

Original Article

Cite this article: Kuhn SAK, Lieb R, Freeman D, Andreou C, Zander-Schellenberg T (2022). Coronavirus conspiracy beliefs in the German-speaking general population: endorsement rates and links to reasoning biases and paranoia. *Psychological Medicine* 52, 4162–4176. <https://doi.org/10.1017/S0033291721001124>

Received: 17 November 2020
Revised: 8 March 2021
Accepted: 9 March 2021
First published online: 16 March 2021



Key words:

Conspiracy beliefs; coronavirus; endorsement rate; paranoia; reasoning bias

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

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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 Vugt, 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 Vugt, 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 Bavel et al., 2020).

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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 relatively 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, Delouvé, & 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; Pytlik, 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.

Aims of this study

Beliefs in coronavirus-related CTs are likely to result in less pandemic containment-focused behaviors. It is therefore important to provide estimates of the occurrence of such beliefs and to examine putative associated factors, such as reasoning biases, to attenuate CT-related negative outcomes. First endorsement rate estimates of coronavirus-related CTs have been provided, mostly for English-speaking countries (e.g. Freeman *et al.* 2020b; Georgiou *et al.* 2020). While common CTs seem less endorsed in German-speaking countries than in other Western countries, it is unknown if this extends to coronavirus CTs (Bruder, Haffke, Neave, Nouripanah, & Imhoff, 2013).

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').

Analyses

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' (equaling 'do not agree'), scores between 21 and 40 were assigned to '2' (equaling '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 $\alpha = 0.05$ 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/qg89e/>).

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 sc2 and sc3) 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 ($Mdn_{Swiss} = 5.6$, $Mdn_{German} = 4.3$; Table 3).

Table 1. Demographic characteristics of the full sample

Characteristics	Mean (s.d.)/N (%)
Age	44.05 (14.45)
Gender	
Women	846 (50.24%)
Men	836 (49.64%)
Diverse	3 (0.12%)
Country of residence	
Germany	1130 (67.10%)
Switzerland	554 (32.90%)
Native language	
German	1604 (95.25%)
English	7 (0.42%)
Other	73 (4.33%)
Education in no. of years	13.27 (3.08)

Note. $N = 1684$.

Likert-scaled endorsement of beliefs

The mean total specific conspiracy belief score for Likert-scaled endorsement was 44.96 ($s.d. = 23.09$), the mean total general conspiracy beliefs 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 [$r_{s_gen}(1682) = -0.07$, $p = 0.007$; $r_{s_spec}(1682) = -0.10$, $p < 0.001$] and lower levels of education [$r_{s_gen}(1682) = -0.21$, $p < 0.001$; $r_{s_spec}(1682) = -0.18$, $p < 0.001$]. Belief endorsement was not associated with gender [$r_{s_gen}(1682) = 0.01$, $p = 0.713$; $r_{s_spec}(1682) = -0.00$, $p = 0.902$], but with higher momentary stress [$r_{s_gen}(1682) = 0.16$, $p < 0.001$; $r_{s_spec}(1682) = 0.19$, $p < 0.001$]. 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

Table 2. Endorsements of coronavirus-related conspiracy beliefs

#	Statements	Endorsement (continuously scaled)			Endorsement (Likert-scaled)													
				% with 0 endorsement ^a	Agreement to some degree ^b		Strong agreement (At least 'Agree a lot') ^c		'Do not agree'		'Agree a little'		'Agree moderately'		'Agree a lot'		'Agree completely'	
		M (s.d.)	% (95% CI)		n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)
	Any conspiracy belief	19.57 (19.83)	26.04 (23.88–28.25)	436	19.99 (17.92–22.10)	339	9.32 (7.68–10.96)	158	70.69 (67.06–74.38)	1187	10.08 (8.99–11.14)	171	9.91 (8.71–11.07)	168	5.64 (4.68–6.54)	96	3.69 (3.00–4.34)	62
	General conspiracy beliefs	25.85 (23.16)	17.86 (15.57–20.18)	301	27.13 (24.16–30.23)	457	14.49 (11.80–17.23)	244	58.38 (53.11–63.93)	983	13.45 (12.14–14.77)	227	13.69 (11.92–15.46)	230	8.80 (7.14–10.42)	148	5.70 (4.50–6.91)	96
	<i>Skepticism</i>	33.33 (26.08)																
sc1	The government is misleading the public about the cause of the virus.	29.82 (28.30)	10.44 (8.97–11.94)	176	38.57 (36.28–40.92)	650	16.08 (14.43–17.81)	270	45.38 (42.93–47.80)	764	19.91 (17.87–21.91)	335	18.73 (16.86–20.61)	315	10.48 (9.09–11.94)	177	5.52 (4.39–6.65)	93
sc2	I'm skeptical about the official explanation about the cause of the virus.	38.70 (30.49)	8.15 (6.89–9.50)	137	38.32 (36.10–40.8)	646	27.01 (24.94–29.04)	456	34.55 (32.19–36.82)	582	18.12 (16.33–19.95)	306	20.14 (18.29–22.03)	340	17.69 (15.86–19.48)	297	9.45 (8.14–10.87)	159
sc3	I don't trust the information about the virus from scientific experts.	31.47 (28.34)	9.91 (8.55–11.40)	167	39.67 (37.41–42.10)	668	16.85 (15.14–18.65)	284	43.48 (40.91–45.90)	732	19.08 (17.16–21.02)	321	20.62 (18.71–22.62)	347	10.80 (9.32–12.35)	182	6.04 (4.99–7.13)	102
	<i>Conspiracy cause of the virus</i>	26.80 (24.13)																
c1	The virus is a hoax.	16.44 (24.37)	22.04 (20.07–24.11)	371	20.57 (18.82–22.51)	346	7.46 (6.18–8.67)	126	71.99 (69.77–74.11)	1212	10.78 (9.32–12.35)	181	9.79 (8.43–11.22)	165	4.33 (3.38–5.34)	73	3.14 (2.38–4.04)	53
c2	The virus is manmade.	39.55 (31.71)	9.13 (7.78–10.51)	153	37.66 (35.27–39.96)	634	27.52 (25.48–29.69)	464	34.80 (32.72–37.06)	586	16.11 (14.43–17.87)	272	21.51 (19.60–23.57)	362	15.54 (13.78–17.28)	262	12.01 (10.51–13.48)	202
c3	The virus is produced by powerful organizations (e.g. government, military).	24.40 (28.40)	7.30 (15.50–19.00)	291	29.13 (27.02–31.35)	491	13.67 (12.11–15.44)	230	57.18 (54.75–59.44)	963	14.85 (13.18–16.69)	251	14.27 (12.65–15.86)	240	8.23 (7.01–9.62)	139	5.39 (4.28–6.47)	91
	<i>The spread of the virus is a deliberate attempt:</i>	22.13 (25.07)																
spr1	...to reduce the size of the global population.	21.12 (26.87)	20.34 (18.41–22.45)	343	26.52 (24.41–28.62)	447	10.62 (9.14–12.11)	179	62.84 (60.51–65.08)	1058	13.33 (11.70–15.08)	225	13.18 (11.58–14.9)	222	6.36 (5.23–7.54)	108	4.21 (3.21–5.23)	71
spr2	...by governments to gain political control.	25.18 (29.73)	17.36 (15.56–19.18)	292	25.10 (23.04–27.26)	423	16.36 (14.67–18.17)	275	58.59 (56.24–60.87)	986	12.16 (10.63–13.84)	205	13.00 (11.40–14.67)	218	10.35 (8.97–11.88)	174	5.97 (4.87–7.13)	101

(Continued)

Table 2. (Continued.)

#	Statements	Endorsement (continuously scaled)		Endorsement (Likert-scaled)														
				Agreement to some degree ^b		Strong agreement (At least 'Agree a lot') ^c		'Do not agree'		'Agree a little'		'Agree moderately'		'Agree a lot'		'Agree completely'		
		% with 0 endorsement ^a																
		M (s.d.)	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n
spr3	...by a group of powerful people to make money.	24.62 (29.88)	18.05 (16.33–19.89)	304	24.98 (22.92–27.02)	420	15.74 (13.95–17.52)	264	59.37 (56.77–61.70)	1000	12.55 (10.92–14.13)	211	12.41 (10.93–13.90)	209	9.20 (7.84–10.57)	154	6.54 (5.34–7.66)	110
spr4	...by a group of powerful people to gain control.	25.24 (30.37)	18.25 (16.45–20.19)	306	24.16 (22.21–26.19)	407	16.59 (14.85–18.35)	278	59.29 (56.95–61.70)	999	11.52 (10.03–13.12)	194	12.61 (10.99–14.25)	213	9.39 (7.96–10.81)	158	7.15 (5.94–8.49)	120
spr5	...by one nation to destabilize another.	22.95 (27.79)	18.71 (16.92–20.72)	315	27.70 (25.53–29.87)	467	12.27 (10.75–13.90)	207	60.07 (57.78–62.23)	1010	13.12 (11.58–14.73)	221	14.62 (12.95–16.33)	246	7.70 (6.47–9.03)	130	4.56 (3.56–5.64)	77
spr6	...by global companies to take control.	22.19 (28.41)	19.88 (18.05–21.73)	334	23.31 (21.44–25.24)	393	13.23 (11.70–14.85)	223	63.4 (61.28–65.56)	1068	11.36 (9.80–12.89)	191	12.02 (10.57–13.60)	202	8.09 (6.83–9.38)	136	5.18 (4.10–6.24)	87
spr7	...by activists to stop climate change.	13.58 (21.28)	24.69 (22.74–26.66)	416	19.11 (17.28–20.90)	322	5.08 (4.10–6.12)	86	75.76 (73.69–77.85)	1276	10.53 (9.09–12.05)	177	8.62 (7.30–10.10)	145	3.47 (2.67–4.34)	58	1.67 (1.07–2.26)	28
	<i>Conspiracy reasons for lockdown:</i>	21.16 (25.05)																
	<i>The real reason for the lockdown is to:</i>																	
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 (58.73–63.24)	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

(Continued)

Table 2. (Continued.)

#	Statements	Endorsement (continuously scaled)			Endorsement (Likert-scaled)													
				% with 0 endorsement ^a	Agreement to some degree ^b		Strong agreement (At least 'Agree a lot') ^c		'Do not agree'		'Agree a little'		'Agree moderately'		'Agree a lot'		'Agree completely'	
		M (s.d.)	% (95% CI)		n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)
	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	2.52 (2.00–3.05)	42
spe 1	Coronavirus is a bioweapon developed by China to destroy the West.	9.25 (25.42)	22.57 (20.72–24.58)	380	25.29 (23.22–27.14)	426	9.06 (7.78–10.39)	153	65.62 (63.30–67.93)	1105	13.17 (11.64–14.79)	222	12.12 (10.51–13.78)	204	5.86 (4.81–7.01)	99	3.22 (2.37–4.10)	54
spe 2	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)	72	1.74 (1.13–2.38)	29
spe 3	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	1.55 (1.01–2.2)	26
spe 4	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	1.07 (0.59–1.60)	18
spe 5	The UN and WHO have manufactured the virus to take global control.	12.45 (21.72)	28.99 (26.78–31.24)	488	15.19 (13.60–16.98)	255	5.77 (4.69–6.89)	97	79.10 (77.26–80.94)	1332	7.91 (6.71–9.26)	133	7.24 (6.06–8.49)	122	3.98 (3.09–4.87)	67	1.79 (1.19–2.43)	30
spe 6	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	1.42 (0.89–2.02)	24
spe 7	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	1.08 (0.59–1.60)	18
spe 8	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)	133	3.56 (2.67–4.51)	60	2.59 (1.84–3.38)	44
spe 9	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	82.94 (81.29–84.62)	1396	5.59 (4.45–6.71)	94	6.23 (5.05–7.36)	105	3.15 (2.38–3.98)	53	2.17 (1.54–2.91)	36
spe 10	Big Pharma created coronavirus to profit from the vaccines.	16.35 (24.64)	26.45 (24.40–28.62)	446	19.70 (17.70–21.67)	332	8.38 (7.07–9.74)	141	71.94 (69.71–74.11)	1211	10.63 (9.14–12.05)	179	9.09 (7.78–10.33)	153	5.39 (4.33–6.41)	90	3.03 (2.26–3.86)	51
spe 11		14.65 (23.78)		473		299	7.12 (6.00–8.25)	120		1265	9.37 (7.96–10.81)	158	8.37 (7.07–9.74)	141	4.12 (3.15–5.05)	69	3.03 (2.20–3.86)	51

(Continued)

Table 2. (Continued.)

#	Statements	Endorsement (continuously scaled)			Endorsement (Likert-scaled)													
				% with 0 endorsement ^a	Agreement to some degree ^b		Strong agreement (At least 'Agree a lot') ^c		'Do not agree'		'Agree a little'		'Agree moderately'		'Agree a lot'		'Agree completely'	
		M (s.d.)	% (95% CI)		n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)
	Coronavirus is being used by the government to implement a police state.		28.10 (26.07–30.29)		17.72 (15.91–19.66)				75.16 (73.16–77.26)									
spe 12	Coronavirus is caused by 5 G and is a form of radiation poisoning transmitted through radio waves.	8.92 (18.29)	36.10 (33.79–38.42)	607	11.02 (9.56–12.47)	186	3.54 (2.73–4.39)	60	85.37 (83.61–87.00)	1438	5.63 (4.51–6.71)	95	5.38 (4.39–6.59)	91	2.68 (1.96–3.44)	45	0.90 (0.48–1.37)	15
spe 13	Coronavirus is an alien weapon to destroy humanity.	8.32 (18.42)	40.53 (38.36–42.87)	682	8.70 (7.42–9.98)	147	3.86 (2.97–4.87)	65	87.40 (85.92–88.90)	1472	4.33 (3.44–5.34)	73	4.37 (3.50–5.35)	74	2.56 (1.90–3.33)	43	1.29 (0.77–1.9)	22
spe 14	The virus is a smokescreen for a global conspiracy that swapped the real world with a simulation.	10.52 (20.47)	35.3 (33.02–37.47)	595	12.13 (10.51–13.72)	204	4.87 (3.92–5.88)	79	83.02 (81.18–84.86)	1398	5.84 (4.75–7.01)	98	6.26 (5.17–7.54)	106	3.28 (2.43–4.16)	55	1.60 (1.01–2.20)	27
spe 15	The virus is a front to implement measures to destroy our privacy.	15.90 (25.73)	29.21 (27.14–31.41)	493	16.23 (14.55–18.11)	274	8.71 (7.48–10.10)	147	75.05 (72.98–77.02)	1263	7.40 (6.18–8.67)	125	8.82 (7.42–10.27)	149	4.86 (3.86–5.88)	82	3.88 (2.97–4.81)	65
spe 16	Companies are being deliberately put out of business to hide the effects of Brexit.	11.31 (20.85)	32.66 (30.34–34.86)	550	14.35 (12.83–15.91)	242	4.41 (3.44–5.46)	74	81.27 (79.45–83.02)	1368	7.20 (6.00–8.43)	121	7.17 (5.94–8.37)	121	2.53 (1.78–3.33)	43	1.82 (1.25–2.49)	31
spe 17	Lockdown is a way to terrify, isolate, and demoralize a society as a whole in order to reshape society to fit specific interests.	25.28 (30.15)	20.99 (18.94–22.92)	353	26.90 (24.88–28.80)	453	15.85 (14.07–17.70)	267	57.27 (54.93–59.68)	964	14.39 (12.77–16.15)	243	12.51 (10.98–14.25)	210	8.42 (7.13–9.80)	142	7.40 (6.23–8.67)	125
spe 18	Coronavirus is a plot by globalists to destroy religion by banning gatherings.	12.12 (21.19)	30.08 (28.03–32.13)	506	15.63 (13.84–17.34)	263	5.01 (4.04–6.00)	84	79.36 (77.49–81.35)	1337	8.38 (7.13–9.68)	141	7.27 (6.06–8.55)	122	3.16 (2.26–4.04)	53	1.83 (1.25–2.49)	31
spe 19	The intention of lockdown is to force people to rely on big corporations rather than their local businesses.	15.08 (23.92)	28.26 (26.07–30.34)	476	18.90 (17.16–20.67)	318	7.31 (6.06–8.61)	123	73.80 (71.73–75.83)	1243	9.95 (8.55–11.40)	168	8.89 (7.66–10.33)	150	4.43 (3.44–5.40)	75	2.86 (2.08–3.68)	48
spe 20	Lockdown is a plot by environmental activists to control the rest of us.	10.35 (19.35)	33.32 (30.88–35.63)	561	13.28 (11.70–14.90)	224	3.97 (3.09–4.93)	67	82.67 (80.88–84.50)	1393	7.38 (6.12–8.61)	124	5.93 (4.87–7.07)	100	2.80 (2.02–3.62)	47	1.19 (0.71–1.72)	20

(Continued)

Table 2. (Continued.)

#	Statements	Endorsement (continuously scaled)			Endorsement (Likert-scaled)													
					Agreement to some degree ^b		Strong agreement (At least 'Agree a lot') ^c		'Do not agree'		'Agree a little'		'Agree moderately'		'Agree a lot'		'Agree completely'	
		M (s.d.)	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n
spe 21	The coronavirus vaccine will contain microchips to control the people.	13.70 (24.02)	33.49 (31.18–35.75)	564	14.37 (12.71–16.27)	242	7.17 (6.06–8.43)	121	78.44 (76.43–80.23)	1321	6.30 (5.17–7.42)	106	8.08 (6.83–9.50)	136	3.95 (3.03–4.87)	67	3.20 (2.43–4.10)	54
spe 22	Coronavirus was created to force everyone to get vaccinated.	16.14 (26.72)	30.21 (28.03–32.48)	509	15.30 (13.66–16.98)	257	9.86 (8.55–11.28)	166	74.87 (72.80–76.90)	1261	7.22 (6.00–8.49)	121	8.07 (6.89–9.32)	136	4.99 (3.92–6.06)	84	4.87 (3.74–6.00)	82
spe 23	The vaccine will be used to carry out mass sterilization.	10.81 (20.77)	33.81 (31.53–36.16)	570	12.24 (10.69–13.78)	206	4.99 (3.98–6.06)	84	82.76 (81.00–84.56)	1394	5.29 (4.28–6.29)	89	6.93 (5.70–8.14)	117	3.47 (2.61–4.28)	58	1.56 (1.01–2.14)	26
spe 24	The coronavirus is bait to scare the whole globe into accepting a vaccine that will introduce the 'real' deadly virus.	13.28 (23.90)	33.38 (31.18–35.57)	562	13.92 (12.35–15.62)	234	7.02 (5.82–8.26)	118	79.08 (77.26–81.06)	1332	6.22 (5.11–7.36)	104	7.70 (6.47–8.97)	130	3.87 (2.91–4.75)	65	3.13 (2.32–3.98)	53
spe 25	The WHO already has a vaccine and are withholding it.	14.71 (22.89)	27.99 (25.77–30.11)	471	19.10 (17.28–21.02)	321	6.71 (5.58–7.90)	113	74.22 (72.15–76.25)	1250	10.05 (8.67–11.40)	169	9.05 (7.72–10.57)	152	4.70 (3.68–5.76)	79	2.02 (1.37–2.73)	34
spe 26	Antibody testing is a plot to harvest our DNA.	12.81 (22.41)	31.02 (28.68–33.25)	522	15.26 (13.66–16.98)	257	5.70 (4.69–6.89)	96	79.03 (77.02–80.76)	1331	7.01 (5.82–8.25)	118	8.27 (6.95–9.56)	139	3.50 (2.67–4.39)	59	2.18 (1.54–2.85)	37
spe 27	Celebrities are being paid to say they have coronavirus.	14.44 (23.88)	29.33 (27.2–31.47)	493	17.04 (15.32–18.77)	286	7.16 (6.00–8.43)	120	75.90 (73.87–77.91)	1278	8.34 (7.07–9.68)	141	8.59 (7.36–10.04)	145	4.22 (3.27–5.23)	71	2.94 (2.08–3.74)	49
spe 28	Politicians (e.g. Boris Johnson) have faked having coronavirus.	13.46 (22.56)	29.63 (27.43–31.77)	499	16.04 (14.31–17.76)	270	6.42 (5.29–7.54)	108	77.50 (75.59–79.45)	1306	8.27 (6.95–9.56)	139	7.81 (6.53–9.09)	131	4.27 (3.33–5.29)	72	2.13 (1.43–2.85)	36
spe 29	The mainstream media is deliberately feeding us misinformation about the virus and lockdown.	22.79 (28.70)	21.17 (19.3–23.16)	356	26.08 (24.17–28.15)	439	13.40 (11.76–14.97)	225	60.61 (58.31–62.95)	1020	15.08 (13.3–16.81)	254	11.00 (9.44–12.59)	185	7.36 (6.06–8.55)	124	5.99 (4.87–7.13)	101
spe 30	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).	9.45 (18.72)	34.84 (32.54–37.12)	586	12.25 (10.75–13.78)	206	3.56 (2.73–4.45)	60	84.23 (82.36–85.93)	1418	5.93 (4.81–7.13)	100	6.31 (5.17–7.42)	106	2.49 (1.78–3.27)	42	1.08 (0.59–1.54)	18

(Continued)

Table 2. (Continued.)

#	Statements	Endorsement (continuously scaled)		Endorsement (Likert-scaled)													
		% with 0 endorsement ^a	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n					
spe 31	Bill Gates intends to use COVID-19 testing and a future vaccine to implant microchips into people.	33.84 (31.65–36.1)	569	12.97 (11.46–14.55)	218	6.31 (5.16–7.42)	107	80.73 (78.86–82.60)	1359	6.14 (5.05–7.30)	103	6.82 (5.70–8.14)	115	2.80 (2.02–3.56)	47	3.56 (2.61–4.39)	60

Note. All items reported here – except item spe31 – were originally developed and published by Freeman et al. (2020b). Where scores which aggregate values from several columns are presented (e.g. percentage of ‘some degree’ endorsement), deviates from the estimated values of the unique columns are possible due to separate bootstrapping procedures. *N* = 1684.

^aThis denotes the percentage of participants who indicated a value of 0 of the respective slider scale.

^bThis rate was derived by summing up the rates of the third and fourth last columns, i.e. of the percentages of ‘Agree a little’ and ‘Agree moderately’.

^cThis rate was derived by summing up the rates of the two last columns, i.e. of the percentages of ‘Agree a lot’ and ‘Agree completely’.

score indicating low BADE; only for specific beliefs), a greater LA bias (indicated by a lower degree threshold), and increased paranoia ideation predicted greater endorsements of general and specific coronavirus-related conspiracy beliefs in statistical models (Table 4). Hypotheses 2a and 3ab were not confirmed: results revealed that BADE did not predict endorsement of general coronavirus-related conspiracy beliefs and that a stated higher likelihood of being mistaken statistically predicted greater endorsements of general and specific conspiracy beliefs.

To allow for other potential trajectories, we conducted exploratory investigations of quadratic associations for each hypothesis by adding the squared statistical predictor to regression models. Quadratic models improved model fit of each model significantly, and within each model, quadratic terms were significant predictors of the corresponding outcome (see Supplementary Materials). For example, both the linear [$b = -3.65, t(1675) = -5.21, p < 0.001$] and the quadratic term of DTD [$b = 0.30, t(1675) = 4.63, p < 0.001$] significantly predicted total endorsement of general conspiracy beliefs in the statistical model (the same pattern was observed for specific conspiracy beliefs). This means, for example, that individuals with very few DTD and individuals with many DTD endorsed these beliefs most strongly. Similarly, a negative linear term [$b = -1.85, t(1675) = -3.78, p < 0.001$] and a positive quadratic term [$b = 0.24, t(1675) = 3.46, p < 0.001$] of BADE predicted total endorsement of general conspiracy beliefs in our statistical model (again, the same pattern was observed for specific beliefs).

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, & Delouvé, 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 (Krouwel,

Table 3. Differences in median endorsement of conspiracy belief categories and specific conspiracy beliefs, between Germany and Switzerland

Conspiracy belief category/Specific statement	Range	Country		Difference statistics <i>U, r (p)</i>
		Germany <i>N</i> = 1130	Switzerland <i>N</i> = 554	
		Median	Median	
General conspiracy beliefs				
Total	0–100	17.1	19.0	$U(N_{\text{German}} = 1130, N_{\text{Swiss}} = 554) = 302\,591, r = -0.03, p = 0.27$
Skepticism	0–100	28.7	33.2	$U(N_{\text{German}} = 1130, N_{\text{Swiss}} = 554) = 300\,141, r = -0.03, p = 0.17$
Conspiracy cause	0–100	21.3	21.0	$U(N_{\text{German}} = 1130, N_{\text{Swiss}} = 554) = 317\,696, r = 0.01, p = 0.62$
Spread as deliberate attempt	0–100	9.6	12.1	$U(N_{\text{German}} = 1130, N_{\text{Swiss}} = 554) = 296\,846, r = -0.04, p = 0.09$
Conspiracy reasons for lockdown	0–100	8.0	10.1	$U(N_{\text{German}} = 1130, N_{\text{Swiss}} = 554) = 301\,344, r = -0.03, p = 0.21$
Specific conspiracy beliefs ^a				
Total	0–100	4.3	5.6	$U(N_{\text{German}} = 1130, N_{\text{Swiss}} = 554) = 293\,440, r = -0.05, p = 0.04$
Item spe2	0–100	3.0	4.0	$U(N_{\text{German}} = 1130, N_{\text{Swiss}} = 554) = 293\,040, r = -0.05, p = 0.04$
Item spe10	0–100	3.0	4.0	$U(N_{\text{German}} = 1130, N_{\text{Swiss}} = 554) = 289\,610, r = -0.06, p = 0.01$
Item spe11	0–100	2.0	3.0	$U(N_{\text{German}} = 1130, N_{\text{Swiss}} = 554) = 293\,960, r = -0.05, p = 0.04$
Item spe23	0–100	1.0	1.5	$U(N_{\text{German}} = 1130, N_{\text{Swiss}} = 554) = 292\,516, r = -0.05, p = 0.03$
Item spe24	0–100	1.0	2.0	$U(N_{\text{German}} = 1130, N_{\text{Swiss}} = 554) = 290\,630, r = -0.06, p = 0.02$
Item spe26	0–100	2.0	2.0	$U(N_{\text{German}} = 1130, N_{\text{Swiss}} = 554) = 288\,610, r = -0.06, p = 0.01$
Item spe29	0–100	6.0	9.5	$U(N_{\text{German}} = 1130, N_{\text{Swiss}} = 554) = 290\,198, r = -0.06, p = 0.01$

Note. Analyses were based upon continuously scaled endorsement (range 0–100). *U* refers to Mann–Whitney *U* test statistic.

^aOnly statements with significant differences ($p < 0.05$) in median endorsement between countries are presented here.

Kutiyski, 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 oversample 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

Effect	General conspiracy beliefs									Specific conspiracy beliefs						
	<i>M</i>	s.d.	<i>B</i>	s.e.	95% CI		β	<i>p</i>	ΔR^2	<i>B</i>	s.e.	95% CI		β	<i>p</i>	ΔR^2
					<i>LL</i>	<i>UL</i>						<i>LL</i>	<i>UL</i>			
Intercept ^a	–	–	808.519	70.478	670.286	946.753	0.000	<0.001	–	1014.150	93.383	830.990	1197.313	0.000	<0.001	–
Reasoning biases																
JTC bias (DTD)	2.71	2.64	–0.535	0.195	–0.917	–0.152	–0.061	0.006	0.140	–0.302	0.146	–0.588	–0.015	–0.044	0.039	0.199
BADE: total score	2.91	2.36	–0.331	0.219	–0.760	0.098	–0.034	0.130	0.138	–0.772	0.163	–1.091	–0.452	–0.101	<0.001	0.207
BADE: emotional scenario score	2.54	2.74	–0.420	0.187	–0.787	–0.053	–0.050	0.025	0.139	–0.616	0.139	–0.889	–0.343	–0.093	<0.001	0.206
BADE: neutral scenario score	3.29	3.01	–0.054	0.171	–0.390	0.282	–0.007	0.753	0.137	–0.429	0.128	–0.679	–0.179	–0.071	<0.001	0.202
Possibility of being mistaken	30.50	32.45	0.156	0.016	0.125	0.187	0.218	<0.001	0.181	0.094	0.012	0.071	0.117	0.168	<0.001	0.224
LA bias ^b	72.58	20.62	–0.099	0.026	–0.149	–0.048	–0.088	<0.001	0.142	–0.082	0.019	–0.120	–0.044	–0.095	<0.001	0.200
Paranoia																
Paranoid ideation	35.21	12.20	0.779	0.046	0.689	0.870	0.410	<0.001	0.137	0.732	0.035	0.664	0.799	0.493	<0.001	0.198

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 R^2 represents the difference in R^2 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.

^aFor 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; Pytlik *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>.

Acknowledgements. The authors would like to thank Ruth Veckenstedt for her support in providing study-relevant material, Ursula Drew for her support in the translation process of the conspiracy-belief items and editing, and Sarah Ulrich as well as Gregory Elbel for their support in study implementation and constructive discussions during the conceptualization period.

Financial support. This research received no specific grant from any funding agency, neither from commercial nor from non-profit sectors. This study was financially supported by the Division of Clinical Psychology and Epidemiology (Head: Prof. Dr Roselind Lieb), Faculty of Psychology, University of Basel.

SK and TZS are supported by an SNF Ambizione Grant (Grant No. 179897 awarded to Dr Thea Zander-Schellenberg).

Conflicts of interest. None.

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