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RESEARCH ARTICLE

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Belief in COVID-19 misinformation: Hopeful claims are rated as truer

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Abstract

Misinformation surrounding COVID-19 spread rapidly and widely, posing a significant threat to public health. Here, we examined whether some types of misinformation are more believable than others, to the extent that they offer people hope in uncertain times. An initial group of subjects rated a series of COVID-19 misinformation statements for whether each made them feel more or less hopeful (if true). Based on these ratings, we selected two sets of misinformation that differed in their average rated hopefulness; the two sets did not differ in word length or reading ease. In two studies, people rated their belief in each statement. Results from both studies revealed that people rated the more hopeful misinformation (e.g., COVID cures and prevention methods) as truer than less hopeful misinformation (e.g., transmission vectors). These findings are consistent with a motivated reasoning account of misinformation acceptance.

KEYWORDS
belief, COVID-19, hopefulness, misinformation

Before health agencies approved COVID-19 vaccines, COVID-19 prevention depended on behaviors such as wearing a mask, social distancing, and isolation. Public health campaigns attempted to convince people of the importance of such behaviors – but at the same time misinformation surrounding COVID-19 was widely and quickly disseminated. COVID-19 misinformation came in many forms, including but not limited to, conspiracy theories (e.g., "*COVID was created to be utilized as a bioweapon.*"), transmission pathways (e.g., "*You can get COVID-19 from packages shipped from China*"), prevention tips (e.g., "*High doses of Vitamin-C can prevent COVID-19*") and treatment suggestions (e.g., "*Antibiotics are effective for treating COVID-19*"). We took advantage of this natural infodemic to explore a motivational account for why some misleading claims might be more believable than others. Specifically, we examined whether belief in misinformation serves a possible psychological function, testing whether people are more likely to believe claims that instill hope during a difficult and uncertain time: the COVID-19 pandemic.

Understanding why people believe misinformation is important given that belief in some false beliefs can be linked to risky behaviors. For example, during the COVID-19 pandemic, belief in misinformation led some people to utilize toxic disinfectants like bleach for personal hygiene and food sanitation use (Joseph, 2020; Lee, 2020), and others to 'sterilize' their face masks by microwaving them, resulting in kitchen fires (Kenney, 2020; Lord, 2020). Such misinformation spread quickly, with most originating on the internet and circulating on social media platforms, such as Twitter, Facebook and WhatsApp (Al-Zaman, 2022). And yet, some misinformation appeared to "stick" more than others. For example, a national U.S survey from June of 2020 found that COVID-19 related conspiracy theories received more support compared to other forms of misinformation, such as medical misinformation regarding the transmission of or treatment for COVID-19 (Enders et al., 2020).

Past research offers some potential reasons as to why some people may believe COVID-19 misinformation. Some factors are cognitive in nature. For example, people are biased to believe that new incoming information is true (Brashier & Marsh, 2020; Ecker et al., 2022; Pantazi et al., 2018). People use ease of processing as a heuristic for truth, with the result that prior exposure to the misinformation increases belief in it, otherwise known as the *illusory truth effect* (Fazio et al., 2019; Hasher et al., 1977; Pan et al., 2021; Pennycook

et al., 2018; Unkelbach, 2007; Unkelbach et al., 2019). A failure to think analytically is also related to misinformation acceptance (*intuitive thinking*: Binnendyk & Pennycook, 2022; Ecker et al., 2022). Additionally, memory errors may also play a role in belief in misinformation, such as when people forget the source of misinformation (Ecker et al., 2022; Lewandowsky et al., 2012; see Marsh & Yang, 2021 for a discussion of the role of source information in misinformation acceptance). Finally, people may forget counter-evidence that disproves the claim (Lewandowsky & Van Der Linden, 2021).

Beyond cognitive factors, it is well known that motivations influence cognitions (Gordon et al., 2005; Krizan & Windschitl, 2007, 2009; Kunda, 1987, 1990; Nickerson, 1998). People have a natural tendency to selectively seek out and favorably evaluate information that support their desires, and dismiss information that is incongruent with their desired beliefs (Kunda, 1987, 1990; Nickerson, 1998). People often engage in *wishful thinking*, meaning they are likely to believe in outcomes that they desire to be true (Barber et al., 2009; Krizan & Windschitl, 2007, 2009) and downplay how convincing a claim is if the outcome is undesirable for them (Kunda, 1987; but see Krizan & Windschitl, 2009; Van Dijk et al., 2003).

To date, some evidence for a motivated reasoning account of misinformation acceptance comes from data showing that conservatives are more susceptible to misinformation about coronavirus than are liberals (Calvillo et al., 2020; Havey 2020; Jamieson & Albarracin, 2020). Of course, both conservatives and liberals are susceptible to motivated reasoning. For example, in one study, two thirds of participants gave up a chance to win additional money to avoid hearing the other political party's positions on issues pertaining to same-sex marriage, elections, marijuana, climate change, guns, and abortion (Frimer et al., 2017). Similarly, another study found that both liberals and conservatives interpreted a study's results to be consistent with their own attitudes, and denied the correct interpretation of the results when it conflicted with their existing beliefs (Washburn & Skitka, 2018). This work has only extended into the domain of misinformation relatively recently, with that, the particular misinformation circulating (i.e., the 2020 election, coronavirus, etc.) may fit with a conservative worldview – but we would make similar predictions for liberals if the topics were different. The misinformation research that exists currently shows that conservatives were more likely to share misinformation about the 2016 presidential election on Facebook, although overall sharing was low (Guess et al., 2019). In another study, conservatism was associated with greater difficulty differentiating misinformation from facts (Calvillo et al., 2020).

Here, we examine another motivational factor that may affect acceptance of COVID-19 misinformation: ***hope***. Hope is an emotional response that can be experienced by all people, regardless of factors like age and political affiliation. In two studies, we explored if hope was a motivating factor behind misinformation acceptance during the early stages of the COVID-19 pandemic. That is, we aimed to determine if COVID-19 misinformation that inspired feelings of hope (especially during uncertain and challenging time) was more likely to be believed. The misinformation we focus on here is not clearly positive or negative; all COVID-19 misinformation likely induces negative emotion as the topic of the pandemic is negative for most people. Rather, our focus is on people's emotional response to that misinformation; and whether misinformation that may offer a ray of positivity is more likely to be believed in comparison to misinformation what may foster a wealth of negativity.

To explore whether people are more likely to believe misinformation that provides a sense of hope, we first conducted extensive pre-testing to identify COVID-19 misinformation that was (1) believable, and (2) could be classified as more or less hopeful. When referring to misinformation we are referring to false and inaccurate information, regardless of whether that information was disseminated intentionally (with malice) or not. We used the pre-testing data to select two sets of misinformation that varied in whether the statements inspired hope. For example, hopeful misinformation included misinformation that suggested ways to proactively deal with the pandemic (e.g., "*High doses of Vitamin-C can help prevent COVID-19*"), whereas less hopeful misinformation included misinformation that did not suggest any solution to the pandemic (e.g., "*The coronavirus was man-made to be utilized as a bioweapon*").

After pre-testing was conducted to determine our final set of stimuli, in two separate studies we tested whether misinformation that sparks feelings of hope is more likely to be accepted as true. To preface, in both Study 1 and Study 2, people rated hopeful COVID-19 misinformation (e.g., cures and prevention methods) as truer than less hopeful misinformation (e.g., transmission vectors), which is consistent with a motivated reasoning account of misinformation acceptance.

When testing for belief in hopeful versus less hopeful misinformation, we included other standard measures that might predict belief in COVID-19 misinformation. Considering prior studies found a relationship between political orientation and belief in misinformation (Guess et al., 2019; pre-print from Harper & Baguley, 2019), including COVID-19 misinformation (Calvillo et al., 2020), we included a measure of political orientation in our studies. We also included measures of anxiety, although we note here the predictions are less clear for this measure than for political orientation. That is, anxiety might predict belief in hopeful misinformation, which would be consistent with a wishful thinking account, but on the other hand, anxious individuals might be anxious because they believe less hopeful misinformation. Similarly, predictions were unclear for how COVID-19 related life disruption (how much the COVID-19 pandemic disrupted a person's life, as measured in Study 2) may play a role in belief. That is, disruption could increase wishful thinking or possibly induce a negativity bias. We included these measures as covariates to ensure they were not somehow related to the hopefulness of misinformation. To preface, in both studies political orientation, specifically conservatism, was predictive of belief in misinformation – but not of a bias towards hopeful misinformation (over less hopeful misinformation). This bias held after controlling for other possible factors like anxiety.

The main goal of this set of studies was to examine wishful thinking in a real-world context. Researchers have speculated that wishful thinking will be more powerful when people are justifying real-world outcomes, as compared to the types of outcomes typically studied in

experiments (i.e., small monetary incentives, Krizan & Windschitl, 2009). Our study provides a real-world test of this prediction; we tested how people evaluated truth of COVID-19 specific misinformation that circulated during the beginning of the pandemic.

1 | STUDY 1

1.1 | Method and materials

1.1.1 | Pre-testing of materials

Our COVID-19 stimuli were taken from various social media sources (e.g., Twitter, Facebook, Instagram, Tik Tok), and were debunked by various well-known debunking platforms, including PolitiFact, FactCheck.org, and Snopes, as well as by government agencies, such as the Center for Disease Control and Prevention (CDC), the National Institutes of Health (NIH), and the World Health Organization (WHO). We conducted three pre-tests of our stimuli with separate samples of participants on Amazon Mechanical Turk (MTurk). Two pre-tests were run to ensure the selection of ambiguous statements (in terms of truth value) at different points in time. The other pre-test was designed to measure the hopefulness of each statement, to allow the selection of more vs. less hopeful misleading statements. All participants in the pre-tests were American residents (same population as in the studies) with at least 500 completed tasks (HITS) and an approval rating greater than 99%.

The first pre-test measured the believability of various COVID-19 statements, including both true statements ($n = 18$) and misinformation ($n = 45$), with the goal of selecting ambiguous items. True statements were considered filler items and were included to conceal the aim of our study. This pre-test was run on April 24th, 2020, which was 44 days after the WHO declared COVID-19 to be an international pandemic. Participants ($N = 69$, after excluding 11 participants for failing at least one of the attention checks) read 63 different COVID-19 statements (true and false), one at a time in a random order. For each statement presented, participants answered two questions. They indicated if they had heard the statement prior to participating in the study (selecting "*Yes*," "*No*", or "*I am not sure*"), and judged how truthful each statement was on a 6-point Likert-type scale from 1 (*definitely false)* to 6 (*definitely true*).

The second pre-test was conducted to classify COVID-19 statements as either more or less hopeful. The statements included 62 statements (18 true and 44 false) from pre-test 1 as well as 21 additional false statements to increase the number of potential stimuli. This pre-test was run on May 1st, 2020, which was 51 days after the WHO declared COVID-19 an international pandemic. Participants ($N = 74$, after excluding 6 participants for failing at least one of the attention checks) were shown the following instructions:

> "*In the second part of this study you will be shown statements about COVID-19 (coronavirus). Some of the statements you will see are* ***true*** *and some are* ***false****. Regardless of whether you believe each statement is true or false in reality, please rate how* ***hopeful*** *each statement would make you feel* ***if it were to be true,*** *from 1 (not at all hopeful) to 6 (extremely hopeful). You can select any number from 1 to 6 in accordance with how you feel. You will also indicate whether or not you have* ***heard the information prior to participation in this study***".

For each of the 83 statements, participants answered two questions: they indicated if they had heard the statement prior to participating in the study, selecting "*Yes*," "*No*", or "*I am not sure*", and judged how hopeful each statement was on a 6-point Likert-type scale from 1 (*not at all hopeful)* to 6 (*extremely hopeful*). At the end of the study, participants were asked to explain how they determined how hopeful a statement was (open-ended response).

A final pretest involved collecting additional truth ratings, for two reasons. First, truth ratings were needed for new statements; there were 21 misinformation claims that were rated for hopefulness (in the second pre-test) that had not been included in the initial truth pretest (the first pre-test). Second, we re-tested items from pre-test 1 to ensure their truth values had not changed drastically over time. We re-tested the truth value of 26 false claims from the first pre-test that less than 60% of people reported having heard before. Thus, participants in pre-test 3 ($N = 69$, after excluding 11 participants for failing at least one of the attention checks) read 65 different COVID-19 statements (18 true statements and 47 false statements) one at a time in a randomized order and rated each on its truth value. This pre-test was run on May 5th, 2020, which was 55 days after the WHO declared COVID-19 to be an international pandemic and 11 days after the first pre-test.

1.1.2 | Stimuli used in experiments

The final stimuli were selected to include 13 hopeful misinformation statements, 13 less hopeful misinformation statements and 13 true statements (see Table 1). Table 2 shows all true/filler statements used in our studies. Statements were selected to be of ambiguous truth value; we removed statements that more than 50% of people had heard before, as well as statements rated with a truth value below 1.85 on average. Final statements were selected to elicit more or less feelings of hopefulness. Less hopeful statements had an average hopefulness rating of 1.41 on a 6-point Likert scale from 1 (*not at all hopeful*) to 6 (*extremely hopeful*), while hopeful statements had an average hopefulness rating of 4.34. More and less hopeful misleading statements did not significantly differ as a function of word length ($M_{\text{LessHopeful}} = 13.85$, $SD_{\text{LessHopeful}} = 3.26$; $M_{\text{Hopeful}} = 16.85$, $SD_{\text{Hopeful}} = 5.31$; $t(24) = -1.74$, $p = .07$), grade level ($M_{\text{LessHopeful}} = 10.13$, $SD_{\text{LessHopeful}} = 4.10$; $M_{\text{Hopeful}} = 9.22$, $SD_{\text{Hopeful}} = 3.43$; $t(24) = 0.61$, $p = .53$), or reading ease ($M_{\text{LessHopeful}} = 46.04$, $SD_{\text{LessHopeful}} = 25.98$; $M_{\text{Hopeful}} = 57.18$, $SD_{\text{Hopeful}} = 20.15$; $t(24) = -1.22$, $p = .35$), as indicated by independent-samples *t*-tests.

TABLE 1 Final set of statements used in Studies 1 and 2 with descriptive statistics for hopefulness judgments (as measured in the second pre-test)

	Hopefulness	
	M	*SD*
Less hopeful misinformation		
Mosquitoes can transmit the coronavirus (COVID-19).	1.15	0.46
The United States is currently developing an anti-virus chip that will track your location.	1.74	1.19
Genetically modified organisms have caused genetic pollution that allow COVID-19 to proliferate due to this environmental imbalance.	1.47	1.16
COVID-19 is an artificially engineered recombination of HIV, SARS, and the flu developed in China.	1.20	0.78
The COVID-19 pandemic is being used to institute martial law in the United States.	1.30	0.84
You can get COVID-19 from any package shipped from China.	1.26	0.60
COVID-19 has been found in poultry (e.g., raw chicken).	1.32	0.91
The virus has mostly ravaged countries that span the 40th parallel in latitude.	1.82	1.01
The Coronavirus Aid, Relief, and Economic Security Act (CARES) passed by congress gives all congress members a pay increase.	1.43	1.05
The healthcare industry is profiting from our surplus demand of handsoap and ventilators.	1.59	1.12
The coronavirus (COVID-19) can live on surfaces for up to 17 days.	1.20	0.62
COVID-19 can be transmitted through food (such as, vegetables at the grocery store).	1.36	1.07
Parents of children infected with COVID-19 cannot stay with their child in the hospital.	1.53	0.97
Hopeful misinformation		
The US Navy is rescuing children trafficked by the deep state on the USNS Hospital Ship Comfort docked in NYC.	3.74	1.97
High doses of Vitamin C can be used to treat COVID-19.	5.03	1.18
Vaccines against pneumonia (such as the pneumococcal vaccine and Haemophilus influenzae type B (Hib) vaccine) can help provide protection against COVID-19.	4.64	1.50
Anyone who wants to be tested for COVID-19 can be tested.	5.23	1.19
Thermal scanners are effective in determining if someone has COVID-19.	4.47	1.37
Placing your mail/packages in direct sunlight can kill off any potential traces of COVID-19 that may be on your package.	4.57	1.45
Shaving your beard can help prevent COVID-19 infection.	3.49	1.66
The United States has tested more people for COVID-19 than every other country combined.	4.26	1.63
Before reusing a disposable face mask, you can sterilize the mask by steaming it at 212 degrees Fahrenheit (boiling point of water) for at least 10 min.	3.45	1.54
Passengers at airports and train stations are being tested for COVID-19 before and after getting on the planes and trains.	4.49	1.42
There is a 1–800 number you can call to track your stimulus payment.	3.89	1.55
If you donate blood, blood donation centers have to test you for COVID-19 free of charge.	4.11	1.61
Companies are giving out free baby formula to parents in need of assistance during the current pandemic.	5.08	1.26

Note: Hopefulness judgments were made on a 6-pt Likert-type scale (1 = *not at all hopeful*, 6 = *extremely hopeful*).

1.1.3 | Participants

A total of 200 American residents with at least 500 completed HITS and an approval rating greater than or equal to 99% voluntarily participated in this study on MTurk for monetary compensation. Nine participants were excluded from analyses, seven of which failed at least one of the attention check questions and an additional two participants self-reported that they had cheated and/or were distracted during participation. Results were analyzed using the remaining 191 participants. The Duke University Campus Institutional Review Board approved all studies reported in this manuscript.

1.1.4 | Method

After providing informed consent, participants completed demographic questions regarding their age (M_{age} = 39 years, *SD* = 12.21; $range_{age}$ = [21,76]), gender (61.8% male), race (72.8% White), education level, political affiliation (categorized by identifying as a member of a specific political party), political orientation [rated on a Likert-scale from 1 (*strongly liberal*) to 7 (*strongly conservative*)], current employment status, pre-pandemic employment status, residential state, household and personal incomes, and the amount of people living in their home. The two employment questions were included so that we could understand the hopefulness bias as a function of having

TABLE 2 True/filler statements used in Studies 1 and 2

One in every five infected individuals need hospital care.
Spectrum Internet is providing free internet to students during coronavirus school closures.
You are more likely to catch the coronavirus by standing next to an infected person than by touching an infected surface.
Animals can become infected with the virus that causes COVID-19 after having contact with a person with COVID-19.
The virus can be detected in the air for up to 3 hours.
Non-alcohol based hand sanitizers are ineffective for COVID-19 prevention.
The virus can live on plastic for up to 72 hours.
Many hotels are offering free hotel rooms for first responders during the pandemic.
The virus that caused COVID-19 is related to the virus that caused SARS (2003; Severe Acute Respiratory Syndrome).
It will take at least 1 year for a vaccine to become available to the public.
Washing your hands with soap and water should be preferred over using hand-sanitizer for effective COVID-19 prevention.
The United States has a shortage of Personal Protective Equipment (PPE) for healthcare workers.
All 50 US states have reported cases of COVID-19.

lost one's job during the pandemic; however, this analysis was not possible as only 14 (7.3%) people fit that description in our sample. We asked about residential state as we originally hoped to use this information to determine the level of severity of COVID-19 at the local level, but this geographical measure was too coarse to be useful (i.e., COVID-19 rates differed dramatically in New York City and upstate New York). Table 3 shows descriptive statistics for each variable.

Participants also completed an attention check question (*"Who is the current president of the United States?"*); those that answered incorrectly were excluded from data analyses) and the State–Trait Anxiety Inventory (STAI; Spielberger et al., 1983). For the state anxiety portion of the STAI, participants were asked to consider their feelings as they related to COVID-19 and the current pandemic. Participants receive the following instructions on this task:

> *On March 11th, 2020, the World Health Organization (WHO) declared the coronavirus outbreak a pandemic. Lives all around the world were impacted by COVID-19. We want to know how you are feeling about the current coronavirus pandemic. In this part of the study, you will see a number of statements that people have used to describe their feelings. For each statement presented, please indicate how representative the statement is of* ***how you feel about the coronavirus (COVID-19) pandemic*** *at the current moment, from not at all to very much so. It is important that you know that there are no "right" or "wrong" answers. People are different, and we are interested in how you personally feel.*

After completing the STAI and demographic information, participants were given the following instructions:

> *In the next part of this study, you will be shown statements about COVID-19 (coronavirus). Your task will be to rate how* ***truthful*** *you think the statements are from 1 (definitely false) to 6 (definitely true). You will also indicate whether or not you have* ***heard the information prior to participation in this study****. **Please do* ***NOT*** *use any outside sources (for example: other people, the internet, or social media) to look up whether these statements are true or false. Please just do your personal best on the task. It is perfectly okay to not know whether the statements are true or false and we do not expect that you have encountered all statements.*

Participants were explicitly instructed to avoid using outside sources (e.g., other people, the internet); that is, not to look up whether the statements were true or false. We tested participants on these instructions prior to the truth rating task with the following true or false question: "*Your job is to rate how truthful each statement is*". Participants who failed this instructional check were excluded from analyses. All participants were given feedback as to the correct answer to the instructional check question. Participants were also presented with a practice item (unrelated to COVID-19; "*Sea otters hold hands when they sleep to keep them from drifting apart*") to ensure they understood the rating scale. In the truth judgment task, the 39 statements (13 hopeful, 13 less hopeful and 13 true statements) were presented one at a time in a randomized order. For each statement, participants indicated if they had heard the statement prior to participating in the study (selecting "*Yes*," "*No*", or "*I am not sure*") and judged how truthful each statement was on a 6-point Likert-type scale from 1 (*definitely false)* to 6 (*definitely true*). Finally, participants answered the following free-response question: "*How did you decide if the statements were true or false? It is okay if you do not know*".

At the end of the study, participants completed two additional questions designed to identify poor data. The first question addressed cheating: "*Please be honest when answering the following question. Your answer will not affect your payment or eligibility for future studies. During this study you were asked to rate how true statements about COVID-19 were. Did you look up if a statement was true using any OUTSIDE sources (e.g., the internet or other people)?*" Participants responded with one of the following: (1) *Yes – I used outside sources to answer questions*, or (2) *No – I did NOT use any outside sources to answer questions*. Only those participants who selected (2) were included in analyses. The second question addressed the participant's level of attention during the study:"*Please be honest when answering the following question. Your answer will not affect your payment or eligibility for future studies. The study you have just participated in is a psychological study aimed at understanding human cognition and behavior. Psychological research depends on participants like you. Your responses to surveys like this one are an incredibly valuable source for data for researchers. It is therefore crucial for researchers' participants pay attention, avoid distractions, and*

TABLE 3 Summary descriptive statistics (mean and standard deviation or number and percent) for Study 1 & Study 2

	Study 1 ($N = 191$)		Study 2 ($N = 236$)	
Variable	***M* or *N***	**% or STD**	***M* or *N***	**% or STD**
Age (years)	39.37	12.21	37.68	11.6
Gender				
Male	118	61.8%	134	56.8%
Female	72	37.7%	98	41.5%
Other	1	0.5%	4	1.6%
Race				
White	139	72.8%	162	68.6%
Hispanic or Latino	9	4.7%	12	5.1%
Black or African American	12	6.3%	19	8.1%
Native American or American Indian	1	0.5%	2	0.8%
Asian or Pacific Islander	26	13.6%	38	16.1%
Other	4	2.1%	2	0.8%
Not reported	0	0.0%	1	0.4%
Education				
Some formal schooling	0	0.0%	0	0.0%
High school diploma or G.E.D.	22	11.5%	20	8.5%
Completion of some college courses	33	17.3%	29	12.3%
Associate's degree	19	9.9%	28	11.9%
Bachelor's degree	91	47.6%	113	47.9%
Master's degree	21	11.0%	37	15.7%
Doctorate Degree	5	2.6%	9	3.8%
Political affiliation				
Republican	44	23.0%	58	24.6%
Democrat	85	44.5%	114	48.3%
Libertarian	7	3.7%	6	2.5%
Independent	51	26.7%	52	22.0%
Other	4	2.1%	6	2.5%
Political orientation[a]	3.50	1.72	3.50	1.83
Change in employment status[b]	14	7.3%	--	--
Lost job[c]	--	--	22	9.3%
Lost work hours[d]	--	--	64	27.1%
Pay cut[e]	--	--	47	19.9%
Trait anxiety[f]	41.47	14.55	--	--
State anxiety[f]	46.87	14.99	49.52	14.1
Disruption[g]	--	--	4.71	1.50

Note: Study 1 $N = 191$; Study 2 $N = 236$; STD = Standard deviation.
[a]Political Orientation = measured on a Likert-scale from 1 (*strongly liberal*) to 7 (*strongly conservative*);
[b]Change in Employment Status = how many subjects reported a change to their employment status during COVID-19 pandemic;
[c]Lost Job = how many subjects reported that they lost job during COVID-19 pandemic;
[d]Lost Work Hours = how many subjects reported that they lost work hours because of COVID-19 pandemic;
[e]Pay Cut = how many subjects reported that they took a pay cut during COVID-19 pandemic;
[f]State Trait Anxiety Inventory (STAI) = comprised of two subscales that measure both state anxiety and trait anxiety. Scores on both subscales can range from 20–80 with higher scores indicating greater levels of either state or trait anxiety;
[g]Disruption = measured much the COVID-19 pandemic disrupted daily life on Likert-scale from 1 (*not at all*) to 7 (*very much so*).

take all study tasks seriously (even when they might seem silly). Do you feel that you paid attention, avoided distraction, and took this survey seriously?" Participants responded with one of the following: (1) *No, I was distracted*; (2) *No, I had trouble paying attention*; (3) *No, I did not take the study seriously*; (4) *No, something else affected my participation negatively*; or (5) *Yes*. Only participants that responded with (5) were included in our analyses. Upon completion of the study, participants were monetarily compensated for their time.

2 | RESULTS

Overall, people who believed in one form of misinformation were also more likely to believe in the other. That is, truth ratings of hopeful and less hopeful misinformation were significantly correlated, $r = .62$, $p < .001$. Consistent with a motivated reasoning account, a paired-samples t-test revealed a significant difference in truth ratings between hopeful and less hopeful misinformation, $t_{190} = 7.05$, $p < .001$. Individuals rated hopeful misinformation as truer ($M = 2.86$, $SD = 0.73$) than less hopeful misinformation ($M = 2.53$, $SD = 0.74$) (Figure 1). On average, more hopeful misinformation was rated almost a third of a point higher than less hopeful misinformation (95% CI [0.24, 0.42]). The effect size observed in Study 1 was 0.64 (95% CI [0.36, 0.66]), which can be classified as a medium effect size. The mean truth ratings across all true/filler statements in Study 1 was 4.35 with a standard deviation of 0.54.

To examine how many subjects showed the effect, we calculated a *hopefulness bias* by subtracting the individual's average rating of less hopeful statements from their average rating of hopeful statements. A positive difference score was coded as a bias towards hopefulness, negative scores indicated a bias towards less hopeful misinformation. A score of zero meant that participants did not show a bias in either direction. By these criteria, 65.97% of the subjects displayed a hopefulness bias – the effect was present in more than half of the subjects, but not all subjects.

We re-analyzed the data treating the hopefulness of misinformation as a within-subjects factor and adding political orientation (measured on a 7 point scale) and the two anxiety measures (state and trait) as covariates in the model. People were more likely to believe hopeful misinformation over less hopeful misinformation, $F(1, 187) = 11.56$, $MSE = 0.20$, $p = .001$. Replicating past findings, political orientation predicted belief in misinformation, $F(1, 187) = 35.0$, $MSE = 0.74$, $p < .01$. That is, participants identifying as more conservative on the political orientation scale rated misinformation as truer on average than the more liberal participants did, $r = .38$, $p < .001$. Participants higher in trait anxiety also reported greater belief in misinformation, $F(1, 187) = 4.17$, $MSE = 0.74$, $p < .05$. However, the critical interactions were not significant. The bias towards believing hopeful (over less hopeful) misinformation did not vary as a function of political orientation, $F < 1$, state anxiety ($F < 1$) or trait anxiety, $F(1,187) = 1.89$, $MSE = 0.36$, $p > .18$. Study 2 was almost identical to Study 1 and was designed to replicate the findings of Study 1. In this study we only focused on pandemic-related anxiety (state-anxiety) and removed the measure of trait anxiety. We also added a few questions regarding the impact of the COVID-19 pandemic on individuals. Study 2 was run 10 days after Study 1 and 68 days after the WHO declared that COVID-19 was an international pandemic.

2.1 | Method and materials

2.1.1 | Participants

A total of 250 American residents with at least 500 completed HITS and an approval rating greater than or equal to 99% voluntarily participated in this study on MTurk for monetary compensation. Fourteen participants were excluded from analyses, eight of which failed at least one of the attention check questions, four of which self-reported cheating, and two of which self-reported being distracted during the study. Results were analyzed using the remaining 236 participants ($M_{age} = 38$ years, $SD = 11.16$, $range_{age} = [19, 69]$, 56.8% males, 41.5% female, 1.6% other). Please refer to Table 3 for full breakdown of each study variable.

2.1.2 | Materials

The materials used in Study 2 were identical to Study 1, with the addition of four questions regarding how COVID-19 had impacted them

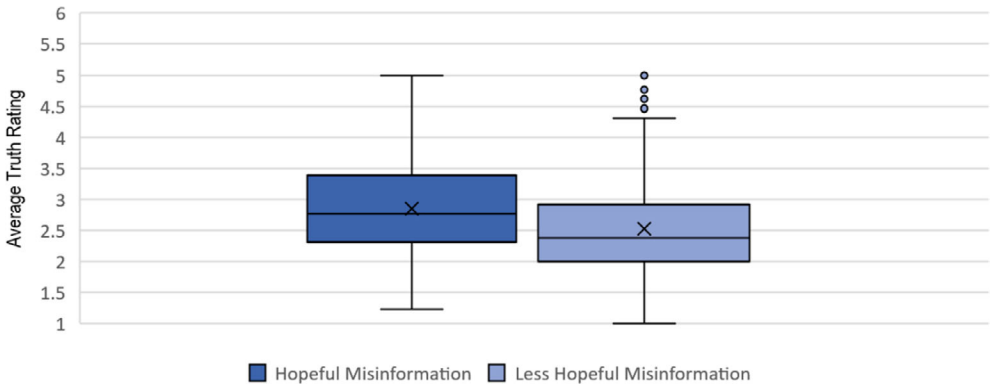

FIGURE 1 Average truth ratings of hopeful v. less hopeful COVID-19 misinformation in Study 1. *Note*: Box and whisker plot representing average truth ratings split up by type of misinformation (hopeful vs. less hopeful). The average truth ratings for each type of misinformation are represented with the black X's and the circles represent outliers.

personally: (1) "*Have you lost your job during the pandemic?*", (2) "*Have you lost work hours because of the COVID-19 pandemic? (i.e., went from working full-time to part-time)*", (3) "*Have you taken a pay cut during the COVID-19 pandemic?*", and (4) "*How much has the coronavirus pandemic disrupted your daily life?*". Additionally, participants also only completed the state anxiety portion of STAI (the degree of anxiety as it relates to COVID-19) as here we were primarily concerned with role of state anxiety as it relates to COVID-19 on COVID-19 misinformation acceptance. The same 26 statements (13 hopeful and 13 less hopeful) from Study 1 were used in Study 2.

2.1.3 | Method

The procedure of Study 2 was nearly identically to Study 1. However, after participants answered demographic questions and the first attention check question, participants answered four questions regarding how COVID-19 has disrupted their life. The rest of Study 2 was identical to Study 1.

3 | RESULTS

As in Study 1, people who believed in one form of misinformation were also more likely to believe in the other; that is, truth ratings of hopeful and less hopeful misinformation were significantly correlated, $r = .68$ $p < .001$. Replicating the pattern observed in Study 1, a paired-samples t-test revealed a significant average difference in truth ratings between hopeful and less hopeful misinformation, $t_{235} = 9.47$, $p < .001$. Individuals in Study 2 rated hopeful misinformation as truer ($M = 2.96$, $SD = 0.70$) than less hopeful misinformation ($M = 2.59$, $SD = 0.77$) (Figure 2). The difference was about a third of a point (95% CI [0.29, 0.44]). Overall, 72.46% of subjects displayed a hopefulness bias, meaning they displayed a bias towards believing hopeful misinformation as opposed to less hopeful misinformation. The effect size observed in Study 2 0.59 (95% CI [0.48, 0.76]), which could be classified as a medium effect size. The mean truth rating across all true true/filler statements in Study 2 was 4.49 with a standard deviation of 0.51.

This bias towards believing hopeful misinformation held even after including political orientation, state anxiety, and self-reported disruption as covariates in the model. People were more likely to believe hopeful misinformation over less hopeful misinformation, F (1, 232) = 4.75, $MSE = 0.17$, $p = .03$. Replicating past findings (and study 1), political orientation predicted belief in misinformation, $F(1, 232) = 22.65$, $MSE = 0.82$, $p < .001$. Conservatism was associated with higher average truth ratings for the misinformation, $r = .30$. However, political orientation did not interact with the bias towards hopeful misinformation, $F < 1$. State anxiety did not predict susceptibility to misinformation ($F < 1$), and this finding did not depend upon whether the misinformation was more or less hopeful, $F(1,232) = 2.32$, $MSE = .17$, $p > .12$. Additionally, disruption did not have an overall effect on misinformation susceptibility, $F(1, 232) = 1.03$, $MSE = .85$, $p > .30$, but did interact with the bias towards hopeful misinformation, F (1. 232) = 5.72, $p < .02$. Numerically the hopefulness bias was stronger for people experiencing lower levels of disruption; however, no strong conclusions can be drawn as very few people reported experiencing little disruption in their lives (i.e., only four people selected "*1 – not at all*" on the disruption scale when asked how much the COVID-19 pandemic has disrupted their daily life).

4 | DISCUSSION

We investigated whether misinformation is more believable to the extent that it offers people hope in uncertain times, operationalized here as during the COVID-19 pandemic. In two studies, we found evidence that people rated hopeful misinformation (e.g., "*High doses of Vitamin C can be used to treat COVID-19*") as truer than less hopeful misinformation (e.g., "*COVID-19 can be transmitted through food*"). The effect size observed in Study 1 was 0.64 (95% CI [0.36, 0.66]) and was 0.59 (95% CI [0.48, 0.76]) in Study 2; both can be classified as medium effect sizes. And even these effect sizes may be underestimates, to the extent that subjects may have been in negative moods, which might eliminate a hopefulness bias. Furthermore, the majority of subjects showed a hopefulness bias: 66% of subjects in Study 1 and 73% of subjects in Study 2 rated hopeful COVID-19 misinformation as truer than less hopeful misinformation.

Although material comparisons must always be made with caution, the two types of statements did not significantly differ in basic linguistic features (i.e., word length, grade level, readability). Of course, the difficulty with material comparisons is that there are always other possible

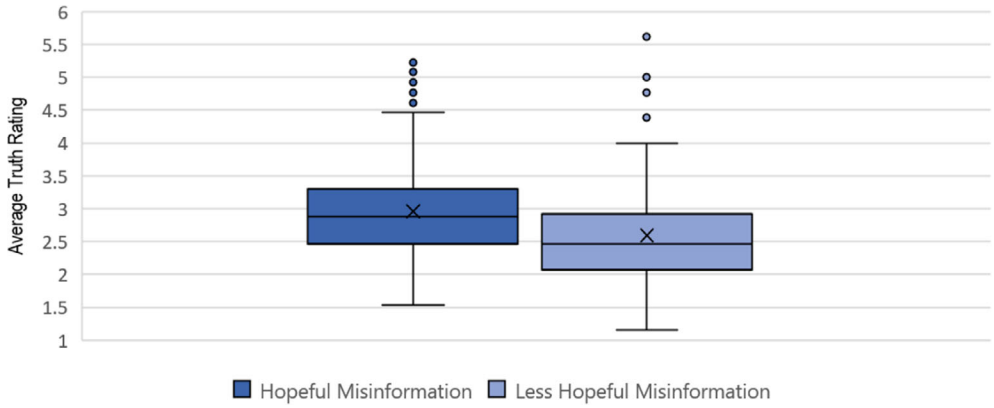

FIGURE 2 Average truth ratings of hopeful v. less hopeful COVID-19 misinformation in Study 2. *Note*: Box and whisker plot representing average truth ratings split up by type of misinformation (hopeful vs. less hopeful). The average truth ratings for each type of misinformation are represented with the black X's and the circles represent outliers.

dimensions that might differ across stimuli, which were not measured or controlled for. For example, some of our items may be seen as more plausible than others. For example, the idea that companies were giving out free baby formula to parents during the pandemic was likely more plausible than the idea that the US was developing an anti-virus chip that could track your location. Unfortunately, we cannot test this possibility as we did not collect plausibility data when we normed our stimuli (and retrospective ratings would reflect the realities of 2022, not the early days of the pandemic). It is also possible that hopeful items may also have had a greater link to prior knowledge (i.e., people know more about baby formula than microchips). Greater knowledge would allow people to elaborate upon the misinformation, with consequences for what is learned and remembered. Another possibility is that "hopefulness" is really a stand-in for the positivity vs. negativity felt when reading the sentence. A recent study showed that misinformation centered around "conspiracy" and "virus characteristics and numbers" elicited more negative emotion and misinformation centered around "cures, prevention, and treatment" elicited more positive emotions (Charquero-Ballester et al., 2021). These items are similar to ours, suggesting that the positivity of one's feelings may have played a role in the results. More generally, research has shown an association between positivity and truth (Brashier & Marsh, 2020; Forgas, 2019; Unkelbach et al., 2011) within a person, and has shown a small but significant correlation between how positively a statement is rated to be and how true it seems to be (Unkelbach et al., 2011). Also, positive moods increase people's belief in claims (Forgas & East, 2008; Koch & Forgas, 2012) whereas negative moods encourage skepticism (Forgas, 2019; Koch & Forgas, 2012).

However, regardless of whether the driving factor is labeled as "hope" or "positivity", the results are consistent with a motivated reasoning account: when evaluating ambiguous information, people are more likely to believe misinformation that allows for optimism (or more positive or hopeful feelings) about a difficult situation. We do not have a direct measure of people's motivations to believe the misinformation in our study; however, we feel comfortable asserting that the pandemic caused major disruptions in most Americans' lives, especially considering in Study 2 participants reported a mean score of 4.71 [on a Likert-scale from 1 (*not at all*) – 7 (*very much so*)] when asked how much the COVID-19 pandemic has disrupted their daily life ($N = 236$, $SD = 1.50$). Additionally, we also included a few measures that we believed might have stood in for motivation – for example, we thought highly anxious people might be more motivated to believe in hopeful misinformation – but the predictions were unclear, given that anxiety can also lead to a negativity bias.

Past research on the relationship between feelings and truth is limited in that most of the materials used are unlikely to elicit strong feelings. For example, Unkelbach et al. (2011) had participants judge statistical claims that were unlikely to elicit personal responses, such as "*Each year 100 people succeed (die) attempting to climb the 6163m of Mount Chunasla*". Our goal with using COVID-19 misinformation was to make the information personally relevant; however, we did not have a direct measure of personal relevance in Study 1 (as the subject's residential state was too coarse of a measure to estimate experienced severity). However, in Study 2 we attempted to understand the role of personal relevance by asking people to rate how much the COVID-19 pandemic had disrupted their lives on a 1 (*not at all*) to 7 (*very much so*) scale. While the data suggested that people who reported more disruption showed less of a hopefulness bias, no strong conclusion can be drawn as very few people reported that COVID-19 did not disrupt their life at the point in which they participated in our study (i.e., less than 2% of the sample reported no disruption (score of 1) from COVID-19).

One question is how our findings (and the other findings about positivity) fit with findings about the appeal of conspiracy theories. Much research shows that people do not like when the world appears random or chaotic (Lerner, 1980; Kruglanski, 1989). Conspiracy theories about the origin of the pandemic are one way to reduce the seeming randomness of the pandemic, especially for people who feel civic structures have failed them (Swami et al., 2016). At least some of the conspiracy theories circulating would be classified as "less hopeful misinformation", and thus belief in them may appear inconsistent with our results – but most of our items are not relevant to conspiracy theories. Furthermore, although the bias was impressive in size and occurred in the majority of subjects, a minority of subjects in each study did not show the bias (34% in study 1 and 27% in study 2) – allowing the possibility that our sample included a few conspiracy adherents who did not show the bias.

5 | CONCLUSION

In summary, our studies support a motivated reasoning account for misinformation acceptance during the COVID-19 pandemic and infodemic. That is, individuals may be motivated to believe in misinformation that fosters a feeling of hopefulness, especially in uncertain and difficult times such as the COVID-19 pandemic. Advertisers and companies have long known that hope can increase people's motivation to purchase a product, such as using diet pills to lose weight fast. Here we show a similar effect but with public health misinformation: misinformation that promotes hope is associated with greater belief in that misinformation.

CONFLICT OF INTEREST

The authors declared that they have no competing interests with respect to the publication of this article.

DATA AVAILABILITY STATEMENT

De-identified data and stimuli from the studies reported in the article are publicly available on OSF (https://osf.io/k5r68/).

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