effects of changes in guidance. In the absence of forewarning, emphasizing inconsistency harmed judgments of public health authorities and reduced health-protective intentions, but forewarning eliminated this effect.

Keywords: COVID-19, forewarning, health communication, science communication, trust

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1 Introduction

> "We have been criticized as public health professionals for changing our advice over time... We have been doing so because the science is evolving."
> Dr. Theresa Tam, Canada's Chief Public Health Officer (The Canadian Press, 2020)

> "Just because the message has changed does not mean to not trust the message. That messages change is actually what we expect in medicine and science. We just have never experienced it this quickly and this publicly in the past."
> Dr. Amy Tan, Physician and Associate Professor of Medicine (Austen, 2020)

The COVID-19 pandemic has been, among many other things, a time of change. Societal norms have changed, at least for a time. Viruses have mutated, resulting in dangerous variants. COVID-19 public health messages, too, have changed dramatically (Zhang et al., 2021). These changes in guidance largely stem from the novelty of the disease and the nature of science, which operates via a process of discovery that is not always linear. Ideally, evidence accumulates and improves, with new findings superseding what was previously the best evidence available. As scientific understanding of COVID-19 changed, so too did public health guidance. To be sure, messages change for political or pragmatic reasons as well, and government communication regarding COVID-19 has not been optimal (for a review of U.S. COVID-19 miscommunication, and suggestions for improvement, see Noar & Austin, 2020). Whatever their causes, revisions have been numerous and are often cited as a source of frustration with, and distrust of, health authorities (Rozdilsky, 2021; Zhang et al., 2021). If changes to health recommendations impair trust, then such changes might be especially harmful during a pandemic, when adherence to public health guidance can mean the difference between life and death (see, for example, Caulfield et al., 2021).

1.1 Negative effects of inconsistency, change, and uncertainty

Conflicting guidance is often associated with negative outcomes for the communicator and the advocacy in question. Pairs of studies with conflicting findings are seen as less informative than studies with consistent findings (Koehler & Pennycook, 2019). Nagler and colleagues (2014) found that self-reported exposure to conflicting nutritional information predicted nutrition confusion, which in turn predicted nutrition backlash (e.g., believing "Scientists really don't know what foods are good for you"). In turn, nutrition confusion and backlash predicted lower intentions to exercise and to eat fruits and vegetables.

Of greater relevance to the present research, highlighting changes in COVID-19 guidance lowered the perceived credibility of the U.S. Centers for Disease Control and Prevention (CDC; Rafkin et al., 2020). The authors presented participants in a "consistent" group with neutral statements (e.g., "The novel coronavirus has affected American life") and presented an "inconsistent" group with examples of Donald Trump downplaying the novel

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coronavirus, after which all participants read statements in which Trump acknowledged the risk posed by the novel coronavirus. Inconsistency led participants to see the government as less credible and to revise their estimated death counts to a lesser extent in response to CDC projections. As the authors note, however, it is not clear whether effects were driven by inconsistency between Trump's statements or by his initial downplaying of the crisis not aligning with people's own impressions of its magnitude. In addition, generalizability to sources other than Trump is unknown.

Consistent with past work (e.g., Rafkin et al., 2020), the present research examines effects of salient changes in COVID-19 guidance on trust and related outcomes. However, the present work also differs in meaningful ways. First, our message sources were "public health officials" or "scientists", rather than Trump, thereby enhancing generalizability. Second, our inconsistent and consistent messages were worded in ways that were similar to one another, reducing the risk of alternative explanations. Third, in Study 1 we recruited respondents from Canada and the United States, allowing for exploratory comparisons across countries. Fourth, our outcome measures differed, including the source characteristics assessed (e.g., trustworthiness, expertise, and bias) and the intention measures included (e.g., intentions to download a contact tracing app). Lastly, whereas Rafkin and colleagues focused on the detrimental effects of inconsistency, we additionally tested an intervention in Study 2, preceding the reminders of (in)consistency. This message explained why guidance changes, with an emphasis on the nature of scientific discovery and public health authorities' reliance on the best evidence – which is evolving. Our intervention might operate via multiple mechanisms, but we will focus on three: expectation-setting regarding change, favorable construal of change, and perspective-taking with public health authorities.

1.2 Tactics to make changes in guidance more acceptable

1.2.1 Setting expectations regarding changes in guidance

Schmid and colleagues (2020) found that forewarning of false balance in a (fictitious) televised discussion reduced the influence of unscientific anti-vaccination messages on outcomes such as vaccination intentions. Forewarning therefore can mitigate effects of contradictory messages on health-related outcomes. However, applicability to the present work is not entirely clear given that their messages were presented by different people simultaneously rather than over time by the same source(s), and their outcome measures focused on the topic of discussion (inoculation) rather than the sources. In a related tactic known as *attitude inoculation* (McGuire & Papageorgis, 1961; van der Linden et al., 2017), prior exposure to persuasive arguments paired with refutations helps protect attitudes or beliefs from subsequent attack. Although changing guidance is not an attack, and our intervention is not necessarily refuting a particular argument, our forewarning message might similarly protect against negative reactions. Forewarning might also operate similarly to *stealing thunder* (Williams et al., 1993), in which pre-emptively revealing

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negative information about oneself can diminish harm to one's reputation compared to having another party do so. However, some forewarning is in order: one's expectations do not always mitigate one's reactions to an impending event. For example, expecting negative outcomes (e.g., poor test performance) might reduce happiness in anticipation of the outcome without helping to improve one's reaction to the outcome (Golub et al., 2009). Barzilai and colleagues (2020) found that pre-emptively explaining why historians might disagree encouraged an evaluativist response to conflicting accounts of an event (e.g., thinking in terms of which account best fit the available data). However, a historian who presented a perspective in line with one's own was seen as more trustworthy than a historian holding an opposing viewpoint, and the pre-emptive explanation did not mitigate this tendency.

1.2.2 Accentuating the positive regarding changes in guidance

Our intervention message construes changes in COVID-19 science and guidance positively, noting that "the body of knowledge is one that is evolving and improving". This message aims to restore some sense of consistency by stating that these changes are due to a consistent reliance on the best available science. Our intervention therefore might lead people to construe revision as a process of evolution, perhaps like how persuasion can be seen as "progress" or "manipulation", with differing effects on message scrutiny (Briñol et al., 2015). Construing uncertainty regarding COVID-19 as normal (e.g., stating, "As with all problems in medicine, we don't know everything but we do the best we can with what we know") has been shown to reduce worry and perceived risk regarding COVID-19 compared to only acknowledging uncertainty (Han et al., 2021). However, these effects were not statistically significant, the normalization intervention accompanied the uncertainty induction rather than preceding it, and the topic was primarily uncertainty rather than changes in guidance. Therefore, the implications for the present work are uncertain.

1.2.3 Taking the perspective of public health authorities

Lastly, our forewarning message encourages perspective-taking, as exemplified by the phrase, "Imagine what this would mean if you were a public health authority". By default, one might attribute inconsistency to deceit or incompetence, but perspective-taking might encourage consideration of situational factors (Epley et al., 2002; Regan & Totten, 1975).

1.3 Overview of the present research

In sum, we hypothesize that emphasizing change (versus consistency) in COVID-19 public health guidance will negatively affect impressions of experts, but this will be mitigated by a pre-emptive message that provides a context and rationale for these changes. Much evidence for negative effects of inconsistent health guidance is anecdotal or drawn from other domains (e.g., nutrition). Forewarning can guard against vaccine hesitancy (Schmid et al., 2020), but we are unaware of a forewarning intervention regarding COVID-19 public health guidance. Given the inevitability of change and implications for trust in public health and engagement in health behaviors, we consider a trust-preserving intervention to have the potential to protect not just the reputations of authorities, but also the lives of citizens.

2 Study 1

Study 1 examined the effects of salient changes in COVID-19 guidance on judgments of public health authorities and scientists as well as behavioral intentions. We presented participants with summaries of findings and health guidance related to COVID-19. Based on condition, all summaries emphasized either inconsistency or consistency in the conclusion over time. We hypothesized that reading messages that emphasized inconsistency (vs. consistency) would lead to lower perceived expertise and trustworthiness of both public health authorities and scientists. We also expected that inconsistent messaging would lead to lower intentions to get a COVID-19 vaccine and to download a contact tracing app. We also predicted that more favorable attitudes toward changes in COVID-19-related scientific conclusions would mitigate these hypothesized effects.

2.1 Method

This experiment was preregistered through Open Science Framework. Deviations from preregistration are noted as relevant. Materials, registrations, and anonymized data for all studies, as well as online appendices, can be found at https://osf.io/s6xzt.[1]

2.1.1 Participants

We recruited participants (N = 300)[2] via Mechanical Turk. Participants were paid $1.00 USD for participation. Over the course of data collection (October 14th to 21st, 2020), we relaxed participant requirements regarding the minimum number of Human Intelligence Tasks (HITs) completed (from 1000 to 100) and minimum approval percentage (from

[1]See Online Appendix A for materials used in Studies 1 and 2. These materials include secondary measures that are not described in the main text.

[2]Reported ages ranged from 18 to 99 (M = 36.96, SD = 12.01) and most participants were male (60.67%). Participants were not asked to report their race in Study 1. One participant's data were rejected due to failure to provide a unique end-of-survey code and implausible speed, and thus an additional participant was recruited during data collection. One participant was excluded after data collection was completed due to reporting an age of 16 years old (below the intended study threshold of 18 years old). 301 participants participated (suggesting that one participant did not complete the crediting process), though the sample of usable data featured 300 participants.

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99% to 95%) in order to expand our sample and hasten data collection.[3] Similarly, we initially intended to recruit only Canadian residents; however, we ultimately transitioned from recruiting from Canada (n = 190) to the United States (n = 110)[4] and present analyses examining effects of Country.

2.1.2 Materials and measures

Guidance manipulation. The Guidance manipulation consisted of four passages that based on random assignment emphasized either consistency or inconsistency of COVID-19 findings and guidance over time, but were otherwise similar (see Table 1). To encourage participants to read carefully, they were asked to rate their familiarity with each issue using a seven-point scale.

Manipulation checks. We measured perceived change in public health guidance and scientific knowledge regarding COVID-19 with four items.[5]

Ratings of scientists and public health authorities regarding COVID-19 recommendations. Participants were asked "How do you feel about [scientists/public health authorities], when it comes to their recommendations related to COVID-19?" and responded on seven-point scales that ranged from "Not at all [descriptor such as 'trustworthy']" to "Completely [descriptor]". Drawing on work that delineates source characteristics (Wallace et al., 2020b), we assessed judgments of trustworthiness, expertise, and bias.[6]

Behavioral intentions. We first assessed COVID-19 vaccination intentions using an ordinal scale (cf. Angus Reid Institute, 2020; Privy Council Office of Canada, 2020). Participants could indicate intentions to get vaccinated as soon as possible, to wait, or to not get vaccinated. Participants intending to wait were asked how long they would wait, among a set of options. This was followed by the preregistered COVID-19 vaccination intention measure, which used a five-point scale[7] and was expected to be more sensitive. Our contact tracing intention measure asked, "Do you intend to download [a contact tracing/the COVID

[3] Data quality was facilitated through the described recruitment criteria and by requiring participants to correctly respond to two "botchas", simple questions aimed to filter out "bots" (e.g., Littrell & Fugelsang, 2021), prior to the study.

[4] Materials were updated for the American subsample regarding, for example, nationalities mentioned, units of measurement, and the contact tracing app (referred to as "a contact tracing app" rather than "the COVID Alert app", which is used in Canada).

[5] Although our preregistered hypotheses conflated scientific findings and health guidance, we examine these separately.

[6] Ratings of scientists and public health authorities were presented separately. Although preregistered hypotheses suggested collapsing across targets and/or traits, we ultimately divided by targets and traits. The order of items was inadvertently counterbalanced for trustworthiness but not for other traits.

[7] The wording of the prompt was based on that used by the World Health Organization (2020). We would like to thank Julian House for recommending the response options used ("definitely not" to "definitely would").

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Table 1: Messages used in each experimental condition (Study 1). (Bolding added for emphasis of differences across conditions. Brackets are used in instances in which wordings differed for Canadian and U.S. samples.)

Message Title	Consistent Messages	Inconsistent Messages
Masks	Months ago, [Canadian/American] public health officials advised [Canadians/Americans] **to wear** non-medical masks. Wearing masks is **still** recommended, for example, when indoors in public places.	Months ago, [Canadian/American] public health officials advised [Canadians/Americans] **against wearing** non-medical masks. Wearing masks is **now** recommended, for example, when indoors in public places.
Asymptomatic Transmission	Earlier in the pandemic, scientists and public health authorities suggested that people who never develop symptoms might **nonetheless** spread COVID-19. Now, further evidence indicates that people without symptoms can spread COVID-19.	Earlier in the pandemic, scientists and public health authorities suggested that people who never develop symptoms might **not necessarily** spread COVID-19. Now, further evidence indicates that people without symptoms can spread COVID-19.
Social (Physical) Distancing	Since early in the pandemic, [Canadians/Americans] have been asked by public health officials to practice social distancing of at least [2 meters/6 feet]. **This** ([2 meters/6 feet]) **remains the recommendation because of its potential to reduce** risk of transmission.	Since early in the pandemic, [Canadians/Americans] have been asked by public health officials to practice social distancing of at least [2 meters/6 feet]. **Newer evidence for aerosolized transmission suggests that** [2 meters/6 feet] **might not be sufficient to eliminate the** risk of transmission.
Spread of COVID-19 by Children	For months, scientists suggested that children might spread COVID-19 at **similar** rates **to** adults. There **continues to be** evidence that children can spread COVID-19 at similar rates to adults.	For months, scientists suggested that children might spread COVID-19 at **lower** rates **than** adults. There **is now** evidence that children can spread COVID-19 at similar rates to adults.

Alert] app?” and participants responded to this question using a five-point scale that ranged from “Definitely not” to “Definitely yes”.

Covariates and demographics. Four questions (α = .80) assessed reported COVID-19 protective behaviors, presented in random order with response options from “1: Never” to

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"7: Always".[8] An additional item asked, "How many times over the last five flu seasons have you gotten vaccinated for the flu?", with response options from 0 to 5 and an "It doesn't apply to my situation" option (not analyzed). We also asked participants to report their age, gender, and urbanicity. Urbanicity was included because guidance varied across locales. This item asked, "What is the size of the community you live in?", with five response options (Privy Council Office of Canada, 2020). We also measured participants' self-reported political ideology using two items (see Federico et al., 2005, for similar items).

2.1.3 Procedure

The study began with the Guidance manipulation, followed by change-related manipulation checks. Participants then rated scientists and public health authorities regarding COVID-19 recommendations and indicated their intentions to get a COVID-19 vaccine and to download a contact tracing app. These items were followed by covariates and demographic questions. Participants then concluded the study by being given the opportunity to provide comments and to guess the hypotheses. A debriefing page aimed to undo potential effects of the guidance manipulation, noting that "… changes in scientific knowledge are natural, and allow us to improve our understanding of COVID-19 and other topics".

2.2 Results

2.2.1 Overview of analytic approach

We used effect coding for categorical predictors: Guidance (-0.5 = Consistent; +0.5 = Inconsistent), Gender (–0.5 = Male; +0.5 = Female), and Country (–0.5 = United States; +0.5 = Canada), which allows for conditional effects to be tested at the grand mean of variables present in higher-order interactions. We included a Country term to allow for potential differences across samples, though these are of secondary importance and will not generally be reported in the main text. We also examined Guidance x Country interactions and included this interaction term when it was significant or almost significant ($p < .100$).[9] We will reserve the main text for primary analyses (e.g., judgments of public health authorities), which, unless noted otherwise, are linear regressions with the predictors of Guidance, Country, and Guidance x Country. See Online Appendix B for cell means and standard deviations as a function of Guidance and see Online Appendix C for regression tables

[8]The behaviors were mask-wearing, reducing one's frequency of social gatherings, social (physical) distancing, and handwashing.

[9]Study 1 data were unbalanced with regard to Country, but in models with the interaction term, the conditional effect of Guidance condition disproportionately takes into account the smaller cell (U.S. data). We removed nonsignificant Country x Guidance interactions to mitigate this issue. For models with interactions, we also examine models with these interactions omitted in the relevant online appendices. Weighted effect coding can also compensate for unbalanced data to an extent (Sweeney & Ulveling, 1972; te Grotenhuis et al., 2017), but given the complexity of models examined, we opted to use a simpler approach. We are grateful to Amanda Montoya and Rense Nieuwenhuis for insight regarding weighted effect coding.

for primary analyses, including ones not presented in the main text (e.g., models with preregistered covariates and models predicting bias ratings).

2.2.2 Primary analyses

Manipulation checks. As expected, perceived change in COVID-19 health recommendations was greater in the Inconsistent condition than the Consistent condition (B = 0.43, SE = 0.15, p = .005). Perceived change in COVID-19 scientific findings showed a similar trend, though this difference was only almost significant (B = 0.23, SE = 0.14, p = .093).

Judgments of experts. Compared with consistency, inconsistency led participants to view scientists and public health authorities in a more negative light. Following reminders of inconsistency, scientists were seen as possessing less expertise (B = –0.44, SE = 0.13, p = .001), and being less trustworthy (B = –0.36, SE = 0.14, p = .011). Similarly, inconsistency led public health authorities to be seen as possessing significantly less expertise (B = –0.47, SE = 0.16, p = .004) and somewhat (though not significantly) lower trustworthiness (B = –0.31, SE = 0.16, p = .055; see Figure 1).

Behavioral intentions. We found no evidence that inconsistent messaging affected COVID-19 vaccination intentions in Study 1 (B = –0.12, SE = 0.13, p = .372). However, this may be due to a ceiling effect, as more than 80% of respondents said that they either probably would or definitely would get the vaccine. We also examined intentions to download a contract tracing app.[10] Participants who had been reminded of inconsistency reported lower download intentions compared with participants reminded of consistency (B = –0.33, SE = 0.16, p = .042). In addition, respondents in Canada reported higher intentions than did respondents in the United States (B = 0.43, SE = 0.16, p = .010). These effects were qualified by a Guidance x Country interaction (B = –0.82, SE = 0.33, p = .013; see Figure 2).[11] For participants in Canada, inconsistency reduced download intentions (M = 2.41, SD = 1.13) compared with consistency (M = 3.16, SD = 1.14; B = –0.74, SE = 0.23, p = .001). In the United States, intentions were similar amid inconsistency (M = 2.39, SD = 1.27) or consistency (M = 2.32, SD = 1.32; B = 0.07, SE = 0.24, p = .753).[12]

[10]Before analyzing intentions to download a contact tracing app, we excluded participants who reported having already done so (n = 68) or being unable to do so (n = 10).

[11]Although we had preregistered the Johnson-Neyman technique for probing interactions (Johnson & Fay, 1950), we used simple effect analyses here and elsewhere because the moderators were categorical.

[12]See Online Appendix D for analyses of various hypothesized (though not apparent) moderating effects of beliefs regarding the positivity of changes in COVID-19 scientific conclusions. See Online Appendix E for exploratory analyses of familiarity of guidance as an outcome.

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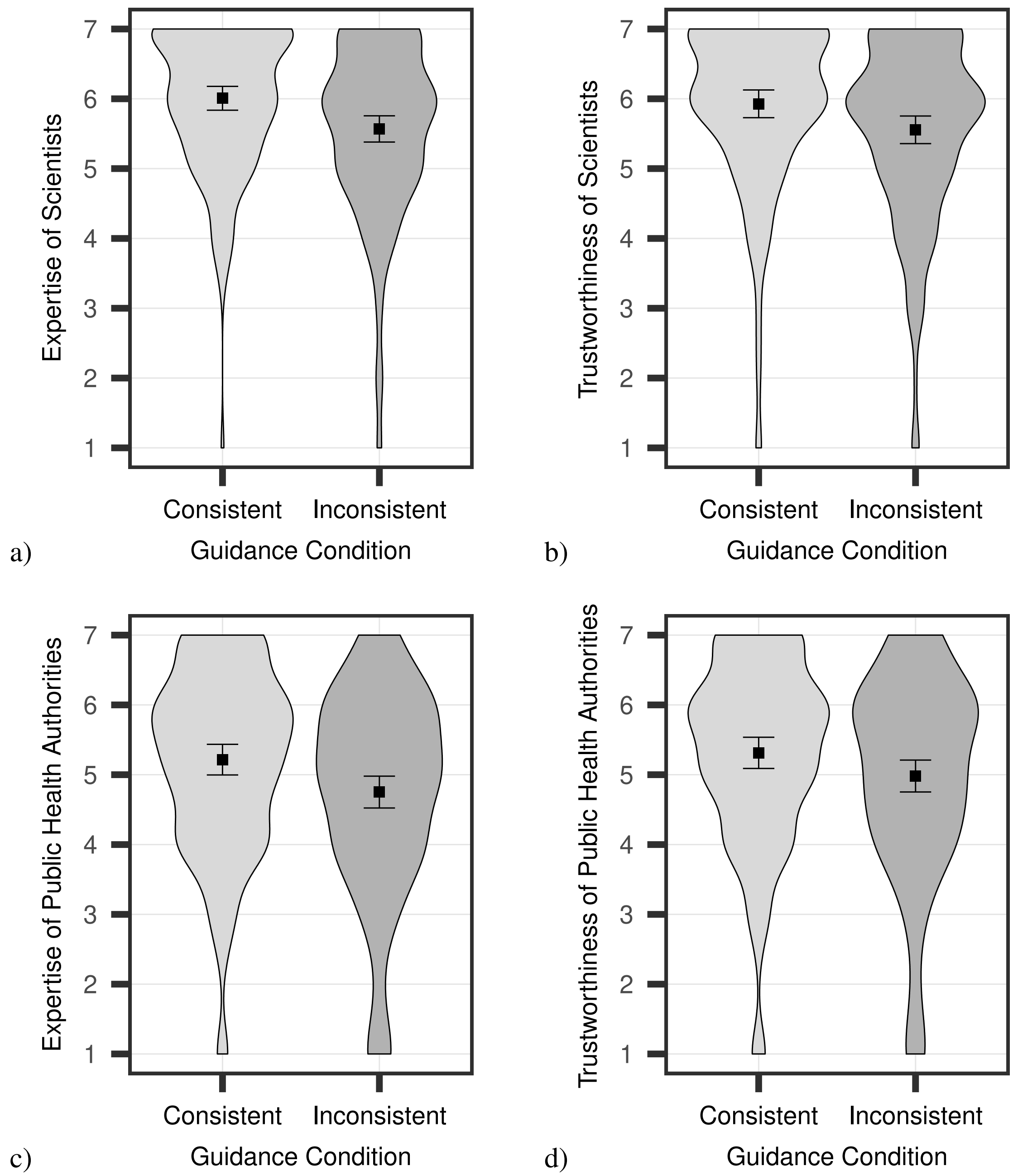

Figure 1: Perceived a) expertise and b) trustworthiness of scientists and c) expertise and d) trustworthiness of public health authorities as a function of Guidance condition (Study 1). Points represent means and error bars represent 95% CI. *N* = 300.

2.3 Discussion

Study 1 showed that highlighting changes in COVID-19 guidance can harm perceptions of scientists and public health authorities. These findings align with those of Rafkin and colleagues (2020), despite the use of different paradigms, targets of judgment, and samples. With regards to behavioral outcomes, results were mixed. Inconsistency in guidance was

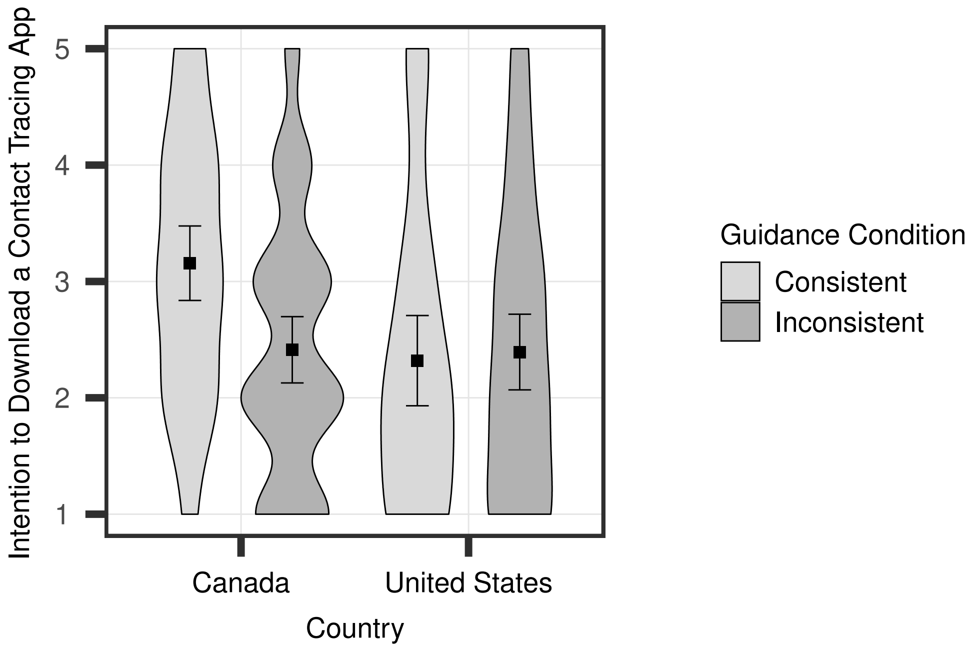

Figure 2: Intention to download a contact tracing app as a function of Guidance condition and Country (Study 1). Points represent means and error bars represent 95% CI. *N* = 222.

associated with reduced intentions to download a contact tracing app in the Canadian sample. A similar effect was not found among U.S. participants, potentially due to different targets of judgment (apps), national differences, or other differences across samples (e.g., the Canadian sample initially having more strict recruitment criteria). COVID-19 vaccination intentions were not influenced by the guidance manipulation in Study 1, potentially due to ceiling effects.

3 Study 2

In Study 2, we examined whether a forewarning intervention might mitigate the effects of changes in guidance. This study consisted of an integrative data analysis[13] (Curran & Hussong, 2009) of two studies (2a and 2b).[14] We predicted that the forewarning intervention would enhance ratings of acceptability of change in COVID-19 health recommendations

[13] Integrative data analysis and the related techniques of internal meta-analysis and mini meta-analysis (e.g., Braver et al., 2014; Goh et al., 2016) have precedent in the psychological literature (Sevi & Shook, 2021; Wallace et al., 2020a), but in light of critiques of internal meta-analysis (Vosgerau et al., 2019), we will elaborate on our approach. At the time of writing, these are the only studies we have conducted using this intervention. We preregistered both studies, albeit without intending to aggregate them, and with some details not finalized. We will note deviations from preregistration as relevant (see Online Appendices F and G) and report alternative analyses (as well as the analyses reported in the main text) in Online Appendix H to examine robustness.

[14] These studies were similar, but we will note differences when pertinent (see Online Appendix F) and will test for heterogeneity through inclusion of a Data Set term and interactions as relevant.

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and COVID-19 scientific understanding. We also predicted that reminders of inconsistency (versus consistency) would reduce perceived expertise and trustworthiness of scientists and public health authorities, but forewarning would mitigate these effects. We also examined effects of the Change and Forewarning manipulations on COVID-19 vaccination intentions, as well as other exploratory analyses.

3.1 Method

3.1.1 Participants

We recruited participants (Study 2a n = 601; Study 2b n = 798) via Mechanical Turk on November 13th (Study 2a) and December 7th, 2020 (Study 2b).[15] Participants were paid $1.00 USD in Study 2a and $0.75 USD in Study 2b. We recruited participants from the United States who had HIT approval rates of 99 percent or higher across at least 100 HITs.[16] This experiment was preregistered through Open Science Framework (https://osf.io/s6xzt).[17]

3.1.2 Materials and measures

Forewarning intervention. The forewarning message stated,

> "The scientific process is one of discovery, in which one research finding might initially be the best evidence available, but even better evidence may be found later and may change scientists' understanding of a topic.
>
> As a result, the body of knowledge is one that is evolving and improving rather than remaining static.
>
> **Imagine what this would mean if you were a public health authority:**
>
> In order for you to **consistently** make decisions and provide guidance based on the best available science, these recommendations will end up changing – because the best available scientific conclusions are changing as well."

Guidance manipulation and change-related manipulation checks. The Guidance manipulation was similar to that used in Study 1 (see Table 2 for messages). In Study 2a, two manipulation checks assessed change in scientific knowledge regarding COVID-19. These items were counterbalanced along with two items asking about perceived change in public health guidance regarding COVID-19. We initially created composites for each pair of items, which correlated, $r(599) = .51$, $p < .001$. In Study 2b, only one item assessed

[15]Ages ranged from 18 to 91 (M = 39.98, SD = 12.70), gender was balanced (49.82% female, 49.32% male, 0.86% selected "Other"), and the majority (73.27%) of participants were White.

[16]As in Study 1, data quality was facilitated through the noted participant recruitment criteria as well as two "botchas" that preceded the study.

[17]Hypotheses in the main text differ somewhat from those we preregistered; see Online Appendix F for notes on deviations from preregistration as well as differences across studies.

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perceived change: "To what extent do you think U.S. public health authorities' guidance regarding COVID-19 has changed over time?" For simplicity, analyses of perceived change in public health recommendations will only use this item.

Table 2: Messages used in each Guidance condition (Study 2b). (Bolding added for emphasis of differences across conditions. Materials used in Study 2a were identical to those used in Study 1.)

Message Title	Consistent Messages	Inconsistent Messages
Masks	Months ago, American public health officials advised Americans **to wear** non-medical masks. **Consistent with** these earlier statements, wearing masks is **still** recommended, for example, when indoors in public places.	Months ago, American public health officials advised Americans **against wearing** non-medical masks. **In a change from** these earlier statements, wearing masks is **now** recommended, for example, when indoors in public places.
Asymptomatic Transmission	Earlier in the pandemic, public health authorities suggested that people who never develop symptoms might **nonetheless** spread COVID-19. In **line** with this previous guidance, more recent public health messages note that people without symptoms can **indeed** spread COVID-19.	Earlier in the pandemic, public health authorities suggested that people who never develop symptoms might **not necessarily** spread COVID-19. In **contrast** with this previous guidance, more recent public health messages note that people without symptoms **actually** can spread COVID-19.
Social (Physical) Distancing	Since early in the pandemic, public health officials have indicated that COVID-19 can spread via droplets expelled by an infected person. Public health guidance regarding transmission **continues** to include transmission via **droplets, including** both larger droplets and tiny, floating droplets known as aerosols.	Since early in the pandemic, public health officials have indicated that COVID-19 can spread via droplets expelled by an infected person. Public health guidance regarding transmission **has changed** to include transmission via both larger droplets and tiny, floating droplets known as aerosols.
Spread of COVID-19 by Children	For months, public health figures suggested that children might spread COVID-19 at **similar** rates **to** adults. **Likewise**, **currently** some public health authorities **continue to** suggest that children can spread COVID-19 at similar rates to adults.	For months, public health figures suggested that children might spread COVID-19 at **lower** rates **than** adults. **On the other hand**, some public health authorities **now** suggest that children can spread COVID-19 at similar rates to adults.

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Source ratings. In Study 2a, participants evaluated scientists and public health authorities as in Study 1. In Study 2b, participants only evaluated public health authorities,[18] with trait ratings presented as pairs in separate blocks. We added ratings of the usefulness of recommendations in Study 2b, reasoning that a source could be considered trustworthy, for example, without guidance being seen as useful. We also hypothesized that salient changes in guidance would harm ratings of usefulness.

COVID-19 vaccination intentions, COVID-19 protective behaviors, and flu vaccinations. Participants indicated their COVID-19 vaccination intentions as in Study 1 (with the exploratory COVID-19 vaccination item omitted in Study 2b). Participants also reported COVID-19 protective behaviors ($\alpha = .85$)[19] and previous flu vaccinations in counterbalanced order.

Forewarning-related manipulation checks. As in Study 1, in Study 2a we measured the perceived positivity of change in COVID-19 science using two items. We also added two questions about the acceptability of changes in guidance, asking, "To what extent is it [reasonable/acceptable] for public health recommendations to change regarding COVID-19?" Participants responded to these items using a seven-point scale.

Covariates and demographics. Participants were asked questions regarding political ideology, urbanicity (in Study 2a), race (similar to U.S. Census Bureau, 2020), age, and gender.

3.1.3 Procedure

In the Forewarning condition, the study began with a message that aimed to mitigate adverse effects of changing guidance. The inclusion of this message was framed as a comprehension task. This message, or a no-message control, was followed by the Guidance manipulation and manipulation check(s) regarding change, followed by judgments of expert sources. Participants then reported their COVID-19 vaccination intentions, COVID-19 protective behaviors, and previous flu vaccination behavior. They then responded to forewarning-related manipulation checks, measures of covariates, and demographic questions. As in Study 1, participants were given the opportunity to provide comments and guess the hypotheses, then were debriefed.

[18]As such, ratings of scientists are exclusive to Study 2a, whereas ratings of public health officials use data from both data sets as applicable.

[19]One health behavior (handwashing to avoid fomite/surface transmission) was dropped following Study 1 due to evidence of less predictiveness (e.g., of vaccination) and due to fomites not being as clear a mode of transmission of coronavirus compared to, for example, aerosols (Centers for Disease Control and Prevention, 2020; Goldman, 2020).

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3.2 Results

3.2.1 Overview of analytic approach

We effect coded Guidance (–0.5 = Consistent; +0.5 = Inconsistent), Gender (0.0, +0.5 = Male; +0.5, 0.0 = Female; -0.5, –0.5 = Other), and Data Set (–0.5 = Study 2a; +0.5 = Study 2b). We dummy coded Forewarning (0.0 = No Forewarning; +1.0 = Forewarning) such that effects of Guidance were conditional on the No Forewarning control condition in models with a Guidance x Forewarning term.[20] We included a Data Set term and examined interactions between Data Set and our conditions, dropping interaction terms when $p >$ .099.[21] However, results involving the Data Set term are secondary and not presented in the main text. We report the results of linear regressions with predictors of Guidance, Forewarning, Data Set, and all interactions (aside from nonsignificant interactions involving Data Set), as well as Age and Guidance x Age (as relevant).[22] Complete regression tables, including analyses with covariates, can be found in Online Appendix H.[23]

3.2.2 Manipulation checks[24]

[20]Means and standard deviations were calculated within this control condition as applicable, though these were computed within the No Forewarning subset rather than being estimated marginal means.

[21]Our rationale is similar to that for the Country variable in Study 1: data are unbalanced with regard to Data Set, such that the smaller data set (2a) has disproportionate influence on lower-order effects when interactions involving Data Set are included. Study 2b was designed to improve upon 2a, thus undue influence of Study 2a would be suboptimal. We first tested a model with all interactions, then removed the Data Set x Guidance x Forewarning term if $p > .099$, after which we removed the Data Set x Guidance and/or Data Set x Forewarning interactions if $p > .099$. Because Forewarning condition was dummy coded, the interpretation of the Data Set x Guidance interaction differs depending on whether the Data Set x Guidance x Forewarning interaction is included: the Data Set x Guidance interaction is conditional on the No Forewarning condition only if the three-way interaction is included. This is reasonable given that the Guidance term is also conditional. Nonetheless, we prioritized reducing the influence of unbalanced data on the Guidance x Forewarning term, and thus will remove nonsignificant three-way interaction terms.

[22]Initial analyses of Study 2b indicated that effects were often weakened or nullified when preregistered covariates were included. We therefore conducted regressions examining whether the manipulations had inadvertently influenced the covariates (see Online Appendix G). The manipulations influenced reported COVID-19 protective behavior, so we treated this as an exploratory dependent variable rather than a covariate. In addition, to ensure that effects of Forewarning were not due to Age (which correlated with Forewarning condition), in models for which Forewarning condition or interactions involving Forewarning condition were significant or almost significant ($p < .100$), we added analogous term(s) that replaced Forewarning condition with Age (mean-centered). Because Urbanicity was not included in Study 2b, we will omit it as a covariate from analyses involving Study 2b.

[23]To test robustness, Online Appendix H contains these models as well as analyses with preregistered covariates from all relevant data sets (i.e., Studies 2a and 2b if both are used in an analysis) as well as Age and Guidance x Age terms as relevant (but excluding COVID-19 protective behaviors and Urbanicity).

[24]In Study 2b, we had bolded the word "change" to emphasize that the target of judgment was change, rather than, for example, authorities or guidance. In Study 2a, the pair of questions regarding the positivity of change in science and the pair of questions regarding the acceptability of change in guidance were presented in counterbalanced order in one survey block. The composites for each pair of measures were correlated, $r(599) = .64$, $p < .001$. Nonetheless, we examined these composites separately given conceptual differences between them (in line with our preregistration for Study 2a).

Participants in the Inconsistent condition perceived more change in COVID-19 guidance (M = 5.12, SD = 1.30) than did those in the Consistent condition (M = 4.38, SD = 1.44; B = 0.71, SE = 0.10, p < .001). Notably, change in guidance was seen as more acceptable following forewarning (M = 5.89, SD = 1.14) compared with no forewarning (M = 5.70, SD = 1.31; B = 0.15, SE = 0.07, p = .022). In Study 2a, participants in the Inconsistent condition perceived more change in scientific findings regarding COVID-19 (M = 5.41, SD = 1.26) than did participants in the Consistent condition (M = 5.06, SD = 1.30; B = 0.35, SE = 0.15, p = .020). However, forewarning did not affect perceived positivity of change in COVID-19 science (M = 5.73, SD = 1.22) compared with no forewarning (M = 5.71, SD = 1.30; B = 0.01, SE = 0.10, p = .893).

3.2.3 Judgments of public health authorities[25]

Expertise. We found a significant Guidance x Forewarning interaction (B = 0.49, SE = 0.15, p = .001; see Figure 3). Without forewarning, inconsistency led to lower expertise ratings for public health authorities (M = 4.91, SD = 1.43) compared with consistency (M = 5.30, SD = 1.31; B = –0.39, SE = 0.11, p < .001). With forewarning, inconsistency (M = 5.09, SD = 1.51) led to similar expertise ratings for public health authorities compared to consistency (M = 5.01, SD = 1.46; B = 0.10, SE = 0.11, p = .352).[26]

Trustworthiness. We found a significant Guidance x Forewarning interaction (B = 0.49, SE = 0.17, p = .003; see Figure 3). Without forewarning, inconsistency reduced trustworthiness ratings for public health authorities (M = 4.80, SD = 1.54) compared with consistency (M = 5.17, SD = 1.50; B = –0.38, SE = 0.12, p = .001). With forewarning, trustworthiness ratings were similar amid inconsistency (M = 5.08, SD = 1.61) and consistency (M = 4.98, SD = 1.53; B = 0.11, SE = 0.12, p = .343).[27]

Intention to get a COVID-19 vaccine (exploratory). We found a significant Guidance x Forewarning interaction with regard to COVID-19 vaccination intentions (B = 0.28, SE = 0.14, p = .048; see Figure 3).[28] Without forewarning, inconsistency reduced vaccination intentions (M = 3.62, SD = 1.33) compared with consistency (M = 3.81, SD = 1.29; B =

[25]Judgments of scientists were limited to Study 2a, and measures of usefulness of public health officials (regarding guidance) were limited to Study 2b, whereas judgments of expertise, trustworthiness, and bias of public health authorities were included in both studies. We will focus on expertise and trustworthiness ratings for public health officials in the main text, but see Online Appendix H for additional analyses.

[26]Described differently, in the Inconsistent condition, forewarning marginally increased expertise ratings compared with no forewarning (B = 0.19, SE = 0.11, p = .081), whereas in the Consistent condition, forewarning reduced expertise ratings (B = –0.30, SE = 0.11, p = .006).

[27]Described differently, in the Inconsistent condition, forewarning enhanced trustworthiness (B = 0.31, SE = 0.12, p = .009), whereas in the Consistent condition, forewarning did not significantly affect trustworthiness (B = –0.18, SE = 0.12, p = .120).

[28]In a model with covariates, the Guidance term (p = .066) and the Guidance x Forewarning interaction (p = .056) were almost significant.

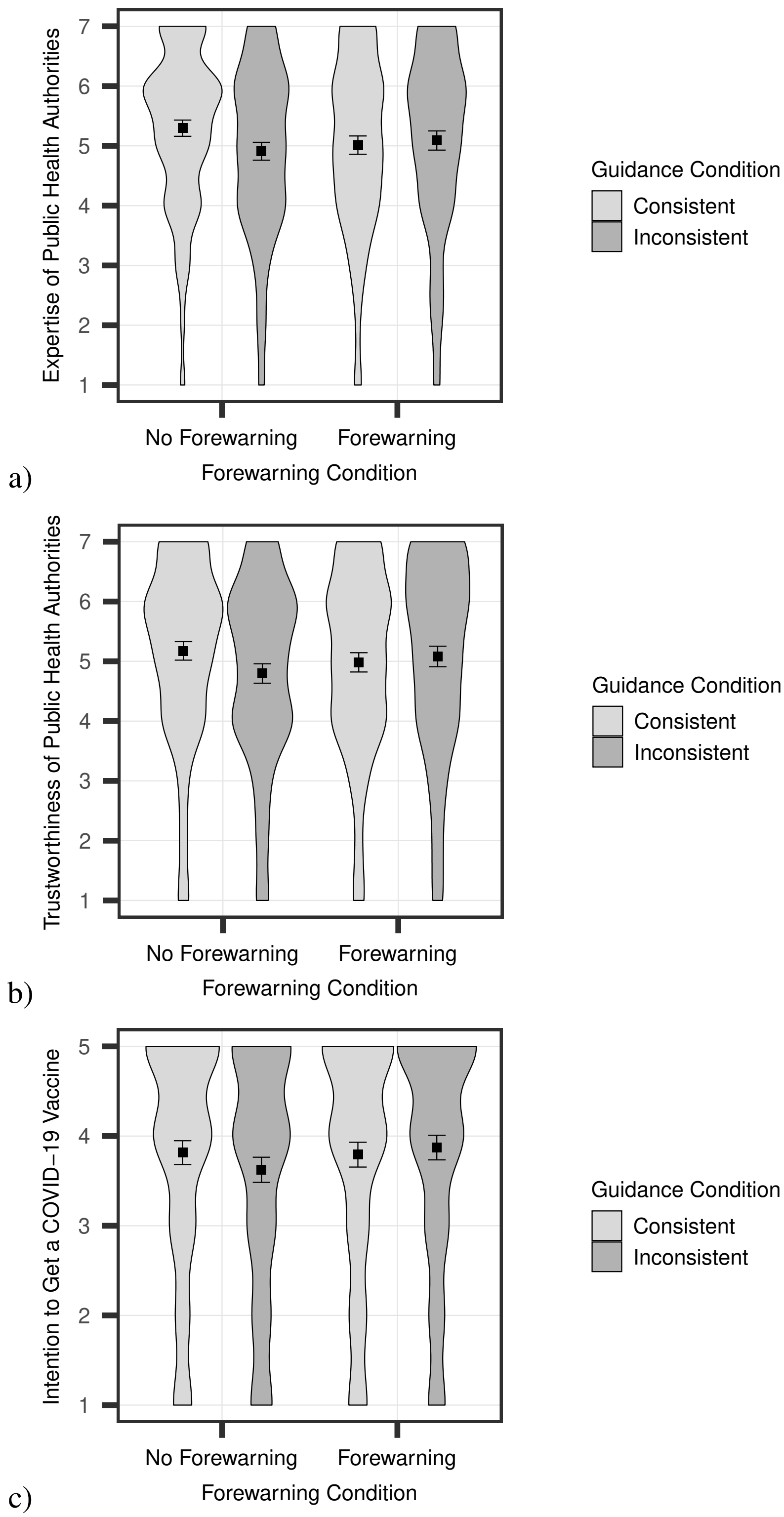

FIGURE 3: Perceived a) expertise and b) trustworthiness of public health authorities and c) intention to get a COVID-19 vaccine as a function of Guidance condition and Forewarning condition (Study 2). Points represent means and error bars represent 95% CI. N = 1399.

–0.20, *SE* = 0.10, *p* = .043). With forewarning, intentions were similar in the inconsistent (*M* = 3.87, *SD* =1.29) and consistent (*M* = 3.79, *SD* = 1.31) conditions (*B* = 0.08, *SE* = 0.10, *p* = .433).[29]

3.3 Discussion

Study 2 was, to our knowledge, the first experimental test of an intervention to mitigate detrimental effects of changes in public health messaging regarding COVID-19. Whereas making guidance change salient tended to have negative effects, these were often eliminated by a brief forewarning intervention. Altogether, change negatively influenced impressions of public health authorities regarding COVID-19 recommendations in terms of trustworthiness, expertise, bias, and usefulness, and reduced intentions to vaccinate against COVID-19. The forewarning intervention mitigated these effects.

4 General discussion

We have demonstrated that highlighting changes, rather than consistency, in public health recommendations can lead to more negative perceptions of public health officials and can discourage intentions to download a contact tracing app. Salient changes in guidance might also lower intentions to vaccinate against COVID-19, though this effect was not reliable in the present studies. Altogether, these effects are in line with previous work showing negative influences of changes in COVID-19 messages on perceptions of government credibility and reliance on CDC projections (Rafkin et al., 2020). Our work is also the first to our knowledge to use forewarning to reduce the negative impacts of message change in the domain of COVID-19 guidance. Although the intervention was overt, it was also "light touch" in that it consisted of a 98-word message, presented once.

4.1 Implications for health communication

Our results suggest it is possible to preserve trust even when experts must revise their recommendations. For example, framing health guidance in terms of consistency can foster perceptions of source expertise. This is in line with research on euphemism, which suggests that a more agreeable wording can instil more favorable attitudes towards the actions described (Rios & Mischkowski, 2019; Walker et al., 2021). That said, citizens might question a public health official who emphasizes consistency, assuming an "ulterior motive" that might not have been salient in the present research studies (see Campbell & Kirmani, 2000 for research on ulterior motives). Our forewarning intervention might also have benefited from being provided by researchers, whereas if a public health official were

[29]Described differently, in the Inconsistent condition, forewarning boosted vaccination intentions compared with no forewarning (*B* = 0.25, *SE* = 0.10, *p* = .012), whereas in the Consistent condition, forewarning did not affect intentions (*B* = –0.03, *SE* = 0.10, *p* = .784).

to both forewarn and revise guidance, the forewarning might be discounted as a mere excuse. Having one communicator forewarn and another person provide updated guidance might circumvent this.

The question of *who* should communicate a message is an important one, but so too is the question of *when* a message should be communicated. We intervened before highlighting the (in)consistent guidance because work on person perception (e.g., Durso et al., 2021) suggests that expectations of inconsistency might need to be set in advance. On the other hand, when correcting misinformation, (post-message) debunking has at times proven superior (Brashier et al., 2021), and at other times inferior (Grady et al., 2021), to prebunking. If expectations must be set in advance, then would such an intervention be moot in situations where public health guidance changes before communicators can pre-empt these changes? This need not be the case. In the present work, (in)consistent message topics were largely familiar to our pandemic-era participants. Nonetheless, both the (in)consistent framing and forewarning influenced participants' reactions. This suggests that an intervention can help even when inconsistency is public knowledge. An intervention might be most influential, however, when change is particularly salient, as in the current paradigm and, perhaps, during news conferences in which guidance is updated.

The Guidance x Forewarning crossover pattern suggests that an intervention like the present one might help when followed by revised, but not consistent, guidance. That is, although forewarning enhanced the perceived trustworthiness (and almost significantly enhanced expertise) of public health authorities and vaccination intentions in the Inconsistent condition,[30] forewarning had a negative influence on perceived expertise and reported COVID-19 protective behaviors in the Consistent condition. This aligns with Shockley and colleagues' (2016) finding that openness to change can reverse the longevity bias (a bias in favor of that which has existed for a long time). As one might imagine, a communicator might benefit from construing change positively only when guidance is changing.

4.2 Mechanisms underlying effects of forewarning and consistency

The abovementioned crossover pattern helps clarify how forewarning operates: it did not simply improve attitudes toward experts. Rather, the interaction suggests that other processes are at play, such as a reconstrual of change as "progress" rather than "flip-flopping". Additional processes are plausible, including perspective-taking with public health figures, though this mechanism seems to better account for positive effects of forewarning before inconsistency as opposed to negative effects of forewarning before consistency.

Just as our intervention might operate via multiple mechanisms, the problem it is designed to solve (i.e., negative effects of salient changes in recommendations) has multiple potential causes. As suggested by Rafkin and colleagues (2020), changes or inconsisten-

[30]In the Inconsistent condition, forewarning also reduced perceived bias (B = –0.32, SE = 0.13, p = .017) and increased rated usefulness (B = 0.42, SE = 0.16, p = .007) of public health authorities with regard to COVID-19 recommendations.

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cies in guidance indicate that the source has inaccurate information. Logically speaking, irreconcilable changes in guidance – for sake of argument, "Don't wear a mask" followed by "Do wear a mask" – indicate that at least one piece of guidance is incorrect. If newer guidance is seen as correct, then nonexperts might exhibit *hindsight bias* (Fischhoff, 1975), thinking they "knew it all along", or the *curse of knowledge* (Newton, 1990), failing to take into account what had been unknown when initial guidance was provided (see Redelmeier & Shafir, 2020 for discussion of biases related to the COVID-19 pandemic). Rather than considering contextual factors and knowledge gaps, one might attribute shifting guidance to lack of competence or to deceit.

The fact that initial guidance has any impact suggests that people are not ignoring the obsolete guidance altogether. This might be relevant to effects on reported COVID-19 protective behaviors: perhaps the reminder of older guidance, though theoretically overwritten, nonetheless affected people's impressions of the acceptability of certain behaviors. Models of dual attitudes (Wilson et al., 2000) suggest that previously held attitudes might not be replaced altogether by presently held ones. Perhaps even on a societal scale, the existence of older guidance might have persistent effects on citizens' gut reactions, albeit not necessarily behaviors that are thoughtful, for which the newer, relatively explicit attitude might be most influential (Wilson et al., 2000).

4.3 Limitations and future directions

4.3.1 Direction of change

In both Rafkin and colleagues' (2020) work and our own, the direction of COVID-19 message change was from lower to higher risk and precaution. This is in line with how knowledge and communications regarding COVID-19 have often progressed, though some changes, such as regarding fomite transmission (Centers for Disease Control and Prevention, 2020), have been in the direction of reduced risk and precaution. It is not clear whether changes from higher risk to lower risk would also diminish trust. On one hand, changes in recommendations might generally be aversive, or suggest deficient competence or honesty. On the other hand, "erring on the side of caution" earlier on (when less is known) and then loosening recommendations might be interpreted more charitably. In the face of conflicting experts, message sources have been found to be trusted more when recommending precaution as opposed to advocating for further engagement in the potentially risky behavior (Markon & Lemyre, 2013). However, these previous effects were small (not meeting standard thresholds for statistical significance) and examined conflicting experts rather than changes in guidance over time.

4.3.2 Is consistency helpful, change harmful, or both?

Because the Guidance condition did not include a control group, it is not clear whether consistency is beneficial, change is detrimental, or both. In addition to negative effects of inconsistency, there might be positive effects of consistency. For example, repetition of similar messages might lead to an *illusion of truth* (Hasher et al., 1977) and greater agreement with messages (Cacioppo & Petty, 1979). With further repetition, however, reactions might become negative due to counterargumentation or boredom (Cacioppo & Petty, 1979).

4.3.3 Moving beyond the lab and beyond COVID-19

As Rafkin and colleagues (2020) note, the COVID-19 pandemic is an optimal, but not necessarily representative, context for examining changing guidance. However, many phenomena that seem to underlie the present findings (e.g., aversion to inconsistency) have been examined in other contexts and may be generalizable. In any case, to ensure robustness, these principles should be examined in additional contexts in which guidance changes (e.g., screen time, diet, exercise).

Our findings are also limited by reliance on self-report. Rafkin and colleagues (2020) found that salient changes in guidance influenced participants' estimations in an incentivized task, which suggests that effects may hold for behavioral outcomes. Self-reported social distancing has been found to correlate with smartphone step counts (Gollwitzer et al., 2021), though anchoring can bias self-reports (Hansen et al., 2021). Vaccination intentions are at times dissociated from behavior, though interventions such as planning prompts (Milkman et al., 2011) can help translate intentions into action (for a review, see Brewer et al., 2017). Ultimately, consistency between attitudes and behaviors will likely depend on factors such as norms (Ajzen, 1991), attitude properties such as certainty (Krosnick & Petty, 1995), and aspects of the behavior such as deliberativeness (Fabrigar et al., 2010; Fazio, 1990).

4.4 Conclusion

Exposure to a virus cannot always be avoided. Thankfully, pre-emptive interventions such as inoculation can protect those who are exposed from experiencing significant harm. Likewise, exposure to changes in guidance might be inevitable, but a forewarning intervention can protect recipients from negative effects. To the extent that forewarning interventions encourage trust in experts and adherence to health-protective behaviors such as vaccination, these interventions, too, might protect the health of recipients and those around them.

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