Coronavirus conspiracy beliefs in the German-speaking general population: endorsement rates and links to reasoning biases and paranoia

Sarah Anne Kezia Kuhn¹, Roselind Lieb¹, Daniel Freeman², Christina Andreou³ and Thea Zander-Schellenberg¹

¹Division of Clinical Psychology and Epidemiology, Department of Psychology, University of Basel, Basel, Switzerland; ²Oxford Cognitive Approaches to Psychosis, University Department of Psychiatry, University of Oxford, Warneford Hospital, Oxford OX3 7JX, UK and ³Department of Psychiatry and Psychotherapy, Translational Psychiatry Unit, University of Luebeck, Luebeck, Germany

Abstract

Background. Coronavirus-related conspiracy theories (CT) have been found to be associated with fewer pandemic containment-focused behaviors. It is therefore important to evaluate associated cognitive factors. We aimed to obtain first endorsement rate estimates of coronavirus-related conspiracy beliefs in a German-speaking general population sample and investigate whether delusion-related reasoning biases and paranoid ideation are associated with such beliefs.

Methods. We conducted a cross-sectional non-probability online study, quota-sampled for age and gender, with 1684 adults from Germany and German-speaking Switzerland. We assessed general and specific coronavirus conspiracy beliefs, reasoning biases [jumping-to-conclusions bias (JTC), liberal acceptance bias (LA), bias against disconfirmatory evidence (BADE), possibility of being mistaken (PM)], and paranoid ideation, using established experimental paradigms and self-report questionnaires.

Results. Around 10% of our sample endorsed coronavirus-related CT beliefs at least strongly, and another 20% to some degree. Overall endorsement was similar to levels observed in a UK-based study (Freeman et al., 2020b). Higher levels of conspiracy belief endorsement were associated with greater JTC, greater LA, greater BADE, higher PM, and greater paranoid ideation. Associations were mostly small to moderate and best described by non-linear relationships.

Conclusions. A noticeable proportion of our sample recruited in Germany and German-speaking Switzerland endorsed coronavirus conspiracy beliefs strongly or to some degree. These beliefs are associated with reasoning biases studied in delusion research. The non-probability sampling approach limits the generalizability of findings. Future longitudinal and experimental studies investigating conspiracy beliefs along the lines of reasoning are encouraged to validate reasoning aberrations as risk factors.

Introduction

History shows that conspiracy beliefs often thrive in crises (van Prooijen & van Vught, 2018). Fake information now spreads (digitally) faster and further than ever before (Ahmed, Vidal-Alaball, Downing, & Seguí, 2020). Beliefs in conspiracy theories (CTs) are commonly also referred to as conspiracy beliefs and can be understood as beliefs concerning patterns of causal connections involving intentional actions of conspirators acting in a group and secretly collaborating towards a harmful or deceptive goal (van Prooijen & van Vught, 2018).

As governments implement unprecedented measures affecting almost all aspects of life to contain the coronavirus disease 2019 (COVID-19) pandemic, conspiracy beliefs regarding the coronavirus – which mainly target the severe acute respiratory syndrome-coronavirus-2 (SARS-CoV-2) – may arise even in people who would not normally endorse CTs. Consequently, both endorsement rates and negative consequences of coronavirus CTs – for example, less infection-conscious behaviors (Allington, Duffy, Wessely, Dhavan, & Rubin, 2020), more precautionary behaviors such as hoarding (Imhoff & Lamberty, 2020), and inter-ethnic hostility (Schild et al., 2020) – may exceed negative outcomes of former CTs. It is therefore important to determine the endorsement rates of coronavirus-related conspiracy beliefs and the psychological risk factors underlying these beliefs to support policy makers in fostering guideline-observing behaviors (Freeman et al., 2020b; Georgiou, Delfabbro, & Balzan, 2020; Van Vavel et al., 2020).
High rates of ‘common’ CTs were reported before the coronavirus outbreak, with around 20% of the general population believing in CTs such as a faked moon landing, for example (Mancosu, Vassallo, & Vezzoni, 2017). In times of corona, a recent study by Freeman et al. (2020b) showed that of a British general population sample, around 15% endorsed coronavirus-related conspiracy beliefs at least strongly, another 25% agreed with them to some degree. This included both beliefs involving a broad, unspecific definition of actors or the conspirational goal (denoted as ‘general conspiracy beliefs’), as well as beliefs involving a specific conception of conspirators, a hidden goal or the measures taken to mislead others (denoted as ‘specific conspiracy beliefs’). In a related study, 28% of participants in a UK sample agreed with any coronavirus-related CT (Allington et al., 2020). Similar rates have been reported for the belief of a manufactured virus across countries (Roozenbeek et al., 2020). Similarly, one in three participants in a US-based survey believed that the coronavirus was created and spread intentionally (Uscinski et al., 2020).

Although beliefs in CTs are not a new phenomenon, psychological research has only recently started investigating associated cognitive factors that may be linked to the occurrence of conspiracy beliefs. For example, greater endorsement of CTs has been observed in people who engage in less analytical and more intuitive reasoning modes (Barron et al., 2018; Georgiou, Delfabbro, & Balzan, 2019; Lantian, Bagneux, Delouvée, & Gauvrit, 2021; Swami, Voracek, Stieger, Tran, & Furnham, 2014). Reasoning biases observed in delusions, which are distinct yet related phenomena, may also be relevant (e.g. Bronstein, Everaert, Castro, Joormann, & Cannon, 2019). While delusions involve a narrower definition of counterparties and are more personally targeted, what they share with CTs is combining seemingly unrelated phenomena into meaningful patterns even if there are none.

Delusion-associated biases such as jumping-to-conclusions (JTC bias; e.g. Dudley & Over, 2003), liberal acceptance (LA bias, a lowered decision threshold; Moritz & Woodward, 2004), bias against disconfirmatory evidence (BADE; Woodward, Buchy, Moritz, & Liotti, 2007) and an excessive confidence in a belief with no ‘possibility of being mistaken’ (PM; Garety et al., 2005; So et al., 2012) might be also associated with the endorsement of coronavirus-related CTs. To our knowledge, only two studies have investigated the association between reasoning biases and CTs and found that a more pronounced JTC is associated with more conspiracy beliefs (Moulding et al., 2016; Pytlík, Soll, & Mehl, 2020). However, no study has yet tested the association between various reasoning biases and beliefs in CTs in a representative general population sample.

We aimed to estimate endorsement rates of existing coronavirus-related CTs in a German-speaking representative general population sample (Aim 1) and test whether reasoning biases and paranoia are associated with coronavirus-related CT beliefs (Aim 2). Regarding Aim 2, we hypothesized that endorsement of general and specific coronavirus conspiracy beliefs is associated with a greater jumping-to-conclusions bias (JTC; Hypothesis 1ab), a greater bias against disconfirmatory evidence (BADE; Hypothesis 2ab), a lower self-stated possibility to being mistaken (PM; Hypothesis 3ab), a greater liberal acceptance bias (LA; Hypothesis 4ab), and greater paranoid ideation (Hypothesis 5ab) (Aim 2). In subsidiary analyses, we expect that stronger endorsement of coronavirus-related conspiracy beliefs is associated with younger ages (Swami, 2012) and lower levels of education (van Prooijen, 2017).

**Methods**

**Participants**

Participants were recruited via Respondi, an ISO-certified recruitment panel facilitating assessment of highly motivated participants via a double-opt-in registration process, fair incentives, and regular quality monitoring. Respondents were recruited via online campaigns of Respondi’s panels. We aimed to collect data within a maximum of two weeks and a minimum of three days to also assess less-than-daily users of online services.

Inclusion criteria were an age of 18–69 years (due to platform characteristics), informed consent, permanent residency in Germany or the German-speaking part of Switzerland, and good proficiency in the German language. No further inclusion criteria were specified in order to obtain a rather representative general population sample. Participants who had responded to all questions uniformly were excluded.

We employed a non-probability quota sampling for both countries. Recruitment was conducted with regard to quota for gender and age groups for the German (Statistisches Bundesamt, 2020a, 2020b; women: 50.65%; of which 20.41% aged 18–29; 18.85% aged 30–39; 18.50% aged 40–49; 23.91% aged 50–59; 18.28% aged 60–69) and the Swiss (Bundesamt für Statistik, 2019; women: 49.63%; of which 21.01% aged 18–29; 20.72% aged 30–39; 20.54% aged 49–49: 21.86% aged 50–59; 15.88% aged 60–69) population of interest.

**Procedure**

This study was a cross-sectional online study performed using UniPark software (Questback GmbH). The study protocol was approved by the local ethics committee of the Department of Psychology, University of Basel. All assessments were completed in one web-based assessment: After providing basic demographic information, participants answered questions on their momentary perceived stress and their endorsement of general and specific coronavirus-related conspiracy beliefs. Reasoning biases and paranoid ideation were assessed through experimental paradigms and self-report items. Recruitment took place between 2 July 2020 and 7 July 2020, at a time when the first wave of COVID-19 infections had been overcome in both countries and a second wave had not started evolving yet.

**Measures**

We first assessed participants’ demographic information and self-described political orientation to describe the sample profile in a way that it can be reasonably compared to other samples (e.g.
Baier & Manzoni, 2020; Freeman et al. 2020b). Political orientation was assessed using one item (‘How would you rate your political orientation on the following spectrum?’) with a 7-point Likert scale ranging from 1 = ‘Left-wing’ to 7 = ‘Right-wing’.

**General and specific coronavirus-related conspiracy beliefs**

General and specific conspiracy beliefs targeting the coronavirus were assessed using items developed and used by Freeman et al. (2020b). The inventory comprises 30 items assessing endorsement of specific coronavirus-related conspiracy beliefs (e.g. ‘Coronavirus is a bioweapon developed by China to destroy the West’) and 18 items assessing endorsement of general coronavirus-related conspiracy beliefs (e.g. ‘The virus is a hoax’). The latter are subdivided into the sub-categories ‘skepticism about the government’s response’ (3 items), ‘general conspiracy views about the cause of the virus’ (3 items), ‘general conspiracy views about the spread of the virus’ (7 items), and ‘general conspiracy views about the reasons for lockdown’ (5 items). All items were selected by Freeman et al. (2020b) to balance out political and religious influences. We added another specific conspiracy belief repeatedly stated on various media platforms (‘Bill Gates intends to use COVID-19 testing and a future vaccine to track people with microchips’). The items were translated into German via forward—backward translation (Supplemental Material).

All items in Freeman et al. (2020b) were answered using a 5-point-Likert scale. To obtain more fine-grained information, we applied a continuous scaling approach with a slider scale ranging from 0 to 100. The scale was labelled from left to right with the scale labels used in the original study: ‘do not agree’, ‘agree a little’, ‘agree moderately’, ‘agree a lot’, ‘agree completely’. The aim was to assess levels of degree of conviction in conspiracy beliefs in a manner clearly understandable by participants and easily interpretable (Freeman et al., 2020a). The beliefs presented were extreme, with a simple, low cognitive load response option (‘do not agree’). Total scores of specific conspiracy beliefs and of general conspiracy beliefs were obtained by averaging all corresponding item scores (range for both total scores: 0–100). Cronbach’s alpha for the general and specific belief subscales were excellent ($\alpha_{\text{general}} = 0.97$; $\alpha_{\text{specific}} = 0.98$).

**Jumping-to-conclusions bias**

The JTC bias was assessed with an established measure of JTC, the ‘fish task’ (e.g. Speechley, Whitman, & Woodward, 2010). Participants were shown two lakes containing orange and grey fish (lake A 80% orange : 20% grey fish; lake B reverse ratio). Ten fish were being successively caught and presented until participants were ready to decide from which lake the fish were being caught. Following each fish caught, participants were asked to indicate the probability with which the fish had been caught from Lake A or from Lake B (0–100%), and whether they had yet decided regarding the source of all the fish caught. All caught fish remained visible throughout the task to minimize demands on working memory. The JTC bias was measured by counting the number of ‘draws to decision’ (DTD; e.g. Andreou, Veckenstedt, Lüdtke, Bozikas, & Moritz, 2018; Moritz et al., 2017). If no final decision for either of the lakes had been made by the tenth catch, DTD was scored as 11. The higher the DTD score, the lower the JTC bias.

**Liberal acceptance bias**

A LA bias was assessed within the ‘fish task’ paradigm via the indicated probability (i.e. the ‘decision threshold’) upon making the final judgment. Consequently, the raw score for LA bias can range from 0 to 100, where a low score represents a greater LA bias in the form of a lowered decision threshold (e.g. Klein & Pinkham, 2018; Moritz et al., 2016, 2018).

**Bias against disconfirmatory evidence**

BADE was assessed using the fictitious scenario task (e.g. Veckenstedt et al., 2011), which is based upon the original BADE task (Eisenacher et al., 2016; Woodward, Moritz, Cuttler, & Whitman, 2006). Participants were presented with initially ambiguous scenarios that became gradually disambiguated. Each trial began with an ambiguous statement, followed by two further statements providing disambiguating information. Four possible interpretations were given for each scenario (one true, one absurd, and two plausible lures). After each statement, the participant was asked to provide probability ratings for each of the four interpretations on an 11-step slider scale ranging from 0–100%. High scores corresponded to high confidence estimates. BADE was calculated by computing the mean change in confidence from sentence one to sentence three for the lure interpretations. In total, two randomly drawn scenarios (one with an emotional answer option, one with a neutral answer option as the true answer) were displayed. This decision was made in order to capture both an affectively charged and a neutrally charged outcome scenario, while minimizing study burden for participants. A total BADE score was obtained by averaging the BADE scores from both scenarios. A higher positive score represents a lower BADE; a higher negative score a higher BADE.

**Possibility of being mistaken**

Here, participants were presented with a random coronavirus-related belief and asked to rate the likelihood of being mistaken in their degree of endorsement of this particular belief. Participants used a slider scale ranging from 0 (=‘very unlikely’) to 100 (=‘very likely’). Several studies have used such a ‘one-item’ approach to operationalize PM (e.g. Dudley et al., 2011; Jolley et al., 2014; So et al., 2012).

**Paranoid ideation**

Paranoid ideation was assessed using the German version of the Paranoia Checklist (PCL; Lincoln, Peter, Schäfer, & Moritz, 2009; original by Freeman et al., 2005). The PCL contains 18 self-report items and is sensitive to dimensional non-clinical paranoia ideation in healthy individuals (Freeman et al., 2005). For each statement, participants rated how convinced they were it was true, using a 5-point Likert scale (1 = ‘not convinced at all’, 5 = ‘very convinced’). A total score for paranoid ideation was obtained by summing up all item scores.

**Momentary perceived stress**

For exploratory purposes and in order to control for potentially confounding effects regarding the assessment of both conspiracy related beliefs (Swami et al., 2016) and reasoning biases (Moritz, Köther, Hartmann, & Lincoln, 2015), we assessed momentary subjective stress using a one-item scale (‘How stressed do you feel at the moment?’; e.g. Bollini, Walker, Hamann, & Kestler, 2004; Clamor, Koenig, Thayer, & Lincoln, 2016). A 10-point Likert scale was used (1 = ‘not at all stressed’, 10 = ‘extremely stressed’).
Endorsement rates of conspiracy beliefs were computed descriptively. In order to estimate endorsement rates of single beliefs in a manner comparable to Freeman et al. (2020b), we post-hoc assigned raw values of the belief assessing slider scales to one of the five sections. Scores between 0 and 20 were assigned to ‘1’ (equalling ‘do not agree’), scores between 21 and 40 were assigned to ‘2’ (equalling ‘agree a little’), and so forth. We also calculated belief endorsement rates with ‘no degree of conviction at all’ (‘0’ scores). 95% confidence intervals of these endorsement rates were estimated using bootstrapping with 1000 samples. This procedure enables to draw comparisons, at least to some degree, with the endorsement rate estimates reported by Freeman et al. (2020b), while at the same time allowing to maintain a continuously scaled raw score for further analyses. To facilitate comparability, we computed Likert-based total scores per subscale by summing up Likert-scaled scores of corresponding items. We also calculated continuously scaled endorsements of single beliefs and belief subscales, always ranging from 0 to 100.

Addressing our hypotheses regarding the associations of conspiracy beliefs with reasoning biases and paranoia, we conducted multiple regression analyses to establish standardized and unstandardized regression coefficients. In each regression model, we controlled for demographic variables and momentary subjective stress, and for paranoid ideation in models for H1ab to H4ab. Exploratorily, we also tested whether quadratic relationships of these biases and conspiracy beliefs better explained the data at hand, as, for instance, CTs might be strongly endorsed both by individuals with low PM and individuals with high PM (who might think they may be misled by conspirators). Quadratic regression models each included a squared predictor. All hypotheses tests relied upon α = 0.05 and were performed using R (R Core Team, 2020). All data have been made publicly available and can be accessed via the Open Science Framework website (https://osf.io/qgb9e/).

Results

In total, N = 1829 individuals were recruited, of which N = 1684 (92.07%; in the following denoted as ‘full sample’; N = 1130 German participants, N = 554 Swiss participants) individuals provided complete data. Of the excluded sample, most participants were excluded due to premature drop-out and two participants were dropped from analyses due to a uniform responding style across items. An overview of demographic information about the full sample is provided in Table 1. Quota of this group was consistent with population-based quota targets for age and gender by country.

Endorsement rates of coronavirus-related conspiracy beliefs

Continuously scaled endorsement of beliefs

On average, conspiracy belief items were endorsed with rather low levels (M = 17.41, S.D. = 24.41, range: 0–100). Only 0.89% of participants did not endorse any conspiracy belief at all (i.e. M = 0.00). Similar results emerged when skepticism items were dropped (1.37% of participants with zero endorsement). Of all beliefs, conspiracy beliefs of skepticism (items s2c and s3c) and those related to the cause of the virus (item c2) were endorsed with highest levels (Table 2). We found that endorsement of specific, but not of general, conspiracy beliefs differed slightly by country: Swiss participants indicated greater endorsement of specific conspiracy beliefs (MdnSwiss = 5.6, MdnGerman = 4.3; Table 3).

Likert-scaled endorsement of beliefs

The mean total specific conspiracy belief score for Likert-scaled endorsement was 34.20 (S.D. = 29.09), the mean total general conspiracy belief score for Likert-scaled endorsement was 34.20 (S.D. = 17.91). An average general and specific conspiracy belief was endorsed strongly (indicated by endorsement of at least ‘a lot’) by 14.49% (95% CI 11.80–17.23) and by 6.32% (95% CI 5.28–7.37), respectively (Table 2). Across both types of belief, 9.32% (95% CI 7.68–10.96) endorsed a conspiracy belief at least strongly. Another 19.99% (95% CI 17.92–22.10) endorsed a belief to some degree (indicated by endorsement of ‘a little’ or ‘moderately’). Similar percentages of Swiss [9.94% (95% CI 8.38–11.42)] and German [9.03% (95% CI 7.40–10.59)] participants endorsed any of the assessed conspiracy beliefs at least strongly.

Associations between conspiracy beliefs, demographics, and stress

As expected, we found evidence that both endorsement of general and of specific conspiracy beliefs was associated with younger ages [rs_gen(1682) = −0.07, p = 0.007; rs_spec(1682) = −0.10, p < 0.001] and lower levels of education [rs_gen(1682) = −0.21, p < 0.001; rs_spec(1682) = −0.18, p < 0.001]. Belief endorsement was not associated with gender [rs_gen(1682) = 0.01, p = 0.713; rs_spec(1682) = −0.00, p = 0.902], but with higher momentary stress [rs_gen(1682) = 0.16, p < 0.001; rs_spec(1682) = 0.19, p < 0.001]. Also, a tendency towards extreme political orientations predicted greater endorsement of both general [linear term: b = −36.26, t(1678) = −0.78, p = 0.433; quadratic term: b = 16.07, t(1678) = −2.70, p = 0.007] and specific [linear term: b = −77.34, t(1678) = −1.24, p = 0.315; quadratic term: b = 20.40, t(1678) = 2.55, p = 0.01] conspiracy beliefs in each regression model.

Associations between conspiracy beliefs, reasoning biases and paranoia

Confirming our hypotheses 1ab, 2b, 4ab and 5ab, a greater JTC bias (indicated by a lower DTD), a greater BADE (positive
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<td></td>
<td>Skepticism</td>
<td>33.33 (26.08)</td>
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<tr>
<td>sc1</td>
<td>The government is misleading the public about the cause of the virus</td>
<td>29.82 (28.30)</td>
<td>10.44 (8.97-11.94)</td>
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<td>sc2</td>
<td>I'm skeptical about the official explanation about the cause of the virus.</td>
<td>38.70 (30.49)</td>
<td>8.15 (6.89-9.50)</td>
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<td>Conspiracy cause of the virus</td>
<td>26.80 (24.13)</td>
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<tr>
<td>c1</td>
<td>The virus is a hoax.</td>
<td>16.44 (24.37)</td>
<td>22.04 (20.07-24.11)</td>
</tr>
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<td>c2</td>
<td>The virus is manmade.</td>
<td>39.55 (31.71)</td>
<td>9.13 (7.78-10.51)</td>
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<td>c3</td>
<td>The virus is produced by powerful organizations (e.g. government, military).</td>
<td>24.40 (28.40)</td>
<td>7.30 (15.50-19.00)</td>
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<td>The spread of the virus is a deliberate attempt:</td>
<td>22.13 (25.07)</td>
<td></td>
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<td>spr1</td>
<td>...to reduce the size of the global population.</td>
<td>21.12 (26.87)</td>
<td>20.34 (18.41-22.45)</td>
</tr>
<tr>
<td>spr2</td>
<td>...by governments to gain political control.</td>
<td>25.18 (29.73)</td>
<td>17.36 (15.56-19.18)</td>
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<td>% with 0 endorsement*</td>
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<td>Agreement to some degreeb</td>
<td>% (95% CI)</td>
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<td></td>
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<td>Strong agreement (At least 'Agree a lot')c</td>
<td>% (95% CI)</td>
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<td></td>
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<td>'Do not agree'</td>
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<td></td>
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<td>'Agree a little'</td>
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<td>'Agree moderately'</td>
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<td>'Agree a lot'</td>
<td>% (95% CI)</td>
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<td>'Agree completely'</td>
<td>% (95% CI)</td>
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<td>spr5</td>
<td>...by one nation to destabilize another.</td>
<td>22.95 (27.79)</td>
<td>18.71  (16.92–20.72)</td>
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<td>spr6</td>
<td>...by global companies to take control.</td>
<td>22.19 (28.41)</td>
<td>19.88  (18.05–21.73)</td>
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<td>spr7</td>
<td>...by activists to stop climate change.</td>
<td>13.58 (21.28)</td>
<td>24.69  (22.74–26.66)</td>
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Conspiracy reasons for lockdown:

The real reason for the lockdown is to:

| r1    | ...stop immigration.                                                      | 13.86 (21.35)                  | 25.91  (23.81–27.91) | 436 | 20.95 (19.00–22.86) | 352 | 5.08 (4.04–6.18) | 86 | 74.03 (71.91–76.19) | 1246 | 12.09 (10.63–13.66) | 203 | 8.83 (7.42–10.15) | 149 | 3.74 (2.91–4.63) | 63  | 1.39 (0.83–1.96) | 23  |
| r2    | ...control every aspect of our lives.                                     | 23.93 (29.99)                  | 20.08  (18.23–21.97) | 338 | 23.53 (21.55–25.71) | 396 | 15.46 (13.6–17.28) | 261 | 61.07 (58.73–65.64) | 1027 | 11.96 (10.45–13.54) | 202 | 11.56 (10.04–13.18) | 194 | 8.68 (7.42–10.10) | 147 | 6.81 (5.70–8.08) | 114 |
| r3    | ...impose mass surveillance.                                              | 25.41 (31.20)                  | 20.40  (18.59–22.33) | 343 | 23.32 (21.38–25.24) | 393 | 17.01 (15.14–18.76) | 287 | 59.67 (57.36–62.06) | 1004 | 12.06 (10.45–13.78) | 203 | 11.32 (9.86–12.89) | 190 | 8.74 (7.48–10.15) | 147 | 8.31 (7.01–9.62) | 140 |
| r4    | ...destabilize the nation for political gain.                             | 21.12 (27.68)                  | 20.44  (18.53–22.45) | 344 | 23.21 (21.20–25.18) | 391 | 12.11 (10.57–13.78) | 204 | 64.67 (62.53–66.92) | 1089 | 11.27 (9.68–12.71) | 189 | 12.04 (10.51–13.60) | 202 | 7.72 (6.41–8.97) | 130 | 4.39 (3.44–5.4) | 74  |
| r5    | ...destabilize the economy for financial gain.                            | 21.48 (28.23)                  | 20.42  (18.59–22.21) | 344 | 22.58 (20.61–24.58) | 380 | 12.67 (11.05–14.31) | 213 | 64.78 (62.47–67.10) | 1091 | 11.34 (9.86–12.77) | 191 | 11.21 (9.80–12.83) | 189 | 7.83 (6.53–9.2) | 132 | 4.83 (3.8–5.82) | 81  |
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</table>

Specific conspiracy beliefs

|    | 13.29 (18.11) | 30.79 (29.22-32.40) | 517 | 15.84 (14.20-17.41) | 268 | 6.32 (5.28-7.37) | 106 | 77.84 (75.42-80.33) | 1309 | 8.13 (7.18-9.07) | 138 | 7.71 (7.05-8.38) | 130 | 3.80 (3.26-4.35) | 65 |

Coronavirus is a bioweapon developed by China to destroy the West.


The virus is a biological weapon manufactured by the United States.

|    | 15.40 (22.33) | 23.71 (21.62-25.83) | 400 | 22.21 (20.31-24.29) | 374 | 6.02 (4.93-7.13) | 102 | 71.82 (69.77-73.87) | 1209 | 12.48 (10.93-14.01) | 211 | 9.66 (8.31-11.10) | 163 | 4.26 (3.33-5.23) | 29 |

The virus is a scaremongering tactic to prevent Brexit.

|    | 10.15 (18.97) | 31.31 (29.28-33.31) | 527 | 14.40 (12.59-16.15) | 242 | 3.15 (2.38-3.98) | 53 | 82.48 (80.70-84.15) | 1389 | 8.01 (6.71-9.21) | 135 | 6.33 (5.23-7.48) | 107 | 1.59 (1.01-2.20) | 27 |

Coronavirus is being used by the elite to stop Brexit.

|    | 10.23 (18.37) | 30.79 (28.56-33.08) | 518 | 15.06 (13.30-16.81) | 254 | 2.94 (2.14-3.80) | 50 | 81.92 (80.11-83.79) | 1380 | 8.74 (7.30-10.1) | 147 | 6.35 (5.17-7.54) | 107 | 1.91 (1.25-2.55) | 32 |

The UN and WHO have manufactured the virus to take global control.


Jews have created the virus to collapse the economy for financial gain.

|    | 8.59 (18.07) | 35.83 (33.43-38.19) | 603 | 10.79 (9.38-12.23) | 182 | 3.14 (2.37-3.98) | 53 | 86.04 (84.32-87.65) | 1449 | 5.79 (4.75-7.07) | 97 | 5.06 (4.10-6.18) | 85 | 1.72 (1.19-2.38) | 29 |

Muslims are spreading the virus as an attack on Western values.

|    | 9.09 (17.99) | 34.76 (32.54-37.05) | 586 | 11.94 (10.39-13.42) | 201 | 3.16 (2.32-3.98) | 53 | 84.95 (83.19-86.64) | 1430 | 6.54 (5.40-7.66) | 110 | 5.41 (4.33-6.53) | 91 | 2.07 (1.43-2.79) | 35 |

The elite have created the virus in order to establish a one-world government.

|    | 13.16 (22.93) | 30.56 (28.44-32.66) | 515 | 15.28 (13.72-16.98) | 257 | 6.19 (5.05-7.36) | 104 | 78.55 (76.54-80.46) | 1323 | 7.35 (6.06-8.55) | 124 | 7.89 (6.65-9.09) | 122 | 3.56 (2.67-4.51) | 60 |

Bill Gates has created the virus in order to reduce the world population.

|    | 10.89 (21.35) | 36.43 (34.09-38.72) | 614 | 11.80 (10.27-13.24) | 199 | 5.27 (4.22-6.35) | 89 | 62.94 (61.29-64.62) | 1396 | 5.59 (4.45-6.71) | 94 | 6.23 (5.05-7.36) | 105 | 3.15 (2.38-3.98) | 53 |

Big Pharma created coronavirus to profit from the vaccines.


Big Pharma created the virus to profit from the vaccines.


(Continued)
<table>
<thead>
<tr>
<th>#</th>
<th>Statements</th>
<th>Endorsement (continuously scaled)</th>
<th>Strong endorsement (At least 'Agree a lot')</th>
<th>Endorsement (Likert-scaled)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>% with 0 endorsement*</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>M (s.a.)</td>
<td>(95% CI)</td>
<td>n</td>
</tr>
<tr>
<td>spe 12</td>
<td>Coronavirus is caused by 5 G and is a form of radiation poisoning transmitted through radio waves.</td>
<td>8.92 (18.29)</td>
<td>36.10 (33.79–38.42)</td>
<td>607</td>
</tr>
<tr>
<td>spe 13</td>
<td>Coronavirus is an alien weapon to destroy humanity.</td>
<td>8.32 (18.42)</td>
<td>40.53 (38.36–42.87)</td>
<td>682</td>
</tr>
<tr>
<td>spe 14</td>
<td>The virus is a smokescreen for a global conspiracy that swapped the real world with a simulation.</td>
<td>10.52 (20.47)</td>
<td>35.3 (33.02–37.47)</td>
<td>595</td>
</tr>
<tr>
<td>spe 15</td>
<td>The virus is a front to implement measures to destroy our privacy.</td>
<td>15.90 (25.73)</td>
<td>29.21 (27.14–31.41)</td>
<td>493</td>
</tr>
<tr>
<td>spe 16</td>
<td>Companies are being deliberately put out of business to hide the effects of Brexit.</td>
<td>11.31 (20.85)</td>
<td>32.66 (30.34–34.86)</td>
<td>550</td>
</tr>
<tr>
<td>spe 18</td>
<td>Coronavirus is a plot by globalists to destroy religion by banning gatherings.</td>
<td>12.12 (21.19)</td>
<td>30.08 (28.03–32.13)</td>
<td>506</td>
</tr>
<tr>
<td>spe 19</td>
<td>The intention of lockdown is to force people to rely on big corporations rather than their local businesses.</td>
<td>15.08 (23.92)</td>
<td>28.26 (26.07–30.34)</td>
<td>476</td>
</tr>
<tr>
<td>spe 20</td>
<td>Lockdown is a plot by environmental activists to control the rest of us.</td>
<td>10.35 (19.35)</td>
<td>33.32 (30.88–35.63)</td>
<td>561</td>
</tr>
</tbody>
</table>

(Continued)
### Table 2. (Continued.)

<table>
<thead>
<tr>
<th>#</th>
<th>Statements</th>
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<th>Endorsement (Likert-scaled)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>% with 0 endorsement*</td>
<td>Agreement to some degree</td>
</tr>
<tr>
<td></td>
<td></td>
<td>M (s.d.)</td>
<td>% (95% CI)</td>
</tr>
<tr>
<td>spe 21</td>
<td>The coronavirus vaccine will contain microchips to control the people.</td>
<td>13.70 (24.02)</td>
<td>33.49 (31.18–35.75)</td>
</tr>
<tr>
<td>spe 22</td>
<td>Coronavirus was created to force everyone to get vaccinated.</td>
<td>16.14 (26.72)</td>
<td>30.21 (28.03–32.48)</td>
</tr>
<tr>
<td>spe 23</td>
<td>The vaccine will be used to carry out mass sterilization.</td>
<td>10.81 (20.77)</td>
<td>33.81 (31.53–36.16)</td>
</tr>
<tr>
<td>spe 24</td>
<td>The coronavirus is bait to scare the whole globe into accepting a vaccine that will introduce the ‘real’ deadly virus.</td>
<td>13.28 (23.90)</td>
<td>33.38 (31.18–35.57)</td>
</tr>
<tr>
<td>spe 25</td>
<td>The WHO already has a vaccine and are withholding it.</td>
<td>14.71 (22.89)</td>
<td>27.99 (25.77–30.11)</td>
</tr>
<tr>
<td>spe 26</td>
<td>Antibody testing is a plot to harvest our DNA.</td>
<td>12.81 (22.41)</td>
<td>31.02 (28.68–33.25)</td>
</tr>
<tr>
<td>spe 27</td>
<td>Celebrities are being paid to say they have coronavirus.</td>
<td>14.44 (23.88)</td>
<td>29.33 (27.2–31.47)</td>
</tr>
<tr>
<td>spe 28</td>
<td>Politicians (e.g. Boris Johnson) have faked having coronavirus.</td>
<td>13.46 (22.56)</td>
<td>29.63 (27.43–31.77)</td>
</tr>
<tr>
<td>spe 30</td>
<td>Coronavirus cannot be passed from person to person, you can only get it if someone deliberately infects you with it (e.g. being injected or poisoned).</td>
<td>9.45 (18.72)</td>
<td>34.84 (32.54–37.12)</td>
</tr>
</tbody>
</table>

(Continued)
endorsement (continuously scaled) Endorsement (Likert-scaled)

<table>
<thead>
<tr>
<th>Statements</th>
<th>Endorsement (continuously scaled)</th>
<th>Endorsement (Likert-scaled)</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19 testing and a future vaccine to implant microchips into people.</td>
<td>‘Agree completely’</td>
<td>‘Agree a little’</td>
</tr>
</tbody>
</table>
| Note: All items reported here except the last item were originally developed and published by Freeman et al. (2020b). Where scores which aggregate values from several columns are presented (e.g. percentage of ‘Agree a little’ and ‘Agree moderately’), deviates from the estimated values of the unique columns are possible due to separate bootstrapping procedures. N = 1684.

Table 2 (Continued.)

Discussion

The results of this study provide an extension of earlier studies, implying that a noticeable proportion of the German and Swiss German-speaking population endorse coronavirus-related conspiracy beliefs strongly or at least to some degree. Using self-report and experimental paradigms, we demonstrated that endorsement of these beliefs was associated with paranoid ideation and reasoning biases, the latter even when controlling for paranoid ideation. Our study contributes to a rapidly emerging body of literature acknowledging the relevance of such beliefs in the context of mental health (Chen et al., 2020), pandemic-containing behaviors (Bertin, Nera, & Delouvée, 2020) and socio-political attitudes (Jutzi, Willardt, Schmid, & Jonas, 2020).

Compared to the British study by Freeman et al. (2020b), we observed a smaller percentage of participants with strong or absolute endorsements, which seems reasonable given the timing of our study. However, overall endorsement on a continuum scale was similar to that found by Freeman et al. (2020b), indicating that our participants more frequently endorsed conspiracy beliefs with moderate degrees. It should be noted, however, that endorsement rates observed in the two studies cannot be directly compared, as differences may have partly arisen from different scaling approaches, culture-specific factors, and different sample characteristics. Swiss participants endorsed specific beliefs only slightly more strongly than German participants, as indicated by small effect sizes. A part of these beliefs referred to the purpose and spread of vaccines, aligning with evidence that vaccination acceptance may be lower in Switzerland than in Germany (McAndrew, 2020) and that, generally, generic conspiracy beliefs are endorsed less in Germany compared to other Western countries (Bruder et al., 2013). Corroborating prior studies, we observed that participants endorsing coronavirus-related conspiracy beliefs tended to be younger (Allington et al., 2020), less well educated (van Prooijen, 2017), politically more extreme (Krouvel,
Kutkiyki, van Prooijen, Martinsson, & Markstedt, 2017), and more stressed (Swami et al., 2016), while no gender differences emerged (Freeman et al., 2020b).

Our hypotheses that reasoning aberrations and paranoia are associated with coronavirus-related conspiracy beliefs were largely supported. People endorsing such beliefs tend to collect less information before making a decision (JTC bias), make judgments with low-to-moderate certainty (LA bias), and adhere more to an already held specific belief, even if this turns out to be invalid (BADE) compared to people who endorse these beliefs to a lesser degree. Regarding JTC, our findings align with novel evidence suggesting that COVID-19 conspiracy beliefs are endorsed more strongly by people who are more impulsive (Alper, Bayrak, & Yilmaz, 2020), lending support to the assumption that a hasty reasoning process may be involved in the formation of such beliefs. Although effect sizes for reasoning biases were fairly small, reasoning aberrations may still represent a factor worth considering when investigating CT beliefs, especially since they may impact particularly on the persistence of beliefs (Freeman, 2016). Our results also imply that coronavirus-related CT beliefs may be an outgrowth of paranoid ideation and/or that paranoia and CT beliefs may favor each other (Darwin, Neave, & Holmes, 2011). Further investigations to substantiate these relationships, particularly longitudinal studies, are needed.

Contrary to expectations, we found that BADE was not associated with endorsement of general beliefs, and that people endorsing conspiracy beliefs claim that they may be more likely mistaken in their beliefs (PM). While the latter finding seems somewhat surprising, it may reflect that individuals endorsing conspiracy beliefs consider themselves more prone to be deceived by conspiring parties in the details of the conspiracy, although not in the conspiracy itself. Alternatively, it seems also logical that particularly people who strongly reject such beliefs and defend official information consider themselves to be ‘right’ in their convictions. With respect to the BADE finding, it may be speculated that associations with conspiracy beliefs only arise if the disconfirmatory evidence is affectively charged and elicits emotional involvement, as is often the case in real life. Given that more research substantiates the associations reported here, public communication strategies targeting COVID-19-related CTs might consider addressing these biases and, rather than merely provide CT-contradictory information, raise awareness of reasoning styles and focus on other CT-relevant factors (e.g. transparent dissemination of virus-related information on social media; Allington et al., 2020).

Furthermore, our study implies that the relationship between reasoning biases and coronavirus-related conspiracy beliefs may be best described by non-linear relationships. It can, for example, be surmised that there is a subgroup of CT-believers who tend to oversimplify information until they have reached a medium-certainty threshold to satisfy a need of competence. There may also be a group of CT-endorsing individuals who successfully discard their invalid beliefs, but only based on information from official sources. This would align with findings that people endorsing coronavirus conspiracy beliefs mainly rely upon subjective, unregulated sources (Allington et al., 2020). Considering that CTs and delusions are related, these results also prompt the question whether the relationship between reasoning biases such as JTC or BADE and delusions might be better described by polynomial trajectories. This could partially explain the heterogeneous findings of the role of JTC in delusions.

Recent studies suggest that JTC may in fact be less pronounced in delusion-prone individuals (as opposed to healthy individuals;
### Table 4. Multiple regression analyses: Reasoning bias and paranoia outcomes predicting endorsement of general and specific conspiracy beliefs

<table>
<thead>
<tr>
<th>Effect</th>
<th>General conspiracy beliefs</th>
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<th></th>
<th>Specific conspiracy beliefs</th>
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<tbody>
<tr>
<td></td>
<td>M</td>
<td>s.d.</td>
<td>B</td>
<td>s.e.</td>
<td>LL</td>
<td>UL</td>
<td>β</td>
<td>p</td>
<td>ΔR²</td>
<td>B</td>
<td>s.e.</td>
<td>LL</td>
<td>UL</td>
<td>β</td>
<td>p</td>
</tr>
<tr>
<td>Intercept</td>
<td>–</td>
<td>–</td>
<td>808.519</td>
<td>70.478</td>
<td>670.286</td>
<td>946.753</td>
<td>0.000</td>
<td>&lt;0.001</td>
<td>–</td>
<td>1014.150</td>
<td>93.383</td>
<td>830.990</td>
<td>1197.313</td>
<td>0.000</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Reasoning biases</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>JTC bias (DTD)</td>
<td>2.71</td>
<td>2.64</td>
<td>–0.535</td>
<td>0.195</td>
<td>–0.917</td>
<td>–0.152</td>
<td>–0.061</td>
<td>0.006</td>
<td>0.140</td>
<td>–0.302</td>
<td>0.146</td>
<td>–0.588</td>
<td>–0.015</td>
<td>–0.044</td>
<td>0.039</td>
</tr>
<tr>
<td>BADE: total score</td>
<td>2.91</td>
<td>2.36</td>
<td>–0.331</td>
<td>0.219</td>
<td>–0.760</td>
<td>0.098</td>
<td>–0.034</td>
<td>0.130</td>
<td>0.138</td>
<td>–0.772</td>
<td>0.163</td>
<td>–1.091</td>
<td>–0.452</td>
<td>–0.101</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>BADE: emotional scenario score</td>
<td>2.54</td>
<td>2.74</td>
<td>–0.420</td>
<td>0.187</td>
<td>–0.787</td>
<td>–0.053</td>
<td>–0.050</td>
<td>0.025</td>
<td>0.139</td>
<td>–0.616</td>
<td>0.139</td>
<td>–0.889</td>
<td>–0.343</td>
<td>–0.093</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>BADE: neutral scenario score</td>
<td>3.29</td>
<td>3.01</td>
<td>–0.054</td>
<td>0.171</td>
<td>–0.390</td>
<td>0.282</td>
<td>–0.007</td>
<td>0.753</td>
<td>0.137</td>
<td>–0.429</td>
<td>0.128</td>
<td>–0.679</td>
<td>–0.179</td>
<td>–0.071</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Possibility of being mistaken</td>
<td>30.50</td>
<td>32.45</td>
<td>0.156</td>
<td>0.016</td>
<td>0.125</td>
<td>0.187</td>
<td>0.218</td>
<td>&lt;0.001</td>
<td>0.181</td>
<td>0.094</td>
<td>0.012</td>
<td>0.071</td>
<td>0.117</td>
<td>0.168</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>LA bias</td>
<td>72.58</td>
<td>20.62</td>
<td>–0.099</td>
<td>0.026</td>
<td>–0.149</td>
<td>–0.048</td>
<td>–0.088</td>
<td>&lt;0.001</td>
<td>0.142</td>
<td>–0.082</td>
<td>0.019</td>
<td>–0.120</td>
<td>–0.044</td>
<td>–0.095</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Paranoia</td>
<td></td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Paranoid ideation</td>
<td>35.21</td>
<td>12.20</td>
<td>0.779</td>
<td>0.046</td>
<td>0.689</td>
<td>0.870</td>
<td>0.410</td>
<td>&lt;0.001</td>
<td>0.137</td>
<td>0.732</td>
<td>0.035</td>
<td>0.664</td>
<td>0.799</td>
<td>0.493</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

BADE, Bias against disconfirmatory evidence; CI, Confidence Interval; DTD, Draws to decision; JTC, Jumping-to-conclusions; LA, Liberal acceptance; LL, Lower limit (2.5% percentile); UL, Upper limit (97.5% percentile).

Note. For value ranges of reasoning biases, please see Method section. The change in R² represents the difference in R² between the corresponding multiple regression model (containing all control variables and the predictor of interest) and a reference regression model (containing only control variables). B refers to the unstandardized regression coefficient. β refers to the standardized regression coefficient. N = 1684.

*a For reasons of parsimony, only intercepts for models involving JTC bias (DTD) as predictor are reported here.

*b N = 1603, as participants who made no decision until the end of the fish task did not indicate a decision threshold and hence cause missing data.
McLean, Balzan, & Mattiske, 2020a; McLean, Mattiske, & Balzan, 2020b) and question whether psychotic patients and healthy individuals differ as largely as previously assumed regarding JTC bias (Moritz et al., 2020; Pytlík et al., 2020). Our non-linear findings reconcile these results with seemingly contradictory results on the presence of JTC bias in strong convictions, and imply that there may be both a subgroup of highly convinced individuals with a pronounced JTC bias and a subgroup of equally strong convinced individuals gathering more as opposed to less information than healthy individuals. Null differences reported by recent studies may hence be partially founded in a non-linear association of JTC bias and delusions. Regarding a mechanism for the over-sampling subgroup, it could be that these individuals’ data gathering style is strongly driven by anxiety (e.g. McLean et al., 2020a), a factor which has been linked to higher endorsement of CT (Sallam et al., 2020) and delusions (Garety et al., 2005). Further evidence supporting this hypothesis remains outstanding.

Our study has the following limitations: First, our cross-sectional design forbids drawing causal inferences on the relationship between reasoning biases or paranoia and conspiracy beliefs; we have investigated reasoning biases as correlates rather than (causal) risk factors (Kraemer et al., 1997). Second, concerning our sample, we cannot eliminate the possibility of any type of selection bias (e.g. individuals with no online access or with profound conspiracy beliefs not being contacted or dropping out). While a majority of the general population is regularly online (Bundesamt für Statistik, 2020; DeStatis, 2020), it remains possible that not all targeted individuals had the same chance to participate (non-probability sampling), and, given our quota sampling for two characteristics only, the representativeness of findings is limited. Third, post-hoc assignment of continuously assessed scores to Likert-scaled categories may have yielded slightly different results from other studies using ordinal scales from the outset. We still believe that this approach was mostly valid, as we aimed to address links to reasoning biases as concisely as possible while attempting to compare our results to the methodologically related study by Freeman et al. (2020b). Further, our study can only make a statement about the level of agreement, not of disagreement with the presented beliefs. As it was our rationale to quantify endorsement for these beliefs and participants had the possibility to choose a low and no-endorsement answer option, we consider this a valid format to address our aim. Also, we did not specifically assess COVID-19 (SARS-CoV-2) conspiracy beliefs, but coronavirus-related beliefs. However, we consider it highly likely that most people answered these items against the background of the current COVID-19 virus. Lastly, we did not assess data for individuals aged older than 69 years, thereby limiting the generalizability of results.

In conclusion, this study provides initial estimates of coronavirus-related CT belief endorsement within a demographically quota-representative and cross-national sample of two German-speaking countries. Although only a rather small proportion of the population strongly endorses coronavirus-related conspiracy beliefs, negative behavioral consequences of these beliefs necessitate the identification of putative risk factors such as reasoning biases. We presented first evidence that distinct reasoning biases relate to coronavirus-related CT beliefs and may be (non-linearly) associated with these beliefs, opening new avenues for empirical research into delusion and related areas. We also hope that this study paves the way for future investigations into cognitive and emotional risk factors promoting COVID-19-related CT beliefs and CT endorsement in general. If additional studies corroborate the specific role of reasoning biases in such beliefs, strategies addressing the modification of these biases may be formulated to prevent strong conspiracy beliefs from arising in the first place.

**Supplementary material.** The supplementary material for this article can be found at https://doi.org/10.1017/S0033291721001124.

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**Conflicts of interest.** None.

**References**


