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Hartman, T.K., Marshall, M., Stocks, T.V.A. et al. (2021) Different conspiracy theories have different psychological and social determinants : comparison of three theories about the origins of the COVID-19 virus in a representative sample of the UK population. *Frontiers in Political Science*, 3. 642510.

<https://doi.org/10.3389/fpos.2021.642510>

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Different Conspiracy Theories Have Different Psychological and Social Determinants: Comparison of Three Theories About the Origins of the COVID-19 Virus in a Representative Sample of the UK Population

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OPEN ACCESS

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Specialty section:

This article was submitted to
Political Participation,
a section of the journal
Frontiers in Political Science

Received: 16 December 2020

Accepted: 20 April 2021

Published: 02 June 2021

Citation:

Hartman TK, Marshall M, Stocks TVA, McKay R, Bennett K, Butter S, Gibson Miller J, Hyland P, Levita L, Martinez AP, Mason L, McBride O, Murphy J, Shevlin M, Vallières F and Bentall RP (2021) Different Conspiracy Theories Have Different Psychological and Social Determinants: Comparison of Three Theories About the Origins of the COVID-19 Virus in a Representative Sample of the UK Population. *Front. Polit. Sci.* 3:642510. doi: 10.3389/fpos.2021.642510

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COVID-19 conspiracy theories have proliferated during the global pandemic, and their rapid spread among certain groups may jeopardize the public health response (e.g., undermining motivation to engage in social distancing and willingness to vaccinate against the virus). Using survey data from two waves of a nationally representative, longitudinal study of life in lockdown in the United Kingdom ($N = 1,406$), we analyze the factors associated with belief in three origin theories related to COVID-19, namely that it 1) originated in a meat market in Wuhan, China; 2) was developed in a lab in Wuhan, China; and 3) is caused by 5G mobile networks. Our findings suggest that political-psychological predispositions are strongly associated with belief in conspiracy theories about the virus, though the direction and effect sizes of these predictors vary depending on the specific content of each origin theory. For instance, belief in the Chinese lab conspiracy theory is strongly associated with right-wing authoritarianism (RWA), social dominance orientation (SDO), and general conspiracy ideation, as well as less reliable news sources, distrust in scientists, and anxiety about the pandemic. Belief in the 5G network conspiracy theory is strongly associated with SDO, distrust in scientists, while less strongly with conspiracy ideation and information from social networks/media; RWA is strongly negatively associated with belief in the 5G conspiracy theory, with older and more wealthy individuals somewhat less likely to endorse it. The meat market origin theory is predicted by intolerance of uncertainty, ethnocentrism, COVID-19 anxiety, and less so by higher income, while distrust in scientists is negatively associated with this origin story. Finally, belief in COVID-19 conspiracy theories is associated with negative public health behaviors such as unwillingness to social distance and vaccinate against the virus. Crucially, our findings suggest that the specific content of COVID-19 conspiracy theories likely determines which individuals may be most likely to endorse them.

Keywords: COVID-19, conspiracy theories, right-wing authoritarianism, social dominance orientation, predisposition, motivated reasoning

It is virtually not assimilable to our reason that a small lonely man felled a giant in the midst of his limousines, his legions, his throng, and his security. If such a nonentity destroyed the leader of the most powerful nation on earth, then a world of disproportion engulfs us, and we live in a universe that is absurd.

- From Oswald's Tale: An American Mystery by Norman Mailer, on the public's obsession with conspiracy theories about the assassination of John F. Kennedy Christmas cancelled. Thank you, China.- Nigel Farage, Twitter, December 2020

INTRODUCTION

Major world events are known to spawn conspiracy theories. This may be due, at least in part, to proportionality intuitions that render mundane explanations for important events inadequate and unsatisfying (Leman and Cinnirella, 2007; Douglas et al., 2019). Thus, the notion that Princess Diana died because her driver was drunk, or that John F. Kennedy was felled by a lone gunman, threatens to engulf us in Norman Mailer's "world of disproportion."

Likewise, the COVID-19 pandemic is an event of immense global significance. The pandemic has occasioned massive social and economic upheaval, including nationwide lockdowns, school closures, the postponement or cancellation of major public events, and the largest global recession since the Great Depression of the 1930s. At the time of writing, the pandemic is already responsible for millions of deaths worldwide.

As with Kennedy's assassination, the COVID-19 pandemic has proven to be fertile ground for conspiracy theories. Some theories, for example, deny the existence of the virus or downplay its severity altogether. Such theories may attribute COVID-19 "propaganda" to assumed nefarious actors such as the United States government (and its plans to link passports with vaccination records as a means of totalitarian control; Rischel, 2020, March 24) or to the purported vested interests of Bill Gates and the World Health Organization (McGreal, 2020, May 14). Yet, as Nigel Farage's blithe tweet illustrates, a number of COVID-19 origin theories are intended to stoke hostility toward foreigners and foreign interests, which comports with the first reported cases in Wuhan, China. Examples include origin theories that posit the virus was engineered by the Chinese government, either in a laboratory as a biological weapon or with the introduction of 5G mobile technology (i.e., ostensibly causing the virus through radiation for which COVID-19 is merely a cover-up; Henley and McIntyre, 2020, October 26; Ahmed et al., 2020; Bruns et al., 2020). While such theories may satiate the need for narrative order among those individuals prone to conspiratorial thinking, they are also animated by intergroup dynamics of conflict and threat. In fact, recent studies on COVID-19 conspiracy theories have demonstrated that predispositions like party identification and ideology are associated with belief in such theories above and beyond a general conspiratorial mentality, though admittedly these reported effects may be context dependent (e.g., Uscinski et al., 2020).

Here we analyze the factors associated with belief in three theories regarding the origin of the COVID-19 pandemic, which at the time of data collection (April 2020) were most prominent: 1) that it originated in a meat market in China (a theory widely held in the early days of the pandemic but now contested); 2) that it originated in a laboratory in Wuhan, China; and 3) that it was caused by the rollout of the 5G mobile network. In the study, we consider the Wuhan laboratory and 5G theories as classic conspiracy theories, which we will explain in subsequent sections, while the meat market origin story serves as a baseline because it falls short of the core definition of a conspiracy theory.

Using data from two waves of a nationally representative, longitudinal dataset collected during the United Kingdom lockdown in 2020 ($N = 1,406$), we analyze several potential factors that may explain belief in COVID-19 origin theories. In particular, we focus on interplay between the specific content of each theory and the political-psychological predispositions that motivate its belief. We also control for several other socio-demographic factors, as well as political orientation, information sources about the pandemic, distrust in scientists, and COVID-19 anxiety, all of which may impact support for conspiracy theories. Our results suggest that political-psychological predispositions such as right-wing authoritarianism (RWA) and social dominance orientation (SDO) are statistically significant and substantively interesting predictors of belief in various COVID-19 origin stories. Moreover, and in contrast to previous research, the effects of these latent predispositions are distinct from and sometimes larger than that of an underlying conspiracy mentality, depending on the content of the specific conspiracy theory in question. Finally, we show that belief in conspiracy theories is associated with certain negative public health attitudes, for example, predicting motivations to violate social distancing guidelines and the unwillingness to vaccinate against COVID-19.

In the sections that follow, we address two research questions: What political-psychological predispositions predict belief in unsubstantiated COVID-19 origin theories? And what implications do these conspiracy beliefs have for health-related behaviors? We contribute to the literature by positing a motivational model of belief in COVID-19 origin theories (see also Miller et al., 2016; Douglas et al., 2017), in which we argue the importance of political-psychological predispositions as motivational factors in explaining susceptibility to belief in conspiracy theories, as well as their behavioral consequences.

THEORY

Belief in (COVID-19) Conspiracy Theories

Conspiracy theories are unsubstantiated explanations of major events with a twist -- that powerful and malevolent actors are involved in secret plots for their own benefit to the detriment of the common good (Goertzel, 1994; Uscinski and Parent, 2014). They generally consist of complex storylines that are hidden from public scrutiny, thus making them especially resistant to falsification (Lewandowsky et al., 2012). Most importantly,

conspiracy theories function to protect entrenched beliefs by discounting contrary evidence as the product of a conspiracy (Lewandowsky et al., 2013). Indeed, some conspiracy theories predict such contrary evidence, evincing what Boudry (2020) calls a “warped epistemology.” Hence, conspiracy theories may even serve a valuable purpose for individuals by allowing them to maintain certain beliefs in the presence of contradictory evidence (Douglas et al., 2017).

A striking finding in the literature on conspiracy theories, however, is that belief in one conspiracy theory tends to predict belief in others (Goertzel, 1994). This is not epistemically problematic when conspiracy theories are mutually consistent or reinforcing. Yet, studies have found that even flagrantly contradictory conspiracy theories are positively correlated in endorsement. For example, Wood et al. (2012) reported that participants who believed Princess Diana faked her own death were also more likely to believe she was murdered. Such findings imply that conspiracist ideation is driven by a conspiratorial worldview, perhaps characterized by higher-level rejection of official explanations (Franks et al., 2017). Indeed, the tendency to believe in conspiracy theories is associated with narcissism (Cichocka et al., 2016), and those highly disposed to believe in conspiracy theories are especially likely to endorse theories which they think are only believed by a minority (Imhoff and Lamberty, 2017).

Yet, conspiracy thinking may also confer a sense of control during periods of perceived uncertainty or threat (Sullivan et al., 2010; Uscinski et al., 2017). Miller (2020), for example, has recently amassed evidence for the “monological belief system” conception of conspiracy theories (e.g., see Goertzel, 1994) in the context of COVID-19, finding that contradictory COVID-19 conspiracy beliefs are positively related in endorsement, though this finding was partially explained by personal uncertainty (i.e., the more uncertain people were about themselves, the world, and the future, the more intercorrelated their evaluations of conspiracy theories). This adds to previous work demonstrating that people are more likely to endorse conspiracy theories when conditions of uncertainty and stress are salient (van Prooijen and Jostmann, 2013; Swami et al., 2016), and that intolerance of this uncertainty is related to a tendency to seek simplifying explanations often involving external and threatening agents (Darwin et al., 2011). Given the uncertainty caused by the global pandemic, it is perhaps unsurprising that people may grasp onto conspiracy theories as a security blanket.

In line with the theory of monological belief systems--that there is a general conspiracist mentality underpinning belief in specific conspiracy theories--we hypothesize that endorsement of one specific theory will be positively associated with belief in others (Hypothesis 1a); and that conspiracist ideation will be associated with belief in specific COVID-19 origin theories (Hypothesis 1b). However, these associations may be limited in helping us understand the diversity in conspiracy belief during the pandemic. Thus, in the sections that follow, we propose a motivational model of belief in various COVID-19 origin theories.

A Motivational Model of Belief in Conspiracy Theories

Research on motivated reasoning suggests that individuals are biased information processors, who seek out and accept information that

conforms to their existing predispositions, while expending considerable effort to discount that which challenges strongly held priors (Taber and Lodge, 2006; Kahan, 2012). For example, Tappin et al. (2017) reported evidence of desirability bias in the context of the 2016 United States election campaign: Individuals presented with polling evidence about the anticipated election outcome updated their beliefs more if the evidence was consistent (vs. inconsistent) with their preferred result. Similarly, Hartman and Newmark (2012) found that Republicans and ideological conservatives were especially predisposed to believe negative rumors about former President Barack Obama because of their different party identification and strong dislike of him.

We argue that two important political-psychological predispositions that may be associated with belief in COVID-19 origin theories are right-wing authoritarianism (RWA) and social dominance orientation (SDO). Both RWA and SDO emerged from research investigating different individual-level factors that explain prejudice and are thought to represent two types of right-wing personalities (Altemeyer, 1981; Diaz-Veizades et al., 1995; Duckitt, 2001; Sibley et al., 2006; Wilson and Sibley, 2013). In the Dual Process Motivational Model, for example, Duckitt (2001) theorized that two sets of motivational schemas, threat-control and competition-dominance, are the foundations of RWA and SDO, respectively, and that these dimensions were responsible for distinct forms of prejudice. For instance, while RWA and SDO both predict prejudice toward lower status groups, RWA-based prejudice typically categorizes outgroups as dangerous as threatening to the security and safety of the ingroup or dissident as representing a symbolic threat to social norms and cohesion (Shaffer and Duckitt, 2013; Kauff et al., 2015; Crowson and Brandes, 2017; Faragó et al., 2019). Conversely, SDO-based prejudice typically categorizes outgroups as inferior, weak, or undeserving (Duckitt, 2001; Ho et al., 2015).

However, the exact relationships that RWA and SDO have with conspiracy belief remains unclear. In the development of the Conspiracy Mentality Scale, for example, Imhoff and Bruder (2014) note the importance of recognizing the distinction between prejudice toward lower status groups (e.g., minority ethnic or religious groups), which is associated with RWA and SDO, and prejudice toward higher status groups (e.g., the wealthy), which is not associated with RWA and SDO. Yet, conspiracy mentality is generally related to prejudice against high-status and powerful groups or members of society, which are perceived as less likable and more threatening compared to low-status and weaker groups (Imhoff and Bruder, 2014). A consistent finding in the literature, then, is that conspiracy mentality predicts belief in conspiracy theories more strongly than RWA and SDO (Dyrendal et al., 2021).

In contrast, Richey (2017) presented an alternative theory in which those with authoritarian personalities are more likely to support conspiracy beliefs due to higher levels of anxiety and difficulty with higher order thinking, which has recently been supported by work that presents a positive association between conspiracy mentality and RWA, SDO and political conservatism (van der Linden et al., 2020; Dyrendal et al., 2021). Yet, Richey’s work focused exclusively on birtherism (i.e., that former United States President Obama is not an American citizen) and trutherism (i.e., that former United States President Bush and the Republican Party knew of 9/11 prior to the

TABLE 1 | Sample demographics ($n = 1,406$) benchmarked against British Election Study (BES) Wave 19 ($n = 32,177$).

| Variable | Category | Proportion | Bes W19 proportion | |
|------------------------|--|--------------------|--------------------|-------|
| Age | 18–24 | 0.055 | 0.042 | |
| | 25–34 | 0.151 | 0.089 | |
| | 35–44 | 0.174 | 0.130 | |
| | 45–54 | 0.218 | 0.170 | |
| | 55–64 | 0.221 | 0.231 | |
| | 65–74 | 0.153 | 0.261 | |
| | 75+ | 0.027 | 0.078 | |
| Gender | Male | 0.517 | 0.468 | |
| | Female | 0.481 | 0.532 | |
| | Other/Prefer not to say | 0.002 | — | |
| Ethnicity | White | 0.930 | 0.942 | |
| | Ethnic minorities (excluding white minorities) | 0.070 | 0.044 | |
| | Prefer not to say | — | 0.010 | |
| | NA | — | 0.005 | |
| Education | Other qualification or no qualifications | 0.556 | 0.684 | |
| | Degree education | 0.444 | 0.316 | |
| Gross household income | Study categories | BES W19 categories | — | |
| | £0–15,490 | £0–£14,999 | 0.198 | 0.184 |
| | £15,491–£25,340 | £15,000–£24,999 | 0.179 | 0.206 |
| | £25,341–£38,740 | £25,000–£39,999 | 0.184 | 0.264 |
| | £38,741–£57,930 | £40,000–£59,999 | 0.221 | 0.186 |
| | £57,931 or more | £60,000 or more | 0.217 | 0.159 |

attack). Nor did it control for SDO, which has been found elsewhere to predict scores on the General Conspiracist Belief scale, along with anxious attachment, interpersonal trust, and a Manichean world view (Green and Douglas, 2018).

Noting the divergent findings on the ability of predispositions to predict conspiracy belief, Wood and Gray (2019) highlight that psychologists tend to treat conspiracies as a unitary construct rather than engaging with the specific content of different conspiracy theories. They note that some conspiracy theories reinforce the RWA-associated view that the world is a threatening place, but that others present a view of the world that is incompatible with RWA, in which authority figures are corrupt, and leaders and traditions are social control mechanisms that must be resisted. In their findings, for example, RWA was positively associated with pro-establishment conspiracy beliefs but was uncorrelated with anti-establishment conspiracy beliefs (i.e., those suggesting that powerful groups are conspiring to restrict individual freedoms). Anti-establishment beliefs were moderately positively correlated with SDO. Wood and Gray (2019) speculate that a dislike of the deviant groups behind anti-establishment conspiracies, which present a material threat to social order, could partly explain the lack of association for RWA. Thus, the model proposes that RWA predicts a susceptibility to a belief in certain conspiracies that are compatible with the individual's existing worldview.

As discussed above, both RWA and SDO are associated with heightened sensitivity to certain types of threat (Duckitt, 2001; Duckitt and Fisher, 2003; Stenner, 2005; Duckitt, 2006; Duckitt and Sibley, 2009; Duckitt and Sibley, 2010). Those high in RWA, which is motivated by a belief that the world is an inherently threatening place, are particularly sensitive to threats posed by dangerous or dissident outgroups, while those high in SDO are

particularly sensitive to the threat of competition from outgroups that challenge societal hierarchies or the dominance of the ingroup. Of the three explanations for the origin of the coronavirus examined in the present paper, it seems likely that people high in RWA would find the theory that the coronavirus was a bioweapon developed by China's military as inherently threatening. In this theory, China's proliferation of bioweapons presents an external danger in the form of a security threat from a potentially hostile political rival, and a social threat in the form of a deviant or dissident political ideology, communism, to which people high in RWA are sensitive (Kauff et al., 2015; Crowson and Brandes, 2017; Faragó et al., 2019). It is also feasible that those high in SDO would be sensitive to the competitive threat this theory poses. In the bioweapon origin theory, an international competitor is trying to gain a military advantage that might threaten international hierarchies and challenge Britain's ability to leverage military power in the international arena, which is compatible with the underlying "competitive jungle" worldview of SDO. Moreover, the bioweapon theory presents a situation that could be used to justify more aggressive foreign policy positions or increased militarization in the United Kingdom. RWA and SDO are both associated with nationalism, support for aggressive foreign policy, and military action (Pratto et al., 1994; Doty et al., 1997; McFarland and Mathews, 2005; Terrizzi and Drews, 2005; Crowson et al., 2006; Jackson and Gaertner, 2010; McFarland, 2015; Lindén et al., 2018). Therefore, we expect that RWA and SDO will be positively associated with belief in the Chinese lab origin story (Hypothesis 2).

Conversely, the links between predispositions and the 5G origin theory appear less clear cut. While the 5G origin theory taps into a potential security threat, the development of 5G technology in the United Kingdom had the support of the

government, and therefore is less compatible with an RWA worldview that would be largely pro-establishment. Rather, the various forms of 5G origin theories are often linked to the virus via somewhat convoluted and contradictory mechanisms, some of which claim the virus is real but caused by 5G, and some of which claim it is a hoax altogether (Sturm and Albrecht, 2020). One such conspiracy claims that COVID-19 is a pretense to cover-up to the negative health effects of 5G radiation established by those profiteering from the technology (Bruns et al., 2020). Such a claim is consistent with theory that predicts people high in SDO may be more likely to perceive dishonesty as an accepted norm in a highly competitive world, in which people do whatever is necessary to succeed (De keersmaeker and Roets, 2019), and is supported by evidence from a UK sample showing a positive association between SDO and belief COVID-19 is a hoax (Imhoff and Lamberty, 2020). A consistent theme running through the proliferation of 5G conspiracy theories has been their mobilization by partisan groups, in particular their assimilation into and conjoining with pre-existing conspiracies frequently espoused in far-right networks (Bruns et al., 2020). SDO has been found to positively predict identification with far right groups, and subsequent intent to engage in extreme and violent actions toward outgroups, providing a justification for beliefs and actions that benefit the ingroup (Bai, 2020). Relatedly, §) has argued that motivation to believe in conspiracy theories is greater when they are related to a salient group identity such as the far right. Therefore, given the proliferation of 5G conspiracies through far-right networks, the extremity of the intent and actions associated with it (e.g., the burning of 5G towers; Jolley and Paterson, 2020), and the consistency of its content that sees the world as competitive and actors as self-interested, we predict SDO will be positively associated with the 5G origin theory (Hypothesis 3).

Yet, we have no strong expectations regarding the association between RWA and 5G belief, and similarly no strong expectations regarding RWA and SDO and belief in the Chinese meat market theory. Our reasoning is that the former does not tap into threats to the social order or status of the ingroup, while the latter is not really a conspiracy theory (i.e., it does not involve intentional actions by a powerful and malevolent group).

Public Health Implications

Finally, endorsement of COVID-19 conspiracy theories may affect critical public health issues such as adherence to social distancing rules and attitudes toward vaccination. Experimental evidence suggests exposure to conspiracy theories reduces the intent to engage in health-promoting behaviors, such as visiting a doctor, and that the relationship is mediated by decreased trust in health professionals (Natoli and Marques, 2020). More recently, conspiracy mentality has been shown to reduce willingness to comply with preventative COVID-19 measures, such as national lockdowns, where they are mandated by governments or authority figures (Marinthe et al., 2020).

Again there is evidence that the content of a conspiracy theory matters for subsequent behavior. For instance, Imhoff and Lamberty (2020) report that claiming the virus was a hoax reduced compliance with social distancing but claiming the

virus was man-made had no effect. In this vein, social distancing motivations may be undermined if the severity of the virus is understated or if the scientific consensus on human-to-human transmission is questioned, as insinuated by claims it is caused by 5G radiation or that the pandemic lockdowns were only a pretense for the cover-up and/or rollout of 5G networks (Bruns et al., 2020). Similarly, a number of conspiracy theories make unfounded claims regarding the supposed dangers of vaccines (Sturm and Albrecht, 2020). Indeed, social network analysis of the spread of COVID-19 conspiracies details the prominence of a conspiracy theory which overlaps across those origin theories tested in this study, suggesting the virus was engineered in China, but that its full effects will be realized via a vaccine that is activated by 5G (Bruns et al., 2020: 19).

Thus, given the negative effect of conspiracy belief on health promoting behaviors, and their potentially corrosive effect on trust in medical interventions and the consensus on human transmission, we expect belief in our set of conspiracies to be negatively associated with social distancing motivations (Hypothesis 4a) and positively associated with vaccine rejection (Hypothesis 4b).

MATERIALS AND METHODS

Data

The data for this study come from a nationally representative longitudinal survey of adults living in the United Kingdom during the early phases of the COVID-19 global pandemic. Participants were recruited by Qualtrics from March 23rd to 28th, 2020 (Wave 1: $N = 2,025$), and were recontacted from April 22nd to May 1st, 2020 (Wave 2: $n = 1,406$, recontact rate = 69%). Data for Wave 1 of the survey occurred during the first week of the strict national lockdown in the United Kingdom, while follow-up data for Wave 2 was collected approximately 1 month later during the lockdown and 3 months after the first confirmed COVID-19 case there, which saw rapidly increasing infections. These data comprise part of a longitudinal, multi-country study that aims to assess the psychological, social, economic, and political impact of the COVID-19 virus in the general population (McBride et al., 2020).

Although the sample was drawn from non-probability methods, research suggests that Qualtrics approximates probability-based samples reasonably well when quotas are used (Zack et al., 2019). Thus, we employed stratified quota sampling matched against known demographics in terms of age, gender, and household income within the United Kingdom. We also present a summary **Table 1** of demographics benchmarked against Wave 19 of the British Election Study, which was collected using similar survey methods. McBride et al. (2020) provide a more detailed description of the panel recruitment, sampling methodology (including post-stratification weights and analysis of panel attrition), and explanation of all measures administered in the study. The full panel dataset will be deposited to the United Kingdom Data Archive and Open Science Framework approximately six months after data collection for the project has been completed.

TABLE 2 | Descriptive statistics of key measures.

| Variable | Mean | SD | Wave | Description |
|---|------|------|------|--|
| Dependent variables | | | | |
| Meat market belief | 0.64 | 0.29 | 2 | Slider scale from 0 to 100, scaled 0–1 |
| Wuhan lab belief | 0.38 | 0.33 | 2 | Slider scale from 0 to 100, scaled 0–1 |
| 5G belief | 0.11 | 0.22 | 2 | Slider scale from 0 to 100, scaled 0–1 |
| Motivation to engage in social distancing | 0.82 | 0.19 | 2 | 4-Item subscale of reflective motivation from the COM-B model, alpha = 0.87, scaled 0–1 |
| Willingness to accept a vaccine | — | — | 2 | Willingness to accept a hypothetical COVID-19 vaccine for themselves? Willing: 67.6% (“yes”); reluctant: 32.4% (“May be” = 23.4%, “No” = 9.1%) |
| Independent variables | | | | |
| Conspiracy ideation | 0.57 | 0.2 | 1 | 5-Item conspiracy mentality scale, alpha = 0.85, scaled 0–1 |
| RWA | 0.51 | 0.17 | 1 | 6-Item very short Authoritarianism scale, alpha = 0.68, scaled 0–1 |
| SDO | 0.36 | 0.18 | 1 | 8-Item SDO ₇ scale, alpha = 0.84, scaled 0–1 |
| Left-right scale | 0.49 | 0.2 | 1 | Self-reported placement on a political scale, ranging from 1 (left) - 10 (right), scaled 0–1 |
| Ethnocentrism | 0.57 | 0.25 | 2 | 2-Item scale, alpha = 0.82, scaled 0–1 |
| Distrust of scientists | 0.34 | 0.25 | 2 | Ordinal degree of distrust in scientists, scaled 0–1 |
| COVID-19 anxiety | 0.61 | 0.26 | 2 | Slider scale from 0 (not at all) to 100 (extremely anxious), scaled 0–1 |
| Intolerance of uncertainty | 0.49 | 0.2 | 2 | 12-Item scale, alpha = 0.91, scaled 0–1 |
| News consumption: Elite | 0.38 | 0.48 | 2 | Dummy for those who read “elite-level” newspapers (yes = 1; none = 0) |
| News consumption: Mid-level | 0.32 | 0.47 | 2 | Dummy for those who read “mid-level” newspapers (yes = 1; none = 0) |
| News consumption: Tabloid | 0.27 | 0.44 | 2 | Dummy for those who read tabloid newspapers (yes = 1; none = 0) |
| Information from family and friends | 0.38 | 0.28 | 2 | Ordinal measure of extent of COVID-19 information received from family and friends, scaled 0–1 |
| Information from social media | 0.3 | 0.32 | 2 | Ordinal measure of extent of COVID-19 information received from social media, scaled 0–1 |
| Age | 0.45 | 0.21 | 2 | Continuous variable, scaled 0–1 |
| Gender | 0.48 | 0.5 | 2 | Dummy variable (female = 1) |
| Income | 0.52 | 0.36 | 1 | Ordinal gross income bands (2019), scaled 0–1 |
| Education | 0.44 | 0.5 | 1 | Dummy for university education (Bachelor’s degree or higher = 1) |

Dependent Variables

To assist interpretation and comparison of effect sizes, we rescaled all of the continuous variables described below to range from zero to one. Descriptive statistics for all measures included in our analyses are available in **Table 2**, which also details the study wave in which they were collected.

Theories About the Origin of COVID-19

Respondents indicated the degree to which they believed various COVID-19 origin stories using a slider scale ranging from 0 to 100. This yielded three outcomes concerning belief in the following:

1. “COVID-19 originated in a meat market in Wuhan, China” ($M = 0.64$, $SD = 0.29$);
2. “COVID-19 was developed in a lab in Wuhan, China” ($M = 0.38$, $SD = 0.33$);
3. “5G mobile networks are responsible for the current global pandemic” ($M = 0.11$, $SD = 0.22$).

The distributions for these three origin stories are displayed in **Figure 1**. Prior to data collection, we reviewed a number of potential conspiracy theories regarding COVID-19 (e.g., see Lynas, 2020, April 20). We selected these three origin theories because they varied along two theoretically interesting dimensions: 1) the degree to which they might be defined as conspiracy theories (low to high), and 2) the nature of the threat that they imply. For instance, the Wuhan lab origin theory is arguably the most conventional conspiracy theory according to the definition we have outlined above, implicating powerful actors in a malevolent plot. In contrast, the meat market

origin story is hardly a full-blown conspiracy theory because it was not created by a cabal of powerful people with selfish intentions.¹ And finally, the 5G theory is a conspiracy theory, but differs from the Wuhan laboratory theory in terms of the nature of the implied threat: Where the laboratory theory implicates a foreign military power and is framed as a potential matter of national security, the 5G theory is an anti-establishment conspiracy concerned with a coalition of powerful corporate, technological and government actors. This variation allows us to analyze the common drivers of belief in COVID-19 conspiracies, and to compare these to the factors related to more mainstream beliefs, but also how a differential sense of threat from a conspiracy theory produces diversity in subsequent propagation and behaviors.

Motivation to Engage in Social Distancing

Four items from the Capability, Opportunity, Motivation-Behaviour (COM-B) model of behavior change (Michie et al., 2011) were used to assess respondents’ motivation to engage in social distancing behaviors ($M = 0.82$, $SD = 0.19$, alpha = 0.87).

Willingness to Take a COVID-19 Vaccine

Respondents were asked “If a new vaccine were to be developed that could prevent COVID-19, would you accept it?” Three

¹Indeed it is worth noting that due to the ongoing investigations into the origin of the virus, what is considered a conspiracy with regards to its origins is to a degree dependent upon time and context. At the time of writing the World Health Organization have explored both the weapons laboratory and meat market hypotheses; however, it is thought that neither origin theory is likely.

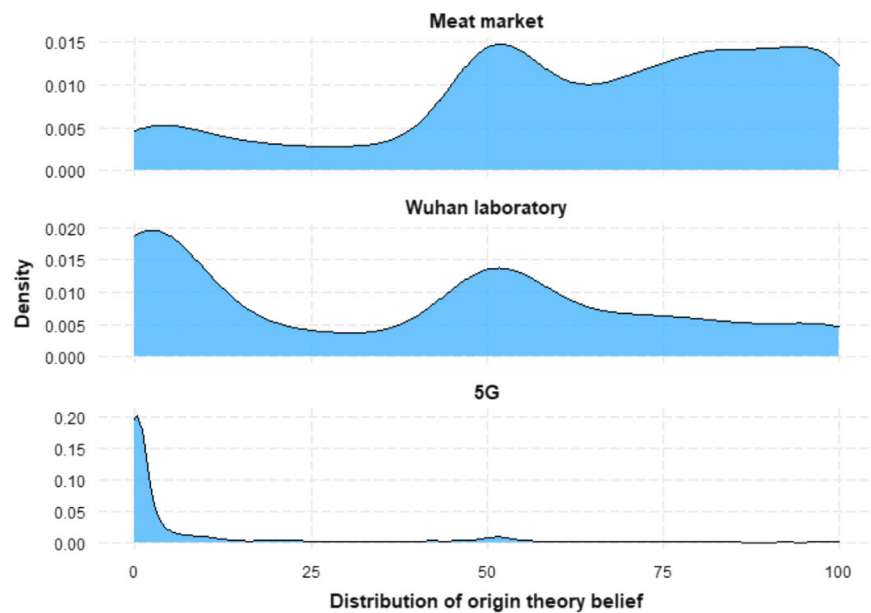


FIGURE 1 | Distributions of belief in COVID-19 origin stories.

response options were available: Yes ($n = 939$, 67.6%), No ($n = 126$, 9.1%), and Maybe ($n = 325$, 23.4%).

Independent Variables

As with the outcomes above, we rescaled all continuous predictors to range from 0 to 1 to aid interpretation and comparison of effect sizes.

Conspiracy Ideation

Conspiracy mentality (Imhoff and Bruder, 2014) was measured using five items (scored on an 11-point scale from 1 “Certainly not 0%” to 11 “Certainly 100%”), including: “I think that many very important things happen in the world, which the public is never informed about”; and “I think that events which superficially seem to lack a connection are often the result of secret activities” ($M = 0.57$, $SD = 0.20$, $\alpha = 0.85$).

Right-Wing Authoritarianism

The 6-item Very Short Authoritarianism scale (Bizumic and Duckitt, 2018) was used to assess respondents’ levels of authoritarianism. Participants indicated the extent to which they agreed with statements (on a 5-point Likert scale ranging from 1 “strongly disagree” to 5 “strongly agree”) such as follows: “It’s great that many young people today are prepared to defy authority”; “What our country needs most is discipline, with everyone following our leaders in unity”; and “Our society does NOT need tougher government and stricter laws” ($M = 0.51$, $SD = 0.17$, $\alpha = 0.68$).

Social Dominance Orientation

Respondents’ levels of social dominance orientation were assessed using the 8-item social dominance orientation scale (SDO-7; Ho et al., 2015). Respondents were asked the extent to which they favored

statements (on a 5-point Likert scale ranging from 1 “Strongly oppose” to 5 “Strongly favor”) such as the following: “An ideal society requires some groups to be on top and others to be on the bottom”; “Some groups of people are simply inferior to other groups”; and “We should do what we can to equalize conditions for different groups” ($M = 0.36$, $SD = 0.18$, $\alpha = 0.84$).

Political Orientation

One question (adapted from the British Election Study 2017) asked respondents how they would describe their political affiliation on a 10-point scale ranging from 1 “left-wing” to 10 “right-wing” ($M = 0.49$, $SD = 0.20$).

Ethnocentrism

Two items to measure ethnocentrism were adapted from Davidov (2011): “The world would be a better place if people from other countries were more like the British” and “Generally speaking, Britain is a better country than most other countries”. Responses were scored on 5-point Likert scales from 1 “strongly disagree” to 5 “strongly agree” ($M = 0.57$, $SD = 0.25$, $\alpha = 0.82$).

Distrust in Scientists

Respondents were asked the extent to which they trusted scientists. Responses were scored on a 5-point Likert scale ranging from 1 “completely trust” to 5 “do not trust at all” ($M = 0.34$, $SD = 0.25$).

COVID-19 Related Anxiety

Respondents’ degree of specific anxiety about the COVID-19 pandemic was assessed using a single visual slider scale, ranging from 0 “not at all anxious” on the left-hand side to 100 “extremely anxious” on the right-hand side ($M = 0.61$, $SD = 0.26$).

TABLE 3 | Correlations among COVID-19 origin theories.

| Origin belief | Meat market | Wuhan lab | 5G network |
|---------------|---------------|--------------|------------|
| Meat Market | — | — | — |
| Wuhan Lab | -0.097 | — | — |
| 5G Network | -0.041 | 0.330 | — |

Note: $N = 1,406$. Cell entries are Pearson's correlations (r). Statistically significant correlations printed in bold (two-tailed test, $p < 0.05$).

Intolerance of Uncertainty

Respondents' intolerance of uncertainty, which is thought to play a key role in the etiology and maintenance of worry, was assessed using the 12-item Intolerance of Uncertainty Scale (IUS) (Buhr and Dugas, 2002). The IUS has a good construct validity (Birrell et al., 2011), and recent psychometric research has shown that it is best scored as a single dimension (Shihata et al., 2018). All 12 items are scored on a 5-point Likert scale ranging from 1 "not at all characteristics of me" to 5 "entirely characteristic of me". The IUS has excellent internal consistency, good test-retest reliability over a five-week period, and convergent and divergent validity when assessed with symptom measures of worry, depression, and anxiety (Buhr and Dugas, 2002) ($M = 0.49$, $SD = 0.20$, $\alpha = 0.91$).

Sources of Information About COVID-19

Respondents were asked to indicate, from a list of the mainstream newspapers, their preferred news source (either in print or online), as a proxy measure for quality of news source and partisan news consumption. Responses to these items were dummy coded by elite news ($M = 0.38$, $SD = 0.48$), mid-level news ($M = 0.32$, $SD = 0.47$), and tabloid news ($M = 0.27$, $SD = 0.44$). In addition, respondents were asked the extent to which they received information about COVID-19 from 1) family and friends ($M = 0.38$, $SD = 0.32$) and 2) social media ($M = 0.30$, $SD = 0.32$).

Socio-Demographic Indicators

Respondents also provided their gender, age, and gross annual household income, each of which were used for quota sampling, as well as their highest level of education (no qualifications; O-level/GCSE or similar; A-level or similar; diploma; undergraduate degree; postgraduate degree; technical qualification; or other).

RESULTS

COVID-19 Origin Theories

To begin, we examine the correlations among beliefs in the respective COVID-19 origin theories. Recall, that we hypothesized that endorsement of one origin theory will be positively associated with belief in others (Hypothesis 1a). **Table 3** displays the Pearson's correlations (r) between each belief, with all estimated correlations that are statistically significant at the 0.05 level (two-tailed) listed in bold. Consistent with prior research, we find that the two COVID-19 conspiracy theories -- that the virus originated from a Wuhan

laboratory or 5G mobile networks -- are moderately positively associated ($r = 0.330$). However, the meat market origin theory appears weakly negatively associated with both major conspiracy theories (Wuhan lab, $r = -0.097$; $r = -0.041$), which is contrary to previous findings on COVID-19 origin beliefs (e.g. Miller, 2020). In sum, these descriptive results suggest that there is a moderately positive association between some but not all of the COVID-19 origin theories; their content seems to matter.

Next, we turn to our test of the factors that predict belief in various COVID-19 origin theories. If we are correct -- that political-psychological predispositions like RWA and SDO are important yet differential predictors of conspiracy theory endorsement depending upon their specific content -- then we should see different patterns for different conspiracy theories. To this end, we regressed each COVID-19 origin theory on political-psychological predispositions -- for example, conspiracy ideation, RWA, and SDO -- as well as several control variables outlined in the previous section, using ordinary least squares (OLS).² Missing values were removed using listwise deletion.³ As such, we present the results of three models: Model 1 (Wuhan laboratory), Model 2 (5G network), and Model 3 (meat market).

To aid in interpretation, we present the estimated coefficients for our main political-psychological predictors (with 95% confidence intervals) across each conspiracy theory in **Figure 2**; the full regression results are available in **Table 4** (for additional model specifications relating to the 5G origin theory, please see the **Supplementary Appendix A2**).⁴ The dashed vertical line represents the null hypothesis (i.e., $b = 0$); plot points to the right of this vertical line indicate a positive association with belief in the listed conspiracy theory; plot points

²Due to the non-normality of the 5G origin belief dependent variable, and issues of heteroscedasticity in the residuals, we ran two supplementary tests on this belief scale. The first involved transforming the dependent variable using the inverse hyperbolic sine (IHS) transformation and subsequently fitting an OLS regression. The IHS transformation approximates the natural logarithm for large values of the dependent variable, but unlike the log transformation, it can accommodate zero values (Burbidge et al., 1988:123,126; Zhang et al., 2000:169). The IHS transformation involves estimating a parameter (θ) using the concentrated log likelihood (Burbidge et al., 1988), but in our application the parameter increased in value indefinitely. Therefore, we use $\sinh^{-1}(x)$ as a case of the IHS transformation that retains the aforementioned benefits with regards to zero and large values, and one which is frequently applied to long-tailed distributions (MacKinnon and Magee, 1990:324; Williams, 2017; Bellemare and Wichman, 2020). The second supplementary test was a Poisson regression, with a parameter added to adjust for overdispersion (31.86), without which the standard errors may be biased. We estimated the Poisson regression model using maximum likelihood. For both supplementary models, the results broadly confirm those of the initial OLS model in terms of statistical significance and effect size, with the exception of the effect of RWA. Therefore, to allow easier comparisons across origin stories, we present the OLS model results for 5G in the sections that follow, with any differences between these results and the supplementary models highlighted where necessary. We present the full results of the supplementary models in the Appendix.

³Missing values were as follows: Three missing for gender, 4 from distrust of scientists, and 9 from the vaccination acceptance outcome. Therefore, for Models 1 to 4, $N = 1,399$, and for Model 5, $N = 1,390$. In short, the number of missing data is relatively small across all models presented.

⁴All Variance Inflation Factors (VIFs) were below 2, suggesting that multicollinearity was not an issue among the various predictors in the models.

to the left, suggest a negative association. Statistically significant results correspond to estimates for which the 95% confidence intervals do not include zero (i.e., those that do not cross the dashed vertical reference line). Finally, recall that all variables have been scaled to range from 0 to 1, which means that while they are not measured in the same units, they do display the associated change in each outcome for a minimum to maximum change in the predictors. For example, a 1-unit change in RWA is equivalent to increasing from those who scored lowest to highest on the 6-item Very Short Authoritarianism scale.

Looking at the results in **Figure 2** (and **Table 4**), we can clearly see that different conspiracy theories have different psychological and social determinants. In other words, the pattern of coefficient plots is not consistent across panels A, B, and C. For example, conspiracy ideation has a relatively large and statistically significant effect on belief in the Wuhan laboratory origin ($b = 0.27$, $se = 0.04$, $p < 0.001$), a relatively small though still statistically significant effect on 5G belief ($b = 0.07$, $se = 0.03$, $p < 0.05$), and a near-zero, non-significant effect on meat market belief ($b = -0.01$, $se = 0.04$, $p = 0.81$). Thus, we find some support for Hypothesis 1b, but our findings suggest the content of each origin theory conditions these effects.

Our regression results also provide support for Hypothesis 2, as we find statistically significant effects of both RWA and SDO on belief in the Wuhan laboratory theory (RWA: $b = 0.15$, $se = 0.05$, $p < 0.01$; SDO: $b = 0.23$, $se = 0.05$, $p < 0.001$), the latter of which has the second largest effect size in the model. As expected, the effect of SDO on 5G belief is positive and relatively large ($b = 0.25$, $se = 0.04$, $p < 0.001$), which is also substantially larger than the effect size of conspiracy ideation as previously noted. However, in line with our expectations, we find a negative effect of RWA on 5G belief ($b = -0.11$, $se = 0.04$, $p < 0.01$),⁵ again reinforcing the notion that the content of each COVID-19 conspiracy theory motivates belief differently depending on an individuals' underlying predispositions. Once again, RWA and SDO are not statistically significant predictors of belief in the meat market origin theory (RWA: $b = -0.06$, $se = 0.05$, $p = 0.26$; SDO: $b = -0.02$, $se = 0.05$, $p = 0.66$). Overall, however, our results provide support for Hypothesis 3.

It is worth noting that a number of other psychological factors also differentially predict belief in various COVID-19 conspiracy theories. For instance, ethnocentrism is a statistically significant and reasonably strong predictor of belief in all three origin theories, which we might expect given the linkages of all origin theories to China in some way or another. Likewise, distrust in scientists is a statistically significant and reasonably large predictor of Wuhan lab and 5G beliefs, but it negatively predicts endorsement of the meat market origin theory. COVID-19 anxiety predicts support for Wuhan lab and meat market beliefs, but not 5G networks, while intolerance of uncertainty only predicts support for the meat market origin

theory. Again, the effect sizes vary considerably across conspiracy theories. News consumption has predictable associated effects: obtaining news from family and friends increases support for classic conspiracy theories, as does reading tabloids or other non-elite news sources. Finally, those individuals who earn less and are less educated are somewhat more likely to believe COVID-19 conspiracy theories, but again the size of the effect and its statistical significance appears to be content dependent.

Before moving on to public health attitudes, we visualize the estimated effects of our main political-psychological predispositions across all three of the COVID-19 origin theories in **Figure 3**. What is immediately apparent is that the predicted effects on beliefs vary considerably by predisposition and, of course, by the conspiracy theory in question.

Attitudes Toward Public Health

We conducted additional analyses seeking to understand the potential effect of conspiracy beliefs on attitudes toward public health policies, namely motivation to engage in social distancing and willingness to accept a COVID-19 vaccine. To this end, we regressed social distancing motivation on the predictor variables from the previous models, plus the three COVID-19 origin theory belief scales, using OLS. The results are presented in full in the **Supplementary Appendix A3**. Using the same predictor variables, we conducted a multinomial logit regression on willingness to accept a vaccine, with the baseline set to "yes", also presented in full in **Supplementary Appendix A3**. Here, we present the unstandardized coefficients of motivation to social distance (with 95% confidence intervals) for visual inspection in **Figure 4**, and in **Figure 5** we present the marginal effects of selected predictor variables (i.e., those that are statistically significant or theoretically interesting) in relation to respondents' willingness to vaccinate, again with 95% confidence intervals.

Closer inspection of **Figure 4** reveals that COVID-19 conspiracy theories do affect attitudes toward public health, albeit in different directions. For instance, belief in the 5G origin theory is statistically significant and negatively associated with social distancing, accounting for a 14-point reduction in motivation. This finding is perhaps unsurprising, given that a vaccine would do little to prevent the perceived damage caused by 5G networks. By contrast, the effect of Wuhan laboratory origin belief is positively signed, near zero, very small, and not statistically significant. Thus, these results provide partial support for Hypothesis 4a, in particular where belief in the 5G theory is concerned. Belief in the meat market origin theory is positively associated with social distancing motivations, though the estimate is relatively small at 7-percentage points. While the effect of general conspiracy ideation is also positive, equivalent to a 5-percentage point increase, this predictor just falls below a threshold for statistical significance.

Interestingly, the largest relative effects on motivations to social distance are observed from the key political-psychological predispositions. For example, SDO is associated with a large and statistically significant reduction in motivation, accounting for a 21-point decrease in social distancing. In contrast, RWA is associated with a relatively large and

⁵It is worth noting that in supplementary models 3a and 3b, this finding was statistically non-significant, and the effect size reduced (see **Supplementary Appendix A2**). Therefore, this finding should be treated with more caution than others which were replicated in the supplementary models.

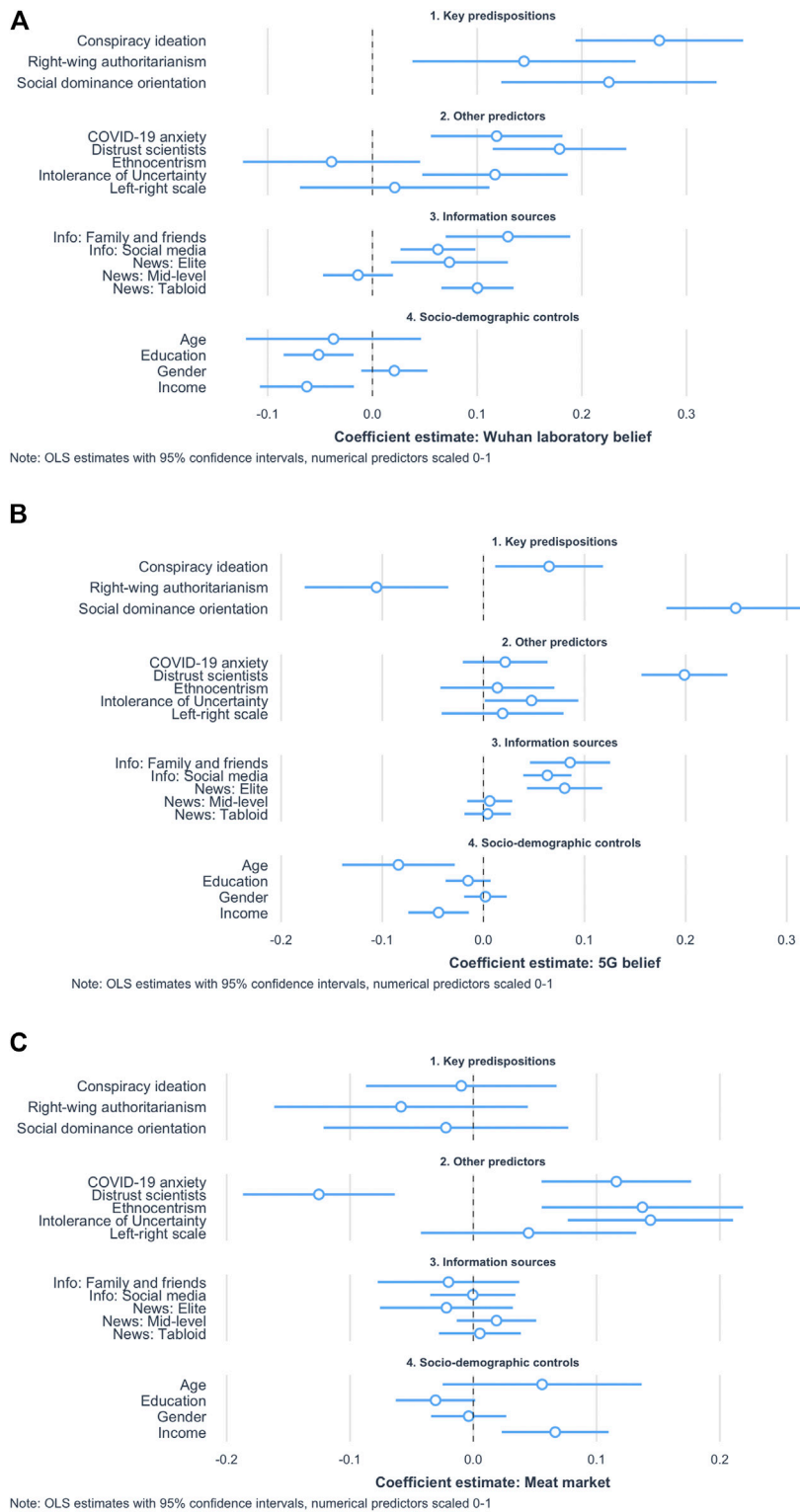


FIGURE 2 | Estimated coefficients for predictors on belief in different COVID-19 origin theories. **(A)** Origin theory: Wuhan lab, **(B)** Origin theory: 5G network, **(C)** Origin theory: Meat market.

TABLE 4 | OLS regression results for belief in each COVID-19 origin theory.

| | Dependent variable | | |
|----------------------------|--------------------|------------------|-------------------|
| | Wuhan lab | 5G network | Meat market |
| Conspiracy ideation | 0.274*** (0.041) | 0.065* (0.027) | -0.010 (0.039) |
| RWA | 0.145** (0.054) | -0.106** (0.036) | -0.059 (0.052) |
| SDO | 0.226*** (0.052) | 0.249*** (0.035) | -0.022 (0.051) |
| Left-right scale | 0.021 (0.046) | 0.019 (0.031) | 0.045 (0.045) |
| Ethnocentrism | 0.117*** (0.035) | 0.048* (0.024) | 0.144*** (0.034) |
| Distrust in scientists | 0.179*** (0.033) | 0.199*** (0.022) | -0.125*** (0.031) |
| COVID-19 anxiety | 0.119*** (0.032) | 0.022 (0.021) | 0.116*** (0.031) |
| Intolerance of uncertainty | -0.039 (0.043) | 0.014 (0.029) | 0.137** (0.042) |
| Elite news | -0.014 (0.017) | 0.006 (0.011) | 0.019 (0.016) |
| Mid-level news | 0.100*** (0.018) | 0.004 (0.012) | 0.005 (0.017) |
| Tabloid news | 0.063*** (0.018) | 0.063*** (0.012) | -0.0004 (0.018) |
| Info: Family and friends | 0.129*** (0.030) | 0.086*** (0.020) | -0.020 (0.029) |
| Info: Social media | 0.074** (0.028) | 0.080*** (0.019) | -0.022 (0.027) |
| Gender | 0.021 (0.016) | 0.002 (0.011) | -0.004 (0.016) |
| Age | -0.037 (0.043) | -0.084** (0.028) | 0.056 (0.041) |
| Income | -0.063** (0.023) | -0.044** (0.015) | 0.066** (0.022) |
| Education | -0.051** (0.017) | -0.015 (0.011) | -0.031 (0.016) |
| Constant | -0.175*** (0.052) | 0.097** (0.034) | 0.444*** (0.050) |
| Observations | 1,399 | 1,399 | 1,399 |
| R2 | 0.254 | 0.235 | 0.068 |

Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

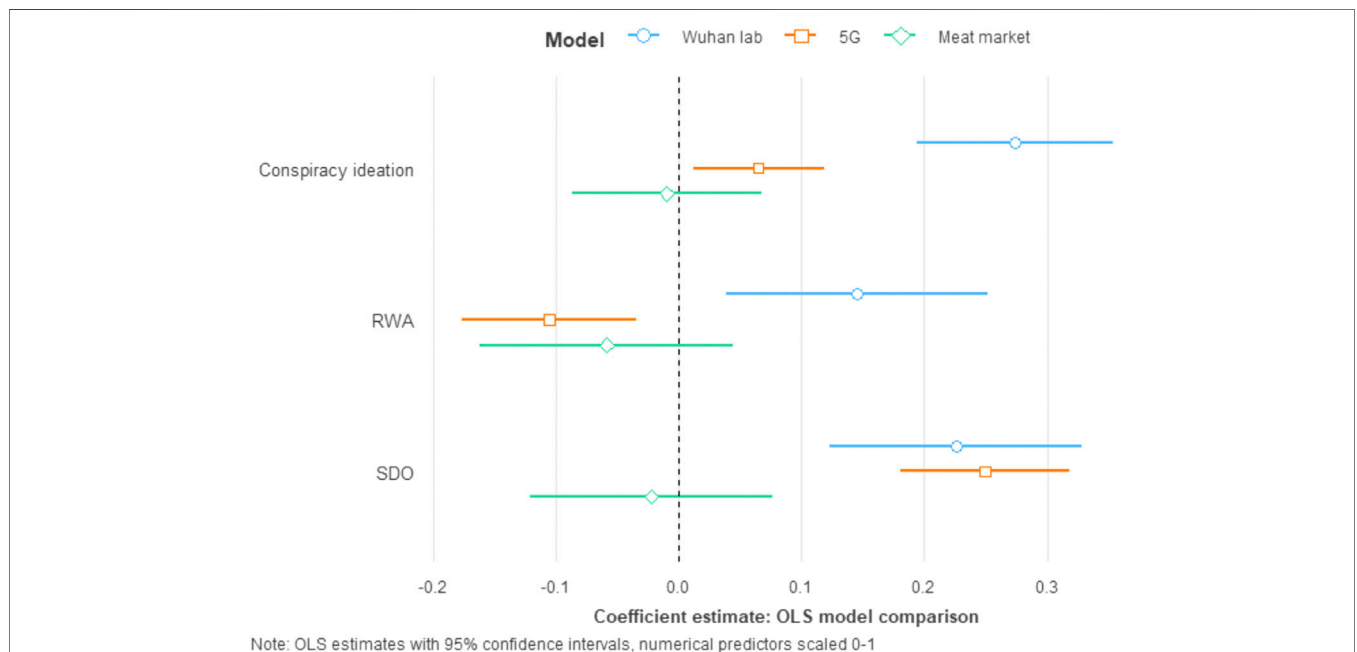
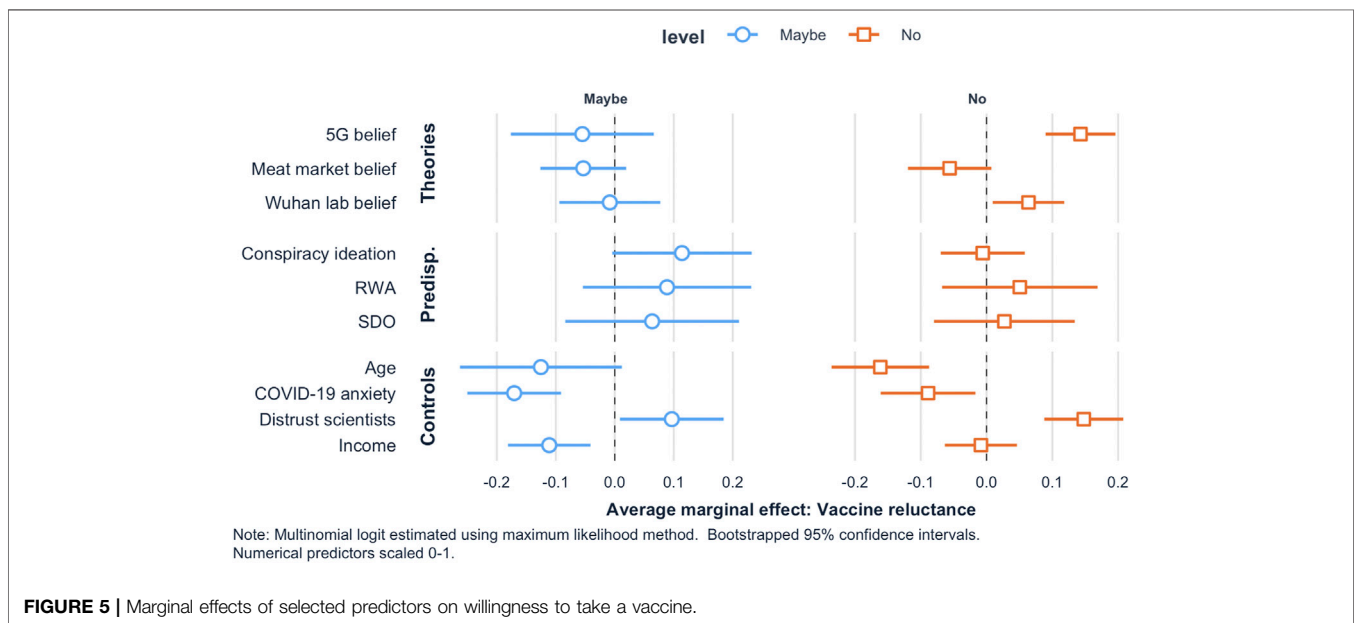
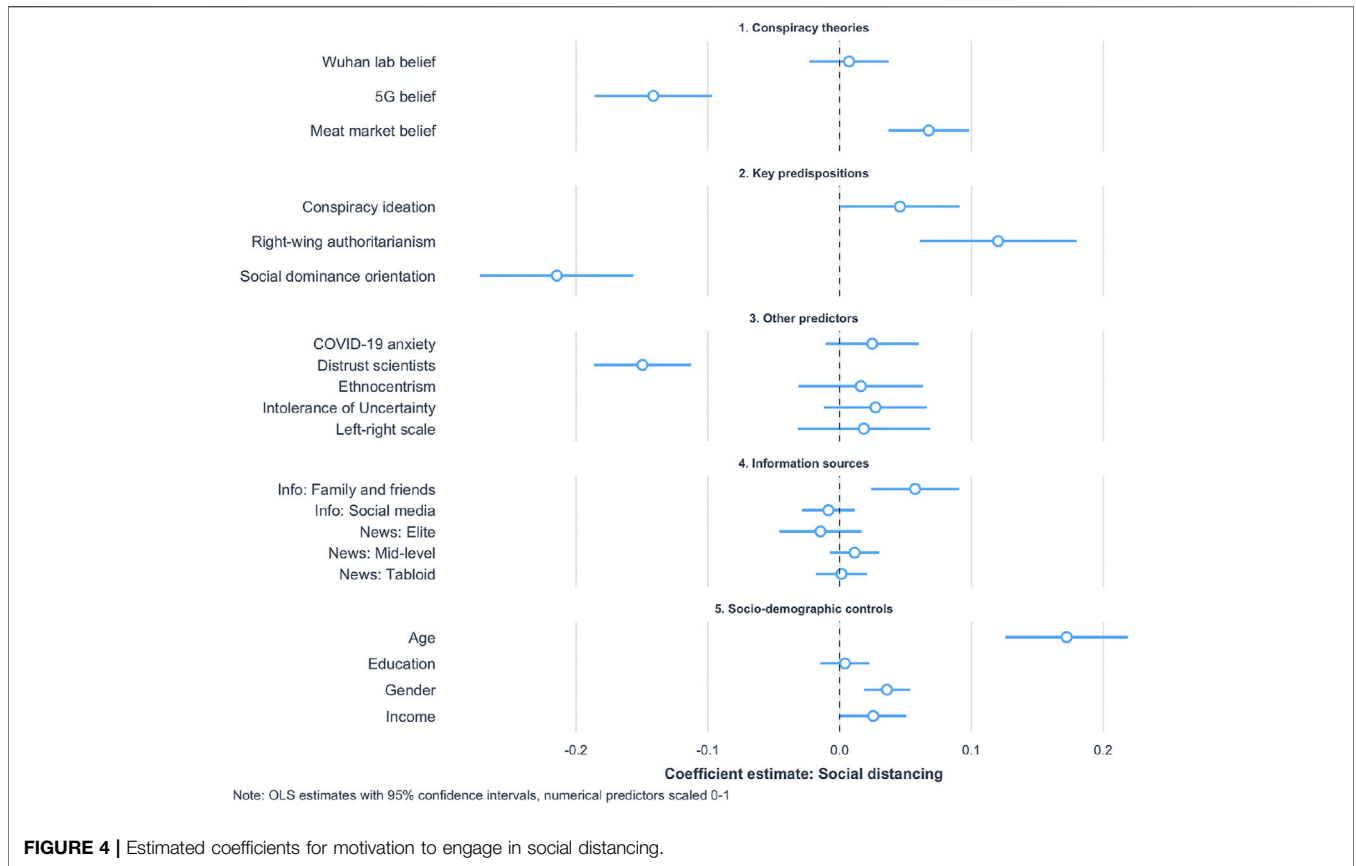


FIGURE 3 | Estimated coefficients for political-psychological predispositions on belief in different COVID-19 origin theories.

statistically significant increase in motivation, representing a 12-point increase in this outcome. Finally, distrust in scientists decreases motivation (by 15 points), while age increases it (by 17 points). These results suggest that certain factors may have a direct effect on social distancing, for instance by reducing empathy or stimulating skepticism toward scientific advice (Eiser et al., 2009; Bentley and Cowan, 2021).

Looking at the plotted marginal effects from the willingness to vaccinate models (in Figure 5), we see that belief in both the 5G and Wuhan lab conspiracy theories is associated with a statistically significant increase in vaccine reluctance (i.e., responding “no”). We also present the full set of relative risk ratios and average marginal effects from these models in the Appendix (see Supplementary Appendix A4). Political-



psychological predispositions like conspiracy ideation, RWA, and SDO, however, do not appear to be associated with a statistically significant direct effect on willingness to vaccinate. Belief in the meat market theory is negatively signed but not statistically significant for

both vaccine rejection and vaccine hesitancy. Overall, we consider the results as providing support for Hypothesis 4b. We should also note that other factors like age, income, and COVID-19 anxiety decrease vaccine reluctance, while distrust in scientists appears to increase it.

TABLE 5 | Summary findings from our hypothesis tests.

| Hypothesis | Results |
|--|--|
| Endorsement of one COVID-19 conspiracy theory will correlate with endorsement of another (Hypothesis 1a) | Supported |
| Conspiracist ideation will be positively associated with belief in COVID-19 origin theories (Hypothesis 1b) | Supported |
| RWA and SDO will be positively associated with belief in the Chinese lab origin theory (Hypothesis 2) | Supported |
| SDO will be positively associated with the 5G origin theory (Hypothesis 3) | Supported |
| Belief in COVID-19 conspiracy theories will be negatively associated with social distancing motivation (Hypothesis 4a) | Partially supported - belief in 5G origin theory negatively associated with social distancing motivation, but no effect of wuhan laboratory belief |
| Belief in COVID-19 conspiracy theories will be positively associated with vaccine rejection (Hypothesis 4b) | Supported |

DISCUSSION

In this study we have tested hypotheses regarding the factors that predict COVID-19 origin theories, including two that we think fit the definition of a conspiracy theory (i.e., the virus originated in a Chinese laboratory and the current pandemic has been caused by 5G wireless technology), as well as one plausible, yet contested origin theory (i.e., the virus originated in a Wuhan meat market). We also studied the implications of these conspiracy theories for attitudes toward public health: 1) Motivation to engage in social distancing, and 2) willingness to accept a COVID-19 vaccine. The results of these hypothesis tests are summarized in **Table 5**. Overall, our results provide support for the notion that belief in COVID-19 conspiracy theories is associated with political-psychological predispositions that align with the specific content of each origin theory. Our results also highlight the negative consequences of conspiracy theories for effective public health interventions.

Previous research has found that there is a general disposition to believe in conspiracy theories, which has sometimes been referred to as a “conspiracy mentality” (Goertzel, 1994; Bruder et al., 2013). Our findings are consistent with this literature, as we report that a general measure of conspiracy ideation is associated with the Wuhan lab theory albeit less so with the 5G theory. Yet, our findings also raise some questions about the monological belief system model of conspiracy theories, at least in the case of COVID-19, as well as the explanatory power of conspiracy mentality to predict subsequent behaviors (Imhoff and Lamberty, 2020; Miller, 2020). In both of our conspiracy theory models, the effect size of conspiracy ideation is smaller than the findings of recent studies that also control for political predispositions like partisanship (e.g. see Uscinski et al., 2020). Of course, differences in effect sizes across studies could be partly due to differences in research design, measures, and analyses’ for example Uscinski et al. (2020) used belief that the virus was purposefully made and spread as their outcome variable, whereas we look at COVID-19 origin theories that may be intentional but differ in terms of their potential plausibility and the nature of the implied threat.

We argue, however, that it is this latter source of variation--and the specific content of the theories themselves--that underlies our primary contribution: Different conspiracy theories have

different psychological and social determinants. Both RWA and SDO are strong predictors of belief in the Wuhan laboratory conspiracy theory, while belief in the 5G conspiracy theory is only positively associated with SDO; RWA, in fact, decreases endorsement in 5G belief. Our findings suggest these underlying predispositions may motivate differential beliefs depending upon, for example, the specific threats triggered by the content of a conspiracy theory, though we acknowledge we do not measure this directly.

Our differential findings between RWA and COVID-19 conspiracy theories is inconsistent with previous research suggesting a positive association between authoritarianism and conspiracy theories, in general (Bruder et al., 2013; Richey, 2017); however, our results are in line with more recent work that indicates a susceptibility of those high in RWA to conspiracy theories conforming to their worldview (Wood and Gray, 2019). For instance, RWA has shown to be associated with pro-military positions, and those high in RWA are particularly sensitive to threats to both security and the social order (Pratto et al., 1994; Doty et al., 1997; McFarland and Mathews, 2005; Terrizzi and Drews, 2005; Crowson et al., 2006; Jackson and Gaaertner, 2010; McFarland, 2015; Lindén et al., 2018). In this respect, a susceptibility of those high in RWA to a specific belief in the Wuhan lab (i.e., bioweapons) theory seems logical.

A similar case was put forward for why those high in SDO would be specifically susceptible to the Wuhan lab theory; however, SDO also predicted belief in the 5G conspiracy theory. While it might seem unexpected that this preference should be associated with conspiracy belief, previous research has reported a similar magnitude of association to that reported here (e.g., see Bruder et al., 2013), and recent research has reported a moderate positive association between SDO and belief COVID-19 that was man-made (Imhoff and Lamberty, 2020). As suggested in our theoretical discussion above, this association may be indicative of a relationship between SDO and anti-establishment conspiracy belief, in which conspiracy accounts are more plausible for those that see the world as naturally hierarchical, ruthless, and a “dog-eat-dog” competition (De keersmaeker and Roets, 2019). Perhaps, then, a theory in which the United Kingdom government has risked or deliberately compromised the health of the population to get ahead technologically, or in which the negative health effects of

5G are hidden as part of a corporate cover-up, might seem more plausible to those high in SDO. Moreover, although this is speculative, the present study cannot rule out the possibility that the responses given by those high in SDO are expressive rather than truthful responses (e.g., see Hartman and Newmark, 2012; Richey, 2017). In other words, perhaps those high in SDO are reporting a belief in the 5G theory due to a desire to express a related opinion that they hold, rather than because they truly believe 5G causes COVID-19. Those high in SDO are particularly sensitive to the economic threat of outgroups and are motivated toward socio-economic dominance (Craig and Richeson, 2014; Ho et al., 2015); it is therefore conceivable that those high in SDO are expressing an attitude about the reliance on Chinese technology during the development of the 5G network, or a more indirect sense of threat from the economic consequences inherent to national lockdowns. It is also possible that the link between 5G and China is more salient to those high in SDO, and their response here is motivated by prejudice (Duckitt, 2001; Ho et al., 2015). Alternatively, perhaps indicating belief in conspiracies in this context is related to a deeper desire to spread conspiracy beliefs, which fits with Lobato et al. (2020) findings.

Amongst our other predictors, distrust in scientists was a strong predictor of both Wuhan laboratory and 5G belief, consistent with previous research suggesting trust in sources is a key motivator of subsequent behavior, but that trust in knowledgeable experts may be undermined where they are perceived as withholding information or possessing ulterior motives (Eiser et al., 2009). Similarly, the influence of political and informational factors on the perceived plausibility of COVID-19 origin theories draws attention to the fact that conspiracy theories are to some extent social phenomena (Kreko, 2015). Both conspiracy theories were associated with obtaining information about the pandemic from family and friends and tabloid newspapers, and 5G belief was uniquely predicted by receiving information from social media.

The more plausible meat market origin theory differed from both of the conspiracy theories by being positively associated with intolerance of uncertainty, which we would expect, whereas this construct had no effect on the conspiracy theories. This is perhaps a counterintuitive finding given evidence of the role uncertainty plays in conspiracy belief (e.g. van Prooijen and Jostmann, 2013). However, it is notable that one mechanism through which uncertainty affects conspiracy belief is through over-attentiveness to prior judgements of the morality of conspiracy protagonists (ibid.), which may not be a salient factor for people's judgements of the protagonists in our conspiracy theories, such as the 5G network. Moreover, the effect of uncertainty in these studies was demonstrated on conspiracies involving political and military espionage that posed no direct threat to the participants (ibid.), whereas we have argued the Wuhan laboratory and 5G origin theories may motivate belief via predispositions due to an increased sense of normative threat.

In addition to revealing general and specific influences on theories about the origins of the COVID-19 virus, our findings also reveal the effects of these theories on willingness to take part

in public health interventions. Our findings provide an interesting comparison to those of recent studies that found that belief the virus was a hoax, but not belief the virus was man-made, reduced social distancing compliance, and that conspiracy mentality negatively predicted compliance with self-isolation to prevent transmission (Imhoff and Lamberty, 2020; Marinthe et al., 2020). Willingness to comply with social distancing was positively associated with the meat market theory but negatively with the 5G theory, despite the content of a number of 5G conspiracy theories which implied the virus is man-made. In addition, we find a small positive effect of conspiracy ideation on social distancing. Rather, our findings may suggest the more salient factor for social distancing is whether the conspiracy implies human transmission. The lack of effect for the Wuhan laboratory theory is congruent with this assertion, given it still implies human transmission. Nevertheless, these reflections on our results are largely exploratory and a matter for further research as they provide nuance on our initial hypothesis that conspiracy belief would be negatively associated with social distancing. Both conspiracy theories were also associated with skepticism about vaccines, perhaps reflecting the fact that these theories are both strongly associated with distrust in scientists or the established relationship between conspiracy belief and rejection of the biomedical model (Lamberty and Imhoff, 2018). These observations highlight the fact that conspiracy theories are a potentially severe threat to public health.

Our study has a number of strengths and limitations that must be acknowledged. The main strengths were a large, representative sample of the United Kingdom population, who had provided a rich dataset encompassing social, demographic, psychological, and political variables. The major limitations were that we had measurements of only three origin theories, which means that we differ from recent research that explicitly models belief that the virus is a hoax (Imhoff and Lamberty, 2020; Uscinski et al., 2020), although as noted above, for some believers in the 5G theory this may be implied. Also, our COVID-19 origin theory measures were observational and cross-sectional, limiting our ability to make stronger causal inferences.

Finally, the findings we outline may be relatively bounded by context, which potentially limits their generalizability. In the first instance, the relationship between predispositions and conspiracy belief, we have argued, will be partly dependent upon the sense of threat implied by conspiracy content. But further than this, Marinthe et al. (2020) find conspiracy mentality reduces compliance with preventative public health behaviors primarily when they are mandated by authorities, rather than aversion to the behavior itself. In a similar sense, the aversion to social distancing and vaccination we find among conspiracy theory believers may be partly mediated by a rejection of government mandates, as opposed to the specific behaviors *per se*. It is plausible that in a context where social distancing and vaccination are not normatively encouraged by government that the relationship with conspiracy belief would be suppressed, though it is unlikely to completely disappear, given the anti-scientific themes running through many conspiracy theories.

Yet, we would argue an important implication of our work is the need for public health agencies to consider conspiracy theories in their planning and interventions that might mitigate these effects. Despite evidence of relative stability, neither SDO nor RWA are immutable; rather, we have argued that they are predispositions that are sensitive to the current context, including the salience of perceived threats to the social order and security of the ingroup (Duckitt and Sibley, 2016:192,199; Stenner, 2005: 14–19). Interventions will therefore need to be part of multifaceted strategies that reflect the complexity of conspiracy theory proliferation, as well as how they might interact with predispositions, with interventions targeted at both the purposeful propagators of conspiracy theories and the susceptible receivers of misinformation. For example, Uscinski et al. (2020) have recently argued that if partisan cues exacerbate the propagation of conspiracy beliefs (at least in the United States), then partisanship may also be mobilized to provide corrective information. While we find no effect of political orientation in our work, there are parallels in that perhaps the group identities salient to people high in RWA and SDO can be mobilized, for instance by having trusted sources within skeptical communities help seed reliable information. The feasibility and efficacy of strategies, given the strongly held prior beliefs of such groups, remains an open question for both practitioners and researchers.

Concerning susceptible receivers, research has demonstrated some success in “inoculating” people against conspiracy theories, either by being pre-warned about them or by taking part in exercises, for example presented as computer games, in which they are asked to generate “fake news” themselves (see van der Linden et al., 2020). Strategies such as these may be amenable to mass dissemination, but this would require public health agencies to include the tracking of conspiracy theories in their pandemic planning and be ready to intervene as widely as possible at the earliest opportunity.

DATA AVAILABILITY STATEMENT

The full dataset and R script files are available at the Open Science Framework: <https://osf.io/v2zur/>.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the ethical committee approval of the University of Sheffield (Reference number 033759). The patients/participants provided their written informed consent to participate in this study.

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AUTHOR CONTRIBUTIONS

TH: Contribution to the design of the study; Drafting or revising manuscript; Data analysis. MM: Contribution to the design of the study; Drafting or revising manuscript; Data analysis. TS: Contribution to the design of the study; Drafting or revising manuscript. RM: Contribution to the design of the study; Drafting or revising manuscript. KB: Contribution to the design of the study; Drafting or revising manuscript. SB: Contribution to the design of the study; Drafting or revising manuscript. JGM: Contribution to the design of the study; Drafting or revising manuscript. PH: Contribution to the design of the study; Drafting or revising manuscript. LL: Contribution to the design of the study; Drafting or revising manuscript. AM: Contribution to the design of the study; Drafting or revising manuscript; Ethical approval. LM: Contribution to the design of the study; Drafting or revising manuscript. OM: Contribution to the design of the study; Drafting or revising manuscript. JM: Contribution to the design of the study; Drafting or revising manuscript. MS: Contribution to the design of the study; Drafting or revising manuscript. FV: Contribution to the design of the study; Drafting or revising manuscript. RB: Contribution to the design of the study; Drafting or revising manuscript; Final approval.

FUNDING

The initial stages of this project were supported by start-up funds from the University of Sheffield (Department of Psychology, the Sheffield Methods Institute and the Higher Education Innovation Fund via an Impact Acceleration grant administered by the university) and by the Faculty of Life and Health Sciences at Ulster University. The research was subsequently supported by the ESRC (grant ref. ES/V004379/1): “A longitudinal mixed-methods population study of the United Kingdom during the COVID-19 pandemic: Psychological and social adjustment to a global threat”. TH, KB, SB, JGM, LL, LM, OM, JM, MS, and RB received financial support from this grant for the submitted work.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpos.2021.642510/full#supplementary-material>

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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