


# Acceptance and Adherence to COVID-19 Preventive Measures are Shaped Predominantly by Conspiracy Beliefs, Mistrust in Science and Fear – A Comparison of More than 20 Psychological Variables

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## Abstract

The global coronavirus (COVID-19) pandemic sparked a great interest in psychological factors that determine or explain peoples' responses to the novel threatening situation and the preventive measures (e.g. wearing masks, social distancing). In this study, we focused on contaminated mindware (conspiracy and paranormal beliefs) and investigated its relationship with both acceptance of and adherence to COVID-19 preventive measures, along with other variables from the domains of emotion (trait anxiety, fear), traditional personality traits (Big 5, locus of control, optimism/pessimism) and motivation (self-control, dispositional regulatory focus). A total of 22 variables were measured in an online survey ( $N = 374$ ) that took place during the second wave of COVID-19 (Nov. 2020 – March 2021) in Switzerland. Of all variables, the endorsement of specific COVID-19 conspiracy beliefs was most strongly associated with lower acceptance and adherence to the preventive measures, together with mistrust in science and a more right-wing political orientation. In contrast, fear of

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COVID-19 and prevention regulatory focus were positively associated with acceptance and adherence. Our results therefore highlight the importance of fighting (conspiratorial) misinformation and of increasing the perceived credibility of science in reducing the spread of the coronavirus. Moreover, when acceptance was used as predictor for adherence, agreeableness and dispositional prevention regulatory focus still explained unique variance in adherence, suggesting that such personality and motivational variables play an important role in adhering and regulating preventive behaviour independent from the attitude towards the preventive measures themselves.

### **Keywords**

COVID-19, preventive measures, adherence, compliance, acceptance, conspiracy beliefs, science scepticism, paranormal beliefs, anxiety, fear, regulatory focus, self-control, Big 5, locus of control, optimism, pessimism

Since the beginning of the coronavirus disease at the end of 2019 (COVID-19), medical and scientific information concerning the new severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is frequently delivered through public media, alongside policymakers' information about current developments and changes as well as suggestions on how the public should respond. From a psychological point of view, it is interesting to observe how people respond to COVID-19 related information and to the preventive measures imposed upon them (wearing masks, social distancing, etc.). While some people experience fear in response to the worrying media reports about increasing numbers of infected people and overcrowded intensive care units (Ahorsu et al., 2020), others think that public media and scientists exaggerate the situation and do not consider the preventive measures as justified (Duplaga, 2020).

Given the undeniable importance of adhering to the preventive measures for the prevention of SARS-CoV-2 spread, researchers have begun to study psychological variables that may explain individual differences in response to the preventive measures. It has, for example, been shown that the endorsement of conspiracy theories, mistrust in science or the government, as well as political conservatism is associated with lower adherence to the preventive measures (e.g. Imhoff & Lamberty, 2020; Plohl & Musil, 2021; Reinders Folmer et al., 2020; Rothgerber et al., 2020), whereas the opposite is true for high levels of fear of getting infected with SARS-CoV-2 (e.g. Carlucci et al., 2020; Jiwani et al., 2021; Kachanoff et al., 2021; Plohl & Musil, 2021; Reinders Folmer et al., 2020; Rothgerber et al., 2020; Vally, 2020) and the Big 5 personality traits agreeableness, openness and conscientiousness (e.g. Brouard et al., 2020; Krupić et al., 2021; Wright et al., 2021).

Despite the increasing number of publications on this topic, there are still important questions that remain open, such as the relative importance of these different variables and the relationships among them, as well as their specific role for cognition and action. The aim of this study was to further explore the psychological landscape behind the

response to the preventive measures with a focus on ‘contaminated mindware’ (e.g. conspiracy beliefs, paranormal beliefs, mistrust in science) and to further assess their relative importance when compared to other relevant variables such as different facets of fear (fear of COVID-19, trait anxiety, fear of death), traditional personality variables (Big 5, locus of control, optimism/pessimism) or motivational variables (self-control, regulatory focus). Moreover, while almost all previous studies focused on either the attitude towards the preventive measures (i.e. *acceptance*) or on *adherence* to the preventive measures, the present study will assess the role of different psychological variables on both of these aspects separately within the same individuals (see also Zajenkowski et al., 2020). Acceptance is undoubtedly expected to be a strong determinant for adherence, yet either of these factors in isolation is most likely not sufficient to explain cognitive and behavioural processes in response to the preventive measures. For example, individuals can accept preventive measures but nevertheless fail to adhere to them due to motivational reasons, or vice versa, individuals might adhere to the preventive measures even though they do not accept them (e.g. to avoid troubles). Thus, some variables might be more directly related to acceptance, while others might be more directly related to adherence. Each set of variables and their presumed effect on acceptance and adherence to the preventive measures is elaborated in the following sections.

### **Cognitive Aspects: a ‘Contaminated Mindware’ Approach**

The new pandemic situation has incited a flood of unwarranted information that contradict the scientifically established view, for example, in the format of ‘fake news’, unsubstantiated rumours or conspiracy beliefs (Duplaga, 2020; World Health Organization, 2020b). Conspiracy beliefs can be seen as ‘unnecessary assumptions of conspiracy when other explanations are more probable’ (Aaronovitch, 2010, p. 5) and an attempt to attribute the cause of an event to secret plots by specific powerful groups or forces who cover-up information to suit their own interests (Douglas et al., 2017; McCauley & Jacques, 1979). Conspiracy beliefs are more likely to occur in times of societal crisis and uncertainty (van Prooijen & Douglas, 2017; van Prooijen & Jostmann, 2013). In such situations, conspiracy beliefs are particularly attractive because they provide seemingly straightforward answers about the emergence of a crisis and the actors behind it (van Prooijen & Douglas, 2017) and thus help to deal with inexplicable or complicated events and possibly diffuse feelings of anxiety and stress (e.g. Erceg et al., 2020; Grzesiak-Feldman, 2013; Swami et al., 2016). Conspiracy beliefs emerged almost immediately after the first reports of COVID-19 and continued to attract attention from people all over the world (Gogarty & Hagle, 2020). Conspiracy beliefs can undermine preventive behaviour (Allington et al., 2021; Bierwiazzonek et al., 2020; Constantinou et al., 2021; Earnshaw et al., 2020; Freeman et al., 2022; Imhoff & Lamberty, 2020; Pavela Banai et al., 2020; Pummerer et al., 2021; Romer & Jamieson, 2020; Teovanović et al., 2021), and the study of conspiracy beliefs is therefore of great relevance for preventing the spread of SARS-CoV-2.

Based on previous research, it can be expected that people who believe that COVID-19 is the result of a secret plot rather than a real threat adhere less to the preventive measures. However, it has also been reported that the relationship between conspiracy beliefs and adherence to the preventive measures disappears in the context of other variables, so that the effective strength of this association remains unknown (Earnshaw et al., 2020). Moreover, previous studies have shown that the belief in conspiracies correlates with anti-science attitudes (e.g. science is considered as unobjective or corrupt) and also with the endorsement of paranormal/pseudoscientific beliefs (i.e. beliefs that are not grounded in evidence, such as telepathy or the efficiency of some alternative treatments) (e.g. Darwin et al., 2011; Drinkwater et al., 2012; Hartman et al., 2017; Lewandowsky et al., 2013; Lobato et al., 2014; Lobato & Zimmerman, 2019; Ståhl & van Prooijen, 2018; van der Linden, 2015). In a recent integrative theoretical framework, Rizeq et al. (2021) suggested to consider conspiracy and paranormal beliefs and anti-science attitudes as three components of a higher-order psychological factor termed as 'contaminated mindware'. According to this approach, specific cognitive processing styles result in a contaminated mindware, such as a biased perception of probability and causality (e.g. perceiving meaningful patterns or causality in unrelated events), low levels of reality testing and open-minded thinking (e.g. low ability or motivation to critically test the plausibility of one's beliefs), ontological confusions (e.g. believing that lifeless natural objects are animate or that thoughts can be manifested as physical forces), and related to all these aspects, an over-reliance on intuitive-experiential over rational processing in judgements and decision making (e.g. Betsch et al., 2020; Blackmore & Moore, 1994; Blanco et al., 2015; Brugger & Graves, 1997; Čavojová et al., 2020; Denovan et al., 2020, 2018; Drinkwater et al., 2012; Foster & Kokko, 2009; Irwin, 2009; Leonard & Williams, 2019; Lindeman & Aarnio, 2007; Matute et al., 2011; Musch & Ehrenberg, 2002; Pencycook et al., 2012; Rizeq et al., 2021; Ståhl & van Prooijen, 2018; van Prooijen, Douglas, et al., 2018; van Prooijen, Douglas, & De Inocencio, 2018).

In line with the contaminated mindware approach, previous studies found that endorsing one conspiracy belief is strongly correlated with endorsing many others (Douglas & Sutton, 2011; Lobato et al., 2014; Swami et al., 2011), even when they refer to completely unrelated events or even when they are contradictive (Sutton & Douglas, 2014; Wood et al., 2012). Such findings have led to the conceptualisation of a trait-like 'conspiracy mentality', characterized by a general tendency to mistrust official information or to take side views (e.g. Brotherton et al., 2013; Bruder et al., 2013; Imhoff & Bruder, 2014). The role of the different components of a contaminated mindware in relation to preventive measures has so far only been investigated independently from each other or in pairs (Allington et al., 2021; Bierwiazzonek et al., 2020; Constantinou et al., 2021; Earnshaw et al., 2020; Freeman et al., 2022; Gratz et al., 2021; Imhoff & Lamberty, 2020; Pavela Banai et al., 2020; Plohl & Musil, 2021; Pummerer et al., 2021; Reinders Folmer et al., 2020; Romer & Jamieson, 2020; Teovanović et al., 2021), but to the best of our knowledge, no study has yet carefully considered all of these components within the same sample. Following the approach of contaminated mindware,

conspiracy mentality, anti-science attitude and paranormal beliefs can be considered as higher-order concepts superordinate to more specific COVID-19 conspiracy beliefs, and we will explore whether these higher-order concepts still have a direct association with acceptance and adherence when controlling for the indirect effect of specific COVID-19 conspiracy beliefs (i.e. when COVID-19 conspiracy belief is considered as mediator). Moreover, since the contaminated mindware variables are an integral part of how COVID-19 specific information are deliberately processed, we expected that they determine acceptance in the first place, and thus only have an indirect effect of adherence (via acceptance). Finally, the role of intuition as a common underlying processing style (e.g. [Denovan et al., 2020](#); see above) will be further investigated.

### **Further Variables I: Fear and Anxiety**

Besides the contaminated mindware variables, we considered the emotion-related variables fear of COVID-19, trait anxiety and fear of death to be of particular interest in the context of the present study. It has been shown that increased fear of getting infected with SARS-CoV-2 has a positive effect on protective behaviour (e.g. [Carlucci et al., 2020](#); [Jiwani et al., 2021](#); [Kachanoff et al., 2021](#); [Plohl & Musil, 2021](#); [Reinders Folmer et al., 2020](#); [Rothgerber et al., 2020](#); [Vally, 2020](#)). Trait anxiety refers to relatively stable tendencies to evaluate situations as threatening and to react to them with an increase in state anxiety such as tension, nervousness and worry ([Spielberger, 1972](#)). Trait anxiety is associated with higher fear of death (e.g. [Hoelter & Hoelter, 1978](#)) and protective health behaviour ([Erceg et al., 2020](#); [Sweeny & Dooley, 2017](#)). Subsequently, it can be expected that high trait anxiety is associated with a more strict adherence to the preventive measures, even though there is mixed evidence for such an assumption, with studies showing positive, negative, or no such association (e.g. [Ebrahimi et al., 2020](#); [Jiwani et al., 2021](#); [Siebenhaar et al., 2020](#)). We hypothesized that a higher level of trait anxiety would be associated with a higher level of the more specific fear of COVID-19 as well as with increased fear of one's own death, and it will be examined which of those facets of fear/anxiety are directly associated with acceptance and adherence to the preventive measures. Moreover, it has been suggested that the endorsement of conspiracy beliefs can serve as coping strategy to reduce anxiety (e.g. [Douglas et al., 2017](#), [van Prooijen & Douglas, 2017](#)). We therefore also further examined how these variables are related to the contaminated mindware variables.

### **Further Variables II: Big 5, Locus of Control, Optimism-Pessimism**

Classical personality-related variables were included in the present study either because they might be directly associated with preventive behaviour and/or because they might be associated with the contaminated mindware variables. Among these are the *Big 5*, a basic model of personality traits (e.g. [Costa & McCrae, 1992](#)). Previous studies suggest weak positive associations with compliance to the preventive measures for

agreeableness, openness, conscientiousness and neuroticism, and a negative association for extraversion, but results were not always consistent (AL-Omiri et al., 2021; Aschwanden et al., 2021; Brouard et al., 2020; Clark et al., 2020; Imhoff & Lamberty, 2020; Krupić et al., 2021; Wright et al., 2021; Zajenkowski et al., 2020). Beside these direct effects, various indirect effects are conceivable, such as a positive association between neuroticism and fear of getting infected with SARS-CoV-2, or between conspiracy beliefs and low agreeableness and high openness to experience and neuroticism (e.g. Bruder et al., 2013; Goreis & Voracek, 2019; Swami et al., 2010, 2013), although the exact relationship between the Big 5 variables and conspiracy beliefs has remained controversial (Bowes et al., 2021).

Another potentially influential variable is *locus of control* (internal vs. external; Rotter, 1966). People with a high internal locus of control tend to believe that they can control their own destinies and are therefore more active in trying to take control of events, which might increase the engagement in preventive behaviours (Amit Aharon et al., 2018; Devereux et al., 2021; Kelly et al., 1990; Olagoke et al., 2021; Steptoe & Wardle, 2001; Weiss & Larsen, 1990). The opposite might be true for people with a high external locus of control, who believe that their destinies are influenced by fate, powerful others or God (although this might not be true for specific health-related external locus of control in regard to medical professionals; cf. Berg & Lin, 2020). Moreover, high external locus of control is associated with an increased tendency to endorse conspiracy beliefs (e.g. Abalakina-Paap et al., 1999; Hamsher et al., 1968).

Also the expectation whether future events will turn out positively or negatively might be relevant for the individual response to the preventive measures (i.e. optimism-pessimism; Carver & Scheier, 2014). In general, optimists have better strategies of coping with stressful situations, higher internal locus of control and a reduced tendency to endorse conspiracy beliefs (e.g. Guarnera & Williams, 1987; Scheier et al., 1986), which might enhance preventive behaviour (Furnham, 2013; Jovančević & Miličević, 2020; Xie et al., 2011). At the same time, optimism is associated with lower levels of anxiety (e.g. Carver & Scheier, 2014; Chang, 1998; Khoo & Bishop, 1997), which in turn may reduce preventive behaviour (Weinstein, 1982). These contradictory predictions make it interesting to further study the role of optimism/pessimism in the context of COVID-19.

Finally, it can be expected that some of these personality variables might influence adherence beyond their effect on acceptance. For example, agreeable people care about others and might adhere because they want to protect others avoid conflicts (Zajenkowski et al., 2020), even though they may personally believe that the danger of COVID-19 is exaggerated (or even faked). It will therefore be interesting to further explore the possible effect of these variables on adherence when controlling for acceptance.

## Further Variables III: Self-Control and Regulatory Focus

When studying adherence to preventive measures, it is also important to consider motivational aspects. Some factors make it harder for people to follow preventive measures, as these might make it necessary to change routines or deal with negative experiences such as these associated with home confinement, even if the measures are viewed as appropriate (Wolff et al., 2020). Thus, individual differences in self-control may play an important role in explaining variance in adherence to the preventive measures (Wolff et al., 2020; Xu & Cheng, 2021).

Related to self-control, previous motivational-emotional theories suggest that people have two distinct self-regulatory foci when approaching goals: promotion and prevention (Higgins, 1998). When promotion focused, people are motivated by growth and development needs as they aim to reach their ‘ideal self’ that is defined by hopes and aspirations. When prevention focused, people are motivated by security needs with the goal of reaching their ‘ought self’ that is defined by responsibilities, duties and obligations. This involves avoiding things that can be harmful to protect themselves and others. Regulatory focus theory has been applied in many domains such as health, relationships, work and education (for a recent review see Scholer et al., 2019). There is to our knowledge only one study that linked regulatory focus theory to the response to COVID-19 (Vaughn et al., 2020), with a main focus on situational regulatory focus. The present study focuses on the dispositional regulatory focus, and it is hypothesized that people with higher dispositional prevention regulatory focus are more willing to accept and adhere to the preventive measures.

Since these motivational aspects are crucial in regulating behaviour, it was hypothesized that they might be directly associated with adherence beyond their possible indirect effect over acceptance. In addition to dispositional regulatory focus, we also assessed social norm compliance. The aspect of norm compliance is partly contained in the concept of dispositional prevention regulatory focus, but in the context of COVID-19, we found it useful to examine this aspect separately.

## Political Orientation

Last but not least, previous research suggests that a more liberal political orientation is associated with higher level of adherence to the preventive measures (Rothgerber et al., 2020; Sanders, 2020; Xu & Cheng, 2021). Moreover, political ideology could be interconnected with many of the factors described so far. For example, conspiracy beliefs are associated with ideological extremism, predominantly with extremist right views (Sutton & Douglas, 2014; van Prooijen et al., 2015; van Prooijen, Rutjens, et al., 2018; van Prooijen, Rutjens, & Brandt, 2018). The role of political extremism was not in the focus of this study and we did not expect our sample to be representative in terms of the distribution of political views. Nevertheless, we included a simple left-right wing association question in order to further explore its role in the context of the examined variables.



To sum up, SARS-CoV-2 is highly contagious and can cause serious health complications. Adherence to the preventive measures is a critical factor in saving lives and eventually overcoming the pandemic situation. It is therefore important and timely to better understand the interindividual variance in response to the preventive measures. This study aims to provide a comprehensive picture about the range of potential effects of various psychological factors (with a focus on contaminated mindware) on both the acceptance and adherence to the preventive measures.

## Materials and Method

### *Participants*

Participants were recruited through the participants pool of UniDistance Suisse and of the University of Bern, as well as by distributing the link to the survey by email. In the former case, students received course credits for participation, and in the latter case, no reimbursement was provided. An opportunity sample of 387 participants completed the study. Thirteen participants were excluded from analyses because they gave an invalid response to at least one lure item (see procedure). The final sample thus consisted of 374 participants, 296 female (79.1%) and 78 male (20.9%) with a mean age of 33.5, ranging from 16 to 76. One hundred eighty-one (48.4%) participants were undergraduate students. About half of the participants ( $n = 193$ ; 51.6%) held a baccalaureate degree, and 134 (35.8%) a university degree. The remaining participants either indicated an apprenticeship diploma ( $n = 41$ ; 11.0%) or school diploma ( $n = 6$ ; 1.6%) as their highest educational degree. Twenty-five participants (6.7%) indicated that they were tested positive with COVID-19, and 333 (89%) reported that they know someone who was tested positive. Seventy-five participants (20.1%) indicated that they or someone in their private environment were severely affected by COVID-19. Fifty-six (14.97%) participants were considered to belong to the risk group.

All participants provided informed consent prior to the study, and the study was approved by the local Ethical Commission.

### *Acceptance and adhere to the preventive measures*

Acceptance and adherence to the preventive measures was assessed by means of a self-constructed scale with 10 items (see [Table 1](#)). The items were generated based on the recommendations of the World Health Organization and the Federal Office of Public Health in Switzerland during the time of the survey. Regarding acceptance, participants rated the degree to which they consider each of the preventive measures as justified on a 7-point Likert scale (1 = completely exaggerated, 2 = exaggerated, 3 = slightly exaggerated, 4 = unsure, 5 = rather appropriate, 6 = appropriate, 7 = does not go far enough). Regarding compliance, participants rated their agreement with the statements describing compliant behaviour on a 7-point Likert scale (ranging from 1 = does not apply at all to 7 = applies completely).



**Table 1.** Items of COVID-19 Preventive Measures.

Item	Acceptance			Adherence		
	M	SD	rIR	M	SD	rIR
Keep social distance	5.61	1.09	0.748	5.15	1.45	0.612
Wearing mask in public transport	5.64	1.07	0.787	6.76	0.77	0.412
Wearing mask indoors	5.45	1.28	0.815	6.64	0.84	0.456
Wearing mask outdoors if distancing is not possible	4.88	1.60	0.793	5.04	1.81	0.667
Hygiene regulations (frequent handwashing, disinfect surfaces)	5.82	0.85	0.546	4.86	1.68	0.587
Stay home and get tested when experiencing symptoms	5.52	1.10	0.732	5.37	1.61	0.551
Go into quarantine when being tested positively	5.86	0.79	0.597	6.61	0.99	0.459
Stick to the limits on events and gatherings	5.13	1.44	0.766	5.27	1.63	0.673
Provide contact data for tracing (e.g. in restaurants)	5.04	1.54	0.783	6.39	1.22	0.521
During lockdown, leave home only for most necessary issues	4.18	1.89	0.701	5.38	1.65	0.601
Mean	5.31	1.01	—	5.75	0.92	—

Note. *M* = Mean, *SD* = Standard deviation,  $r_{IR}$  = correlation between the item and the rest of the scale (item discrimination).

Mean, SD and item-rest correlation for the acceptance and adherence of the COVID-19 preventive measures are summarised in Table 1. All item-rest correlations are above the acceptable threshold of .40, and Cronbach's alpha was high, both for acceptance,  $\alpha = .92$ , 95% CI [.91, .93], and adherence,  $\alpha = .85$ , 95% CI [.83, .87]. This indicates that, although the items tap into different facets of behaviour, these behaviours were associated with each other. An acceptable fit for the model with a single acceptance and adherence factor was further confirmed by a confirmatory factor analysis (see [Supplementary material](#)).

## Questionnaires

The questionnaires used in this study including the number of items, Likert scale range and labelling, *M*, *SD* and Cronbach's Alpha are summarised in Table 2.

**COVID-19 Conspiracy Beliefs.** Similar to Šrol et al. (2021), a selection of typical COVID-19 specific conspiracy beliefs were chosen that describe beliefs concerning the outbreak, spread and cure of SARS-CoV-2. The items were: 'SARS-CoV-2 is an artificially created biological weapon', 'SARS-CoV-2 was put into circulation (or, respectively, has not been stopped) in order to reduce the overcrowded human population', 'COVID-19 could have been stopped right at the start, but the large companies made a business out of keeping it going', 'SARS-CoV-2 is not very different from an ordinary flu but is reframed as being dangerous by pharmaceutical companies to increase the sales of medication', and 'When defining the preventive measures, the government was

**Table 2.** Summary of the Different Psychological Variables.

Psychological variables	Likert scale	N Items	Cronbach's Alpha [95% CI]	M	SD
COVID-19 conspiracy	1-11 <sup>C</sup>	5	.86 [.84, .88]	3.55	2.07
Conspiracy mentality	1-11 <sup>C</sup>	5	.84 [.82, .87]	6.18	1.96
Mistrust in science	1-11 <sup>C</sup>	5	.87 [.85, .89]	4.54	1.83
Paranormal	1-7 <sup>D</sup>	12	.93 [.92, .94]	3.33	1.40
Faith in intuition	1-7 <sup>B</sup>	6	.79 [.75, .82]	4.84	0.83
Fear of COVID-19	1-5 <sup>B</sup>	7	.78 [.75, .81]	1.89	1.04
Trait anxiety	1-4 <sup>A</sup>	10	.90 [.88, .91]	1.94	0.57
Fear of death	1-5 <sup>B</sup>	6	.94 [.93, .95]	1.69	0.54
Big5-openness	1-5 <sup>B</sup>	2	—	3.78	0.94
Big5-conscientiousness	1-5 <sup>B</sup>	2	—	3.78	0.80
Big5-extraversion	1-5 <sup>B</sup>	2	—	3.40	0.99
Big5-agreeableness	1-5 <sup>B</sup>	2	—	3.34	0.76
Big5-neuroticism	1-5 <sup>B</sup>	2	—	2.91	0.98
LOC-internal	1-7 <sup>B</sup>	2	—	5.59	0.90
LOC-external	1-7 <sup>B</sup>	2	—	6.02	2.26
Optimism	1-5 <sup>B</sup>	3	0.79 [.75, .83]	3.66	0.80
Pessimism	1-5 <sup>B</sup>	3	0.80 [.77, .84]	2.20	0.86
Self-control	1-5 <sup>B</sup>	13	.83 [.81, .86]	3.31	0.62
Promotion	1-7 <sup>B</sup>	5	.55 [.48, .63]	5.11	0.75
Prevention	1-7 <sup>B</sup>	5	.45 [.37, .54]	4.51	0.83
Compliance	1-7 <sup>B</sup>	2	—	3.98	1.17
Political orientation	1-5 <sup>E</sup>	1	—	2.95	1.20

Note. LOC = Locus of control. Cronbach's Alpha was not computed when the scale had less than 3 items. Likert scale labelling: A = almost always – almost never, B = does not apply at all – applies completely, C = certainly not – certainly, D = strongly disagree – strongly agree, E = clearly left – clearly right.

influenced by interest groups that do not have the protection of people as their primary goal but rather economic interests or the legitimization of the surveillance of citizens’.

**Conspiracy Mentality.** The general susceptibility to conspiracy beliefs was assessed using the Conspiracy Mentality Questionnaire (CMQ; Bruder et al., 2013). The five items were ‘I think that...’ (1) ‘...many very important things happen in the world, which the public is never informed about’, (2) ‘...politicians usually do not tell us the true motives for their decisions’, (3) ‘...government agencies closely monitor all citizens’, (4) ‘...events which superficially seem to lack a connection are often the result of secret activities’ and (5) ‘...there are secret organizations that greatly influence political decisions’.

**Mistrust in Science.** Mistrust in science was assessed using the Negative Perceptions of Science Scale (NPSS; Morgan et al., 2018). In order to keep the number of items in the survey at a reasonable range, only the five items from the subscale ‘science as corrupt’

were employed. The full NPSS also captures science as heretical, onerous and limited, but arguably, the science as corrupt subscale reflects best the perceived trustworthiness of science. Specifically, the five items reflect variation in the view that scientists have underlying agendas, often financial or political, that influence results in ways that cannot be trusted (see [Morgan et al., 2018](#)). Unlike in the original scale, we used the same 11 point Likert scale as used for the CMQ and COVID-19 conspiracy beliefs.

**Paranormal Beliefs.** Paranormal beliefs were assessed by means of a self-created scale termed Proneness to the Paranormal (ProPara), as the established scales are either (1) relatively long and therefore not ideal for large-scale surveys (e.g. the Revisited Paranormal Belief Scale, RPBS; [Tobayck, 2004](#)), (2) focus only on very specific domains of parapsychology (e.g. the Australian Sheep-Goat Scale, ASGS; [Thalbourne & Delin, 1993](#)), (3) employ forced-choice responses, limiting the sensitivity in capturing weak tendencies of paranormal beliefs (e.g. the Magical Ideation Scale, MIS; [Eckblad & Chapman, 1983](#); see also [Thalbourne, 2010](#)) or (4) contain ‘difficult’ items (i.e. items that most people would disagree with), leading to floor effects and left-skewed distributions when applied to groups of people for which strong paranormal beliefs can a priori not be expected, such as for students (e.g. [Aarnio & Lindeman, 2005](#)). Some attempts to overcome these limitations have been made already but to our knowledge these scales have not been validated ([Betsch et al., 2020](#); [Musch & Ehrenberg, 2002](#); [Schulter & Papousek, 2008](#)).

For all these reasons, the ProPara was created, containing a limited set of items ( $n = 12$ ) that cover a large variety of paranormal beliefs with a medium item difficulty, making it suitable for the use of a students’ population. The ProPara was validated in a pretest ( $n = 110$ ) and showed a high internal consistency (Cronbach’s  $\alpha = .88$ ) and test-retest reliability ( $r = .89$ ). Moreover, ProPara scores were highly correlated with the three established scales (RPBS:  $r = .84$ ; MIS:  $r = .70$ ; ASGS:  $r = .83$ ; all  $ps < .001$ ) and ProPara scores were considerably less left-skewed when compared to the other scales (see [Appendix 1](#)). We therefore consider the ProPara as valid, brief alternative to the established scales. The full list of items is provided in the [Appendix 1](#) of this study.

**Intuition.** Intuition was measured using a short version of the Faith in Intuition Scale ([Epstein et al., 1996](#)), with German translation of the items from [Keller et al. \(2000\)](#). Specifically, from the original 15 items used in [Keller et al. \(2000\)](#), we used the 6 items with the highest loadings on the intuition factor (all  $> .66$ ). An example is: ‘When I have to form an opinion about something, I rely entirely on my intuition’.

**Fear of COVID-19.** Fear of COVID-19 was assessed using the Fear of COVID-19 scale ([Ahorsu et al., 2020](#)). Participants indicate their level of agreement with 7 German-translated statements (e.g. ‘I cannot sleep because I’m worrying about getting coronavirus-19’).

*Trait Anxiety.* Trait anxiety was assessed using the German trait version of the State-Trait-Anxiety-Inventory (Laux et al., 2013). Trait anxiety was measured by 10 items, five of which assessing agitation/emotionality (e.g. 'I am easily tense') and five of which assessing worry/apprehension (e.g. 'I worry about problems that might occur').

*Fear of Death.* Fear of death was assessed using the revised death anxiety scale (Thorson & Powell, 1994). As in Bruder et al. (2013), we only included the 6 items loading on the first factor that is related to the concept of 'not being'. The items were: 'Not knowing what the next world is like troubles me', 'The idea of never thinking again after I die frightens me', 'I hate to think about losing control over my affairs after I am gone', 'The subject of life after death troubles me greatly', 'I hate the idea that I will be helpless after I die' and 'I am worried about what happens to us after we die'.

*Big 5.* The Big 5 personality traits openness, conscientiousness, extraversion, agreeableness and neuroticism were assessed with a German short version (Rammstedt et al., 2013) with two items per trait.

*Locus of Control.* Locus of control was assessed using the four-item scale for the assessment of locus of control (IE-4; Kovaleva, 2012).

*Optimism-Pessimism.* Optimism-pessimism was assessed using a German version of the Revised Life Orientation Test (Glaesmer et al., 2008; Scheier et al., 1994). Optimism and pessimism were assessed separately by 3 items each (e.g. optimism: 'Even in uncertain times, I usually expect the best'; pessimism: 'I rarely count on good things happening to me').

*Self-Control.* Self-control was assessed using a German version of the Brief Self-control Scale (Bertrams & Dickhäuser, 2009; Tangney et al., 2004).

*Promotion and Prevention Regulatory Focus.* Dispositional regulatory focus was assessed using a German-translated version of the Composite Regulatory Focus Scale (CRFS; Haws et al., 2010). The CRFS combines items from the most popular existing scales (Carver & White, 1994; Higgins et al., 2001; Lockwood et al., 2002) and was intended to overcome individual weaknesses of each of these scales (Haws et al., 2010). The CRFS considers regulatory focus as a relatively broad concept and assesses different aspects of this concept with five items each. The items are quite diverse, for example, assessing the reference in goal-orientation with respect to the 'self' (ideal self vs. ought-self) and also childhood experiences (e.g. 'I usually obeyed rules and regulations that were established by my parents'). For these reasons, a high internal consistency cannot be expected for this scale.

*Compliance.* Social norm compliance was assessed by means of two self-constructed items: ‘I think it is important to behave in a way that conforms to societal norms’ and ‘I feel uncomfortable when I stand out because I don’t behave like the others’

## Procedure

The survey was conducted online using the survey tool LimeSurvey ([www.limesurvey.org](http://www.limesurvey.org)). The survey was accessible between 28, Nov. 2020 and 7, March 2021. This time period roughly corresponds to the time the second wave of COVID-19 hit Switzerland. On the starting page, participants were informed about the general aim and procedure of the survey and they gave their informed consent by clicking on an ‘accept’ button. On the next page, they were asked to enter the demographic variables age, sex, educational level, occupation (student vs. non-student) and income. They were also asked to indicate their political orientation by the single item ‘How would you describe your political attitude?’ (1 = clearly left, 2 = predominantly left, 3 = slightly left, 4 = middle, 5 = slightly right, 6 = predominantly right, 7 = clearly right). They were then asked to indicate the following COVID-19 related information: (1) ‘Have you been tested positive with COVID-19?’ (2) ‘Do you know someone personally who was tested positive with COVID-19?’ (3) ‘Have you or someone of your acquaintances been seriously affected by COVID-19?’ and (4) ‘Do you suffer from at least one of the following preconditions associated with an increased risk of COVID-19? (hypertension, cardiovascular disease, diabetes, chronic respiratory disease, cancer, chronically weakened immune system)’. Regarding question 3, we did not expect a high proportion of participants who themselves were seriously affected by COVID-19, and we therefore did not differentiate between *oneself* and *knowing an acquaintance* that were seriously affected. For the sake of simplicity, we refer to this variable henceforth as ‘seriously affected’.

The order of measurements was as follows: 1 = trait anxiety, 2 = fear of COVID-19, 3 = acceptance and adherence to the preventive measures, 4 = intuition, locus of control, compliance, CRFS, 5 = Big 5, self-control, fear of death, optimism/pessimism, 6 = paranormal beliefs, 7 = CMQ, COVID-19 conspiracy beliefs and mistrust in science. The scales within points 4, 5 and 7 used the same Likert scale and the items of these scales were presented intermixed in random order on one webpage. In order to validate that participants read the items carefully and do not simply click through the survey, two lure items were incorporated into the measurements (one item under point 4, and the other item under point 5). Participants were informed in the general procedure information at the beginning of the experiment that they will encounter statements that will not make sense and that they are supposed to disagree on these statements. The items were: ‘Most birds can run faster than they can fly’ and ‘I have never seen a person with blue eyes before’. Some additional items unrelated to this study were also included in the survey.

## Data Analysis

Mean scale values were computed for each participant and used for further analyses. Some of the mean scale values were not normally distributed, and multivariate normal distribution was not given in most cases. To account for this, we used non-parametric Spearman tests for all correlations. Moreover, for all regression analyses (incl. mediation and path analyses), we used 'robust' estimates of standard errors using Satorra and Bentler correction (Satorra & Bentler, 1994), which has been suggested as valid approach to deal with nonnormality (Curran et al., 1996; Hu et al., 1992). Data processing and analyses were performed using R. Regression, mediation and path analyses were performed using the lavaan package (Rosseel, 2012).

*Pre-processing of demographic, health and political orientation information.* Due to the low number of participants in the lowest education category (school diploma,  $n = 6$ , 1.6%), the two lowest education categories were merged for further analysis (school + apprenticeship diploma,  $n = 47$ , 12.6%). Education thus contained three levels. Given that around half of the sample consisted of students ( $n = 181$ , 48.4%), using the variable income may be misleading since it mainly captures whether someone is a student or not. In fact, there was a high correlation between these two variables (i.e. correlation between student: 1 = yes, 0 = no and income:  $r_{\text{Spearman}} = -.751$ ,  $p < .001$ ). In addition, these two variables were highly correlated with age (age and income:  $r_{\text{Spearman}} = -.641$ ,  $p < .001$ ; age and student:  $r_{\text{Spearman}} = -.773$ ,  $p < .001$ ). In the light of the high intercorrelations among these three variables, only age was further considered. Regarding health-related information, the binary variable 'risk group' was created. All participants who indicated that they suffered from preconditions associated with an increased risk of COVID-19 ( $n = 47$ ) or who were older than 65 years ( $n = 9$ ) were allocated to this group. Regarding political orientation, the frequency of responses was 1 (clearly left) = 45 (12.0%), 2 (predominantly left) = 100 (26.7%), 3 (slightly left) = 102 (27.3%), 4 (middle) = 82 (21.9%), 5 (slightly right) = 39 (10.4%), 6 (predominantly right) = 6 (1.6%) and 7 (clearly right) = 0 (0.0%). Due to the low frequency of clearly ( $n = 0$ ) and predominantly ( $n = 6$ ) rightward orientation, these two levels were merged with slightly rightward ( $n = 39$ ). Political orientation thus contained five levels.

*Definition of Control Variables.* Prior to the analysis of the psychological variables, the relevant demographic and COVID-19-related control variables were defined. To this end, zero-order correlations were computed between acceptance, adherence, age, sex, education, risk group, tested positive with SARS-CoV-2, knowing someone that was tested positive, and seriously affected. Variables that were associated with acceptance or adherence were then used as control variables for the analysis of the psychological variables. These control variables constitute the 'baseline model'.

*Assessment of Psychological Variables.* We first reported the zero-order correlations and possible cluster structures of the psychological variables by means of hierarchical

cluster analysis. It was predicted that the conceptually related variables (e.g. contaminated mindware, fear-related; see Introduction) would form separate sub-clusters.

In order to assess the impact of each psychological variable for the preventive measures, each variable was entered separately into the baseline model for acceptance and adherence. The separate analysis guarantees that the regression weights of the psychological variables were not biased by multicollinearity. The standardised regression coefficients of each psychological variable and its associated change in  $R^2$  was reported. We used standardised regression coefficients as a measure of effect size because they allow for a better comparison across different Likert scales. To counteract the problem of multiple comparisons, Bonferroni-Holm correction was applied, and only those variables that survived this correction were considered relevant and used in further analyses.

Next, to better understand the specific role of the psychological variables that were associated with acceptance and adherence, a series of mediation analyses was conducted. Specifically, for all variables that were associated with both acceptance and adherence, we assessed whether the association with adherence was fully mediated by acceptance, or whether these variables also explain variance that is specific to the actual preventive behaviour (adherence). Moreover, for the contaminated mindset variables conspiracy mentality, paranormal belief and mistrust in science, we assessed the possible mediating role of COVID-19 conspiracy beliefs (see Introduction).

Finally, the results from the preceding analyses were summarised by an integrative path model in which adherence was predicted by acceptance. The path model included all variables that have been identified as ‘relevant’ in the preceding analyses. Variables were considered relevant when they showed a significant association with acceptance or adherence in the separate regression analyses described above after Bonferroni-Holm correction for multiple comparisons. Contaminated mindware variables which fulfilled this condition were included as predictors, unless the preceding mediation analysis indicated that their association was fully mediated by COVID-19 conspiracy beliefs. Other variables that met the Bonferroni-Holm criterion were selected as predictors for adherence when they (1) were only associated with adherence but not with acceptance in the separate regression analyses, or (2) if they were associated with both and the preceding mediation analysis indicated that their effect on adherence was not fully mediated by acceptance. The path model thus shows the relative weight of each variable that explains specific variance in acceptance or adherence in the context of all relevant variables and therefore extends the separate analysis described above.

## Results

### *Defining Control Variables*

The zero-order correlations between the demographic variables, the COVID-19 related variables, and acceptance and adherence are reported in [Table 3](#). There were positive associations with acceptance and/or adherence for belonging to the risk group, age and



**Table 3.** Zero-Order Correlation Between Demographic and COVID-19-Related Variables and Acceptance and Adherence to the Preventive Measures.

	Acceptance	Adherence	1	2	3	4	5	6
1. Age	.05	.19***	—					
2. Sex	-.03	.08	-.07	—				
3. Education	-.01	.04	.26***	-.02	—			
4. Tested positive	-.03	-.03	-.07	-.10	.02	—		
5. Risk group	.22***	.19***	.22***	-.05	-.12*	-.04	—	
6. Knowing tested positive acquaintances	.00	-.06	-.08	.05	.12*	.10	-.07	—
7. Seriously affected	.12*	.10	-.03	-.02	.09	.08	.01	.15**

Note. Values represent zero-order Spearman's rho correlation coefficients. Sex is coded as 0 = male and 1 = female. \* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$ . In the context of the control variables,  $p$ -values were not corrected for multiple comparisons.

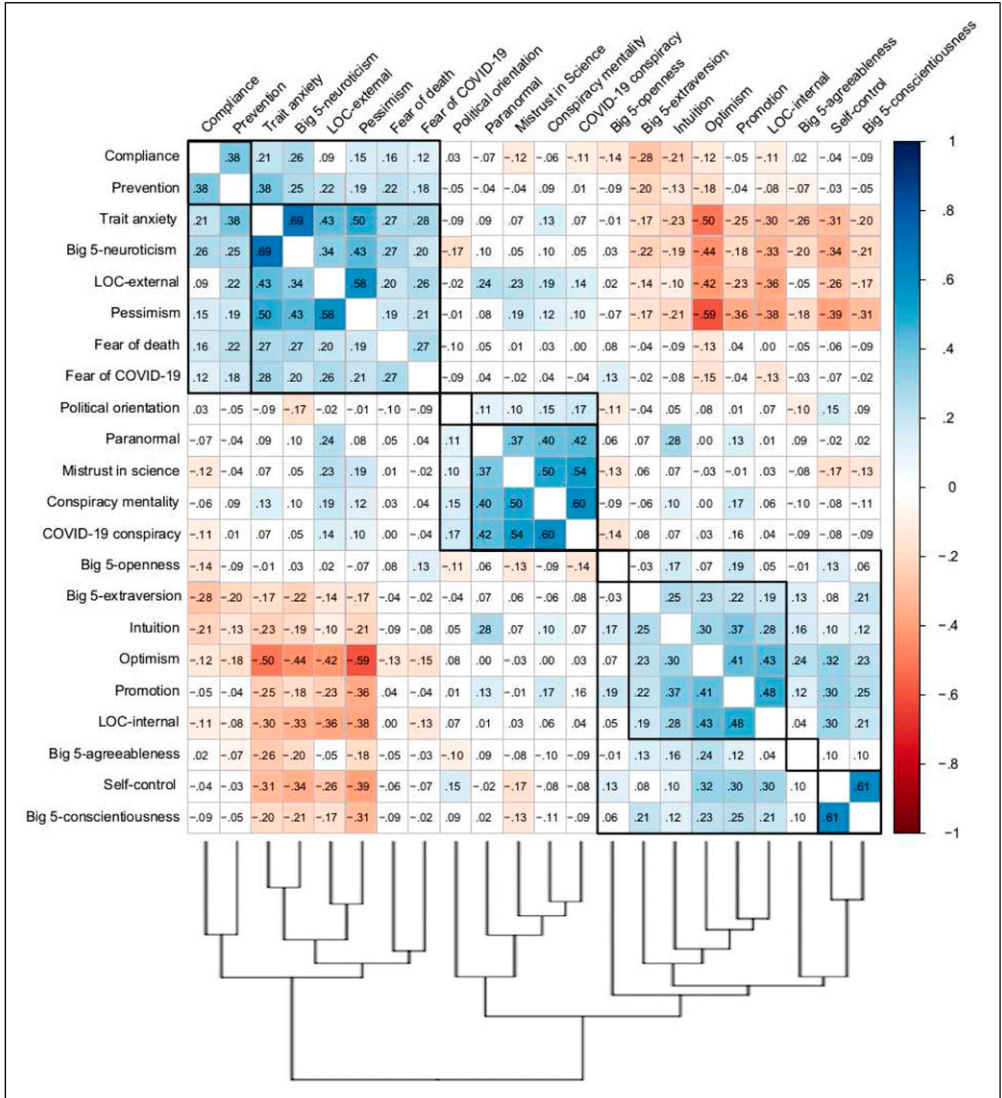
for seriously affected. Even though not all these three variables were significantly associated with both acceptance and adherence, we still entered all three variables into the baseline models for acceptance and adherence, respectively, to guarantee a balanced comparison. The baseline models accounted for 3.5% of variance in acceptance, and for 5.2% of variance in adherence.

### Assessment of Psychological Variables

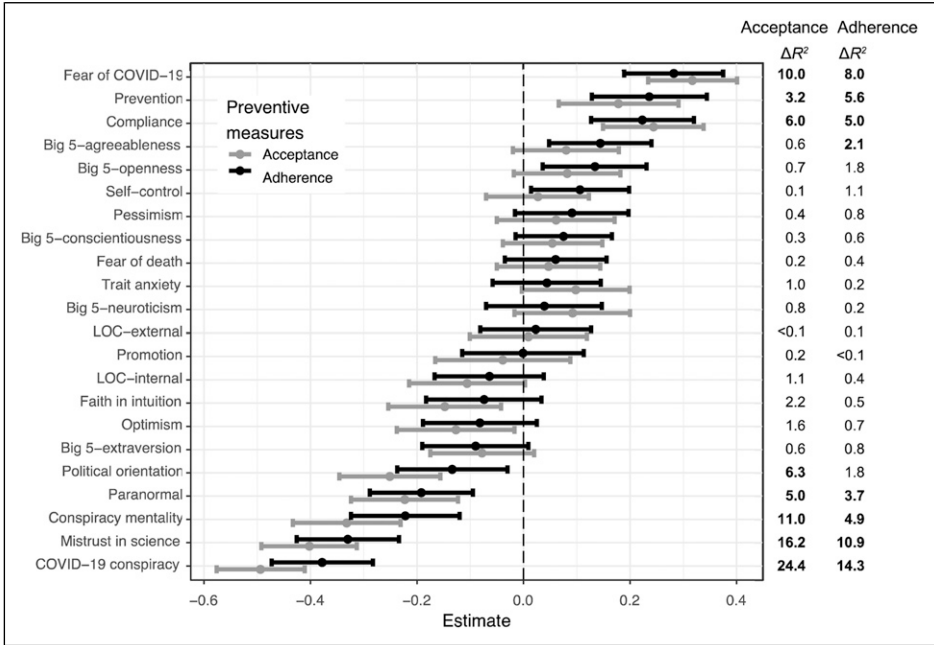
Figure 1 shows the intercorrelations and cluster structures of the psychological variables. The results suggest that the variables can be grouped broadly into three hierarchically superior clusters (illustrated by the three big squares in Figure 1). The first superior cluster consisted of the fear-related variables (trait anxiety, fear of death, fear of COVID-19), Big 5 neuroticism, pessimism, external locus of control, prevention regulatory focus and social norm compliance.

The next superior cluster consisted of the conceptually related contaminated mindware variables (COVID-19 conspiracy beliefs, mistrust in science, conspiracy mentality and paranormal beliefs) as well as political orientation. The final superior cluster consisted of all the remaining variables. The inner squares in Figure 1 represent a possible sub-cluster structure with  $n = 8$ , which in our view leads to sub-clusters of conceptually related variables in a meaningful way (e.g. a sub-cluster with prevention regulatory focus and social norm compliance, or with self-control and Big 5 conscientiousness).

Next, each variable was entered separately into the baseline models for acceptance and adherence. The change in  $R^2$  and the standardised regression coefficients with 95% CI are shown in Figure 2. The results showed that all variables from the first cluster were positively associated with acceptance and adherence, with significant associations for fear of COVID-19, prevention regulatory focus and social norm compliance.



**Figure 1.** Zero-order correlations (Spearman's rho) between predictors. Blue and red colours indicate positive and negative associations, respectively. White colours indicate no significant correlations ( $p > .05$ ). The big three squares indicate three superior clusters of predictors, and the inner squares indicate a possible (meaningful) sub-cluster structure with  $n = 8$  clusters. The dendrogram is shown at the bottom of the matrix.



**Figure 2.** Graphical overview of effects sizes (standardised regression weights) of the 22 predictors for acceptance (grey) and adherence (black) to the COVID-19 preventive measures. Predictors are ordered according to the regression weights for adherence. Error bars represent 95% confidence interval. In general, an effect is considered significant at  $p < .05$  when the 95% confidence interval does not include zero. In the context of the multiple tests in the present study, variables were considered relevant when they remained significant after Bonferroni-Holm correction for multiple comparisons. The R2 values (in %) of variables that met this criterion are marked in bold.

Moreover, all variables from the second cluster (contaminated mindware variables and political orientation) showed a significant negative association with acceptance and adherence, first and foremost COVID-19 conspiracy beliefs and mistrust in science. Remarkably, COVID-19 conspiracy beliefs explained more than twice as much of variance in acceptance of the preventive measures than fear of COVID-19. There were also associations for some of the variables from the third cluster, either with acceptance (optimism and intuition) or adherence (Big 5 agreeableness, Big 5 openness and self-control). As predicted, a higher level of self-control was associated with higher adherence, possibly due to the increased self-regulatory capacities (Wolff et al., 2020). However, when correcting for multiple comparisons following Bonferroni-Holm procedure, Big 5 agreeableness remained the only significant variable of the third cluster.

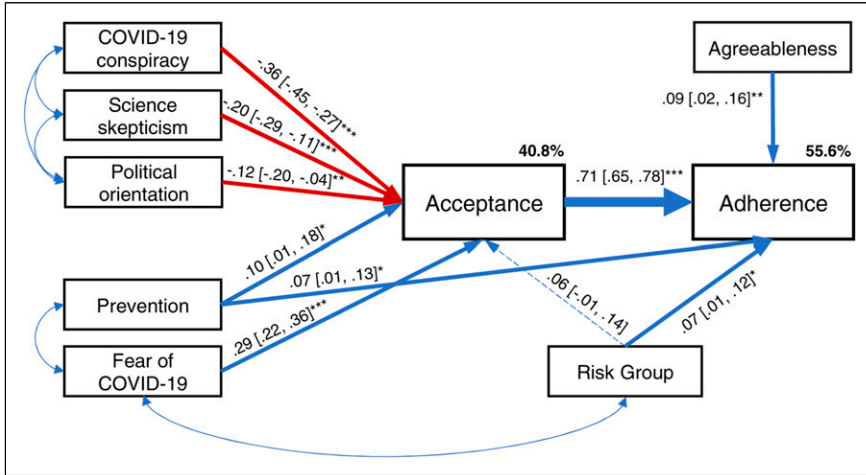
**Table 4.** Results of Mediator Analyses.

Predictor (X)	Mediator (M)	Criterion (Y)	Indirect effect	Direct effect
Fear of COVID-19	Acceptance	Adherence	.25 [.18, .31]***	.05 [-.02, .13]
Prevention	Acceptance	Adherence	.12 [.04, .19]**	.11 [.04, .18]**
Compliance	Acceptance	Adherence	.18 [.10, .25]***	.05 [-.02, .12]
COVID-19 CB	Acceptance	Adherence	-.36 [-.44, -.28]***	-.02 [-.11, .07]
Mistrust in science	Acceptance	Adherence	-.28 [-.36, -.21]***	-.05 [-.12, .02]
Conspiracy mentality	Acceptance	Adherence	-.23 [-.31, -.16]***	.02 [-.04, .09]
Paranormal beliefs	Acceptance	Adherence	-.16 [-.24, -.08]***	-.03 [-.11, .05]
Political orientation	Acceptance	Adherence	-.18 [-.26, -.10]***	.06 [-.02, .14]
Mistrust in science	COVID-19 CB	Acceptance	-.15 [-.22, -.09]***	-.17 [-.29, -.06]**
Conspiracy mentality	COVID-19 CB	Acceptance	-.24 [-.31, -.16]***	-.03 [-.09, .14]
Paranormal	COVID-19 CB	Acceptance	-.15 [-.21, -.10]***	-.03 [-.14, .07]

Note. COVID-19 CB = COVID-19 conspiracy beliefs. All regressions include the control variables age, risk group and seriously affected. \*\* $p < .01$ , \*\*\*  $p < .001$ .

In order to better understand these significant associations, a series of mediator analyses was conducted (see data analysis). From all variables with a significant association with both acceptance and adherence, only the direct association between adherence and prevention regulatory focus remained significant when acceptance was considered as mediator (Table 4, lines 1-8). This suggests that the remaining variables in the first place influence the attitude towards the preventive measures, which in turn determines adherence. This was also true for the contaminated mindware variables. We therefore limited the mediator analysis for these variables to acceptance. Specifically, we examined whether the more proximal variable COVID-19 conspiracy beliefs mediated the associations of the more distal variables conspiracy mentality, mistrust in science and paranormal beliefs. The analyses revealed a partial mediator effect for mistrust in science and a total mediation effect for conspiracy mentality and paranormal beliefs. Thus, only the direct association between acceptance and mistrust in science remained significant when the indirect effect via COVID-19 specific conspiracies was included.

Next, the results were integrated into a path model (Figure 3) that included all the relevant variables associated with acceptance, and the variables that explained variance specific for adherence (i.e. when controlling for acceptance). Specifically, all variables that were associated with acceptance in the separate analyses reported above (following Bonferroni-Holm correction for multiple comparisons) were entered into the path model except for conspiracy mentality and paranormal beliefs, whose effects were fully mediated by COVID-19 conspiracy beliefs (see Table 4). Regarding adherence, Big 5 agreeableness which was exclusively associated with adherence was used as predictor, as well as preventive regulatory focus, whose association was not fully mediated by



**Figure 3.** Path model including the relevant predictors for acceptance, and for adherence when controlling for acceptance. Prevention refers to dispositional regulatory focus. Blue lines represent positive, and red lines represent negative associations. The dotted path represents a non-significant association. \*  $p < .05$ , \*\* $p < .01$ , \*\*\*  $p < .001$ .

acceptance (see Table 4). In order to reduce the number of variables entered into the path model, we omitted the variable social norm compliance due to its conceptual relatedness to preventive regulatory focus (remember also that social norm compliance was a self-created scale based on two items only, whereas regulatory focus was measured using an established scale). Moreover, we only included one of the three (intercorrelated) control variables that seems most appropriate in the context of COVID-19: risk group. Covariances were allowed in the model for intercorrelated predictors.

The model fitted the data well,  $\chi^2(21) = 38.92, p = .010, \chi^2/df = 1.85, CFI = 0.97, TLI = 0.95, RSMEA = 0.05, SRMR = 0.05$ . Most importantly, all path coefficients of the psychological variables remained significant in the context of the other variables, confirming that they all explain unique variance in either acceptance (COVID-19 conspiracy beliefs, science scepticism, political orientation, fear of COVID-19), adherence (Big 5 agreeableness, risk group), or both (prevention regulatory focus). The predictors explained 40.8% of variance in acceptance and 55.6% in adherence.

### Further Exploratory Analyses of COVID-19 Conspiracy Beliefs

Upon discovering that COVID-19 conspiracy beliefs had the strongest association with acceptance and adherence to the preventive measures, the decision was made to further examine this relationship. Specifically, one could ask whether this association was possibly driven by 'real' conspiracy believers only, that is, people who agreed with the

conspiracy statements, as opposed by people who did not. We therefore re-assessed the association between COVID-19 conspiracy beliefs and acceptance of the preventive measures separately for the sub-group of participants who agreed (scale value of  $> 6$ ) with at least one COVID-19 conspiracy statement ( $n = 174$ ; 46.5%) and for the sub-group who disagreed with all statements ( $n = 200$ , 53.5%). The standardised regression estimates for the first group revealed a significant negative association,  $\beta = -.47$ , 95% CI  $[-.58, -.35]$ ,  $p < .001$ . The results for the second group also revealed a near-significant negative association,  $\beta = -.14$ , 95% CI  $[-.28, .01]$ ,  $p = .059$ . This trend suggests that the lower acceptance of the preventive measures is not exclusively shaped by people who agreed with the conspiracy statements but also by people who disagreed with varying levels of (un)certainty.

## Discussion

The aim of this study was to assess the role of different psychological variables ( $n = 22$ ) from the domains of cognitive evaluation (e.g. contaminated mindware), emotion (e.g. fear of COVID-19, trait anxiety), personality psychology (Big5, locus of control, optimism/pessimism) and motivation (self-control, regulatory focus) on the acceptance and adherence to the COVID-19 preventive measures.

Early in the COVID-19 pandemic emergence, the WHO Director postulated that we are ‘not just fighting an epidemic; we’re fighting an infodemic. Fake news spreads faster and more easily than this virus, and is just as dangerous’ ([World Health Organization, 2020a](#)). Our results substantiate these concerns: COVID-19 conspiracy beliefs and mistrust in science were most strongly associated with lower acceptance and adherence to the preventive measures. Remarkably, COVID-19 conspiracy beliefs explained more than twice as much of the variance in acceptance of the preventive measures when compared to the variable with the highest positive association (fear of COVID-19) when each variable was considered separately, and COVID-19 conspiracy beliefs also had the strongest effect when all relevant variables were considered in combination.

Our results therefore add to a growing body of recent evidence for the significant impact of unwarranted beliefs in the fight against the pandemic ([Allington et al., 2021](#); [Bierwiazzonek et al., 2020](#); [Bruder & Kunert, 2021](#); [Constantinou et al., 2021](#); [Earnshaw et al., 2020](#); [Freeman et al., 2022](#); [Gratz et al., 2021](#); [Imhoff & Lamberty, 2020](#); [Pavela Banai et al., 2020](#); [Plohl & Musil, 2021](#); [Pummerer et al., 2021](#); [Reinders Folmer et al., 2020](#); [Romer & Jamieson, 2020](#); [Šrol et al., 2021](#); [Teovanović et al., 2021](#)). Remarkably, this result emerged in a sample that did not consist of particularly strong conspiracy believers. Nevertheless, about half of the sample (46.5%) agreed with at least one of the COVID-19 specific conspiracy statements, and this sub-sample had the most pronounced negative association with acceptance and adherence to the preventive measures. However, also in the group of participants who did not agree with any of the conspiracy statements, a tendency towards a negative association between COVID-19 conspiracy beliefs and acceptance was observed, suggesting that even when

one does not believe that a conspiracy statement is true, the level of (un)certainty with which it is rejected might influence preventive behaviour. This suggests that interventions aiming at fighting misinformation should not be specifically directed towards groups of conspiracy believers only, but rather the general population.

Moreover, our results confirm a strong association between the contaminated mindware variables conspiracy mentality, paranormal beliefs and anti-science attitudes (e.g. Darwin et al., 2011; Drinkwater et al., 2012; Hartman et al., 2017; Lewandowsky et al., 2013; Lobato et al., 2014; Lobato & Zimmerman, 2019; Ståhl & van Prooijen, 2018; van der Linden, 2015). Going beyond previous research, we demonstrated that the direct association of these variables with acceptance disappeared when controlling for the indirect effect via the more specific COVID-19 conspiracy beliefs, the only exception being mistrust in science. Mistrust in science can therefore have a negatively effect on the acceptance of the preventive measures, independent of whether a person also endorses COVID-19 specific conspiracy beliefs or not. This finding highlights that interventions should not only focus on fighting conspiracy-related misinformation but also aim at modifying the more general perception of science as an objective and trustworthy tool to gain knowledge.

In contrast to conspiracy belief and mistrust in science, there was a positive association between acceptance and adherence to the preventive measures and the specific fear of COVID-19 (e.g. Carlucci et al., 2020; Jiwani et al., 2021; Kachanoff et al., 2021; Plohl & Musil, 2021; Reinders Folmer et al., 2020; Rothgerber et al., 2020; Vally, 2020). Fear of COVID-19 was also intercorrelated with fear of death and trait anxiety, and the latter tended to be positively associated with acceptance of the preventive measures. However, fear of COVID-19 was the only fear-related variable that was associated with adherence to the preventive measures. The separate assessment of acceptance and adherence might help to explain previous mixed results regarding the role of trait anxiety (e.g. Ebrahimi et al., 2020; Jiwani et al., 2021; Siebenhaar et al., 2020). Specifically, our results indicate that trait anxiety influences how the pandemic situation is perceived and consequently shapes the attitude towards the preventive measures (Erceg et al., 2020; Sweeny & Dooley, 2017), but only the specific fear of COVID-19 is a reliable determinant of the actual preventive behaviour.

Besides fear of COVID-19, the two conceptually related variables prevention regulatory focus and social norm compliance were also positively associated with both acceptance and adherence to the preventive measures. Thus, individuals who care about social norms or who are characterized by high concerns about security and duties are most likely to accept and adhere the preventive measures. Given that the individual characteristics of prevention regulatory focus are most relevant for preventive behaviour, it is surprising that this study was one of the first that linked dispositional prevention regulatory focus to interindividual responses to COVID-19. Interestingly, preventive regulatory focus was the only variable whose effect on adherence was not fully mediated by acceptance. This further points to an important, mostly neglected role of motivational and regulatory aspects for adherence of COVID-19 preventive measures (Wolff et al., 2020; Xu & Cheng, 2021). The current pandemic situation requires a



*situational preventive regulation focus* of behaviour from all individuals, and those individuals with a congruent dispositional regulatory focus (prevention) may be more successful in regulating their behaviour (see regulatory fit; Higgins, 1998).

Somewhat surprisingly, none of the more classical personality-related variables (Big 5, locus of control, optimism/pessimism) was associated with acceptance of the preventive measures. However, agreeableness was associated with adherence. This is largely in line with previous findings, although associations with conscientiousness and neuroticism have sometimes also been reported (AL-Omiri et al., 2021; Aschwanden et al., 2021; Blagov, 2021; Brouard et al., 2020; Clark et al., 2020; Imhoff & Lamberty, 2020; Krupić et al., 2021; Wright et al., 2021; Zajenkowski et al., 2020). Our results suggest that the more COVID-19 specific variables (conspiracy beliefs, fear) primarily determine acceptance, so that the direct effect of classical personality-related variables on attitude towards preventive measurement is limited, but they may nevertheless determine some aspects of behaviour. Specifically, we showed that agreeableness was still associated with adherence when controlling for acceptance. Thus, agreeable individuals do not necessarily strongly believe that the preventive measures are justified, but they nevertheless adhere more to them because they care for others or because they want to avoid conflicts (Zajenkowski et al., 2020). Agreeableness may therefore be a critical personality trait in mitigating the effect of a negative attitude of the preventive measures on actual preventive behaviour.

Given the relevance of conspiracy beliefs in the context of COVID-19, it is important to further examine its relationship with other variables. Previous studies suggested that intuitive thinking style fosters unwarranted beliefs (e.g. Aarnio & Lindeman, 2005; Denovan et al., 2020; Rizeq et al., 2021). In the present study, intuition was positively associated with paranormal beliefs and conspiracy mentality, but there was no direct association with preventive measures. It has also been hypothesized that conspiracy beliefs may be particularly attractive in times of uncertainty because the conspiracy explanations reduce stress and fear associated with the pandemic situation (e.g. Erceg et al., 2020; Grzesiak-Feldman, 2013; Swami et al., 2016). If reducing fear is indeed a critical motivator for the endorsement of conspiracy beliefs (Bowes et al., 2021; Leone et al., 2018), one could expect a positive association between conspiracy beliefs and trait anxiety, and possibly between specific COVID-19 conspiracy beliefs and fear of COVID-19 (Bruder et al., 2013; Grzesiak-Feldman, 2013; Sallam et al., 2020; Šrol et al., 2021). There was indeed a positive association between trait anxiety and conspiracy mentality in this study, but neither fear of COVID-19 nor trait anxiety was associated with the endorsement of COVID-19 conspiracy beliefs. Thus, while people with higher trait anxiety might be more prone to conspiracy beliefs in general, the association between specific fear and conspiracy beliefs seems to be more complex in the case of COVID-19. For example, someone who believes that SARS-CoV-2 is an artificially created bioweapon to reduce the human population will probably have a higher level of fear of COVID-19 than someone who believes that Sars-Cov-2 is a hoax (see also Imhoff & Lamberty, 2020). Moreover, it is conceivable that, once conspiracy beliefs have been endorsed, fear of COVID-19 is reduced (or increased, depending on

the content of the belief), so that the positive relationship (Šrol et al., 2021) is modulated. Future studies could therefore also focus on possible temporal dynamics of these associations.

While we replicated the positive association between neuroticism and fear of getting infected with SARS-CoV-2 (e.g. Caci et al., 2020; Lippold et al., 2020; Montag et al., 2021), we failed to replicate the associations between conspiracy beliefs and low agreeableness and high openness to experience and neuroticism (e.g. Bruder et al., 2013; Goreis & Voracek, 2019; Swami et al., 2010, 2013). Our results highlight that the exact relationship between the Big 5 variables and conspiracy beliefs remains controversial (Bowes et al., 2021; Brotherton et al., 2013; Galliford & Furnham, 2017; Orosz et al., 2016; Wood & Gray, 2019). For example, openness towards unconventional ideas might support conspiracy beliefs, but at the same time openness is also associated with willingness to deal with complex information which in turn might prevent the endorsement of conspiracy beliefs and increase reasonable preventive behaviour (e.g. Bogg & Milad, 2020; Bowes et al., 2021; Stadler et al., 2020).

Furthermore, the present results do not support the initial hypothesis that high internal locus of control and optimism increases the engagement in preventive behaviour (Amit Aharon et al., 2018; Devereux et al., 2021; Jovančević & Miličević, 2020; Kelly et al., 1990; Olagoke et al., 2021; Steptoe & Wardle, 2001; Weiss & Larsen, 1990). A possible explanation for this would be that people with high locus of control may think that they can control whether they get infected or not (or how badly they would be affected by the disease). Similarly, optimists expect good things rather than bad things happening to them. Such views (i.e. illusory optimism) might reduce the perceived probability that one could get seriously affected by the virus and consequently counteract preventive behaviour. Such an explanation is in line with the findings of this study, given that optimism and internal locus of control was negatively correlated with fear of COVID-19, whereas the opposite was true for pessimism and external locus of control. In order to shed more light on the exact role of locus of control and optimism/pessimism for the individual response to the preventive measures, more research is needed that focuses on more specific domains, such as optimism/pessimism regarding the effect of the preventive measures themselves, the course of the pandemic and or personal health consequences, or the specific locus of control of health as a result of COVID-19 (e.g. Olagoke et al., 2021; Šrol et al., 2021). Despite the fact that the direct associations of locus of control and optimism/pessimism with the preventive measures was limited in this study, the various associations with other relevant variables show that these variables are nevertheless important for a better understanding of the cognitive and behavioural response of individuals. For example, external locus of control and pessimism were positively associated with fear of COVID-19 and also with COVID-19 conspiracy beliefs. Such complex interrelationships suggest that, when informing the public about future scenarios, the need to balance the depiction of dangerous consequences and optimistic outcomes arises – as both too optimistic and pessimistic scenarios could evoke detrimental consequences.

It is also noteworthy that a higher score in political orientation – that is, a more right-wing orientation – was negatively associated with acceptance and adherence to the preventive measures, and positively with conspiracy beliefs. These findings are in line with previous studies (e.g. Galliford & Furnham, 2017; Rothgerber et al., 2020; Sanders, 2020), but since our sample was not balanced in terms of left/right political attitudes, we cannot draw firm conclusions. Most previous studies found that political extremism rather than simple left-right classification is a better predictor (e.g. van Prooijen et al., 2015), or found the association to be dependent on the content of the particular conspiracy belief (e.g. pro vs. anti-establishment conspiracy beliefs; Enders & Uscinski, 2021; Wood & Gray, 2019). A simple distinction between right- and left-wing orientation might not be sufficient to represent the spectrum of political opinions. Right-leaning individuals might be more focused on individual freedoms, and thus be less likely to accept or adhere to preventive measures that are instantiated to protect others, but right-leaning parties oftentimes also focus more on safety or law and order related issues, maintaining the status quo, or upholding traditional societal norms. Similarly, libertarian, progressive left-wing political viewpoints focus highly on individualism and personal freedom and expression, while other forms of left-wing orientations might be more concerned about the well-being of all, social justice and collectivism. More research is needed to understand the link between political orientation, preventive behaviour, conspiracy beliefs, and we suggest that in future studies aiming to explore this connection, a higher dimensional spectrum of political orientation should be taken into account (e.g. Choma et al., 2010; Uscinski et al., 2021).

To conclude, this study extends the understanding of different psychological variables related to the individual response to the COVID-19 preventive measures. With the assessed variables in this study, we were able to explain 40.8% of variance in the acceptance of the COVID-19 preventive measures. Reduced commitment to preventive measures increases the risk of serious infections and fatalities. It also leads to the reinforcement of preventive measures (e.g. lockdown), which in turn has negative socioeconomic consequences for society. Conspiracy beliefs and mistrust in science therefore have a direct effect of the course of the pandemic and consequently on the well-being of the general population. Our results highlight the importance of fighting (conspiratorial) misinformation and fake news about COVID-19, as well as the importance of increasing the credibility of science.

### *Limitations and Outlook*

The study has some limitations. First of all, our sample was not representative of the general population in Switzerland, limiting the generalizability of our results. Consequently, we were not able to assess the role of different demographic aspects (income, educational level, gender, etc.) for the response to the preventive measures and for other psychological variables. Second, we conducted a cross-sectional survey and causal inferences are therefore beyond the scope of this study. More longitudinal research is required to better understand the temporal dynamics of the associations found in this

(and previous) studies. For example, we assumed that mistrust in science endorsed COVID-19 conspiracy beliefs, but it is also possible that the endorsement of COVID-19 conspiracy beliefs reduces trust in science in the long run (Pummerer et al., 2021). In a similar vein, we considered acceptance as a predictor of adherence, but the opposite effect may also be considered. For example, if an individual prefers not to wear masks or fails to maintain hygiene behaviour, she or he may reduce cognitive dissonance by ignoring or denying scientific evidence for the protective effects of these behaviours (Festinger, 1957), which in the long run may change the individual's general acceptance of the measures.

Furthermore, as in most previous studies, adherence to preventive measures was self-reported. With this measurement, it cannot be conclusively stated that higher self-reported adherence directly relates to more or more frequent preventive behaviour, as no objective measurements of the behaviour itself were obtained. Explicit social distancing behaviour, for example, could be inferred from individual mobility assessed via step counts on participants smartphones (e.g. Gollwizer et al., 2021). It could be insightful to correlate self-reported adherence to reported behaviour frequencies such as how many social gatherings were attended over the last month, how often a person washes their hands or uses disinfectant and so on if preventive behaviour cannot be directly observed.

Our list of psychological variables was long but not exhaustive. There are other variables that might further explain variance in individual response to the preventive behaviour. Some researchers have used the HEXACO model of personality rather than the Big 5 and found that the additional variable honesty-humility was negatively associated with both preventive behaviour and conspiracy beliefs (Jolley et al., 2019; Volk et al., 2021). In a similar vein, the variables of the Dark Triad narcissism, Machiavellianism and psychopathy have been found to be related to lower adherence to the preventive measures (e.g. Blagov, 2021; Nowak et al., 2020; Triberti et al., 2021; Zajenkowski et al., 2020) and also to conspiracy beliefs (e.g. Ahadzadeh et al., 2021; Bowes et al., 2021; Cichocka et al., 2016; Hughes & Machan, 2021; March & Springer, 2019). Furthermore, among others, psychological entitlement (Zitek & Schlund, 2021), empathy (Frias-Armenta et al., 2021), intolerance for uncertainty (Jiwani et al., 2021), or religious attitudes (DeFranza et al., 2020; Olagoke et al., 2021) have also been associated with adherence to the preventive measures. Thus, while the present work made an important contribution towards a comprehensive understanding of the psychology behind individual responses to the preventive measures, more extensive and integrative work is required including such further variables to complement the picture.

Finally, while this work focused on the individual variance in response to the COVID-19 preventive measures, a useful next step will be to focus on individual variance in the sharing behaviour of conspirational misinformation and fake news (Lobato et al., 2020). A better understanding of the psychological profile of those people can be useful to better understand how fake news and misinformation are spread and how it can be prevented. Relatedly, previous studies found a positive relationship between COVID-19 conspiracy beliefs and the use of social media as source of

information (Allington et al., 2021). An important step forward might thus, for example, be to encourage people to rely more on trusted sources (Constantinou et al., 2021; Pavela Banai et al., 2020).

## Appendix I

### *ProPara – A New Brief Measurement for Proneness to the Paranormal*

The aim was to create a brief measurement scale that includes a broad range of paranormal phenomena (e.g. telepathy, future vision, extrasensory perceptions, good and evil powers, spiritualism, omens) with medium difficult items (i.e. avoiding items with floor and ceiling effects), so that the scale is well applicable for students. A total of 12 representative items were selected from different existing scales. Some items were slightly reformulated for different reasons (e.g. increase clarity, make the statement less strong). Items are shown in Table A1.

The items were presented to a sample of 110 undergraduate students (mean age = 21.8, ranging from 18 to 40; 91 female). Participants first completed the new items from the ProPara, followed by the Revised Paranormal Belief Scale (RPBS; Tobayck, 2004) without the subscale ‘extraordinary life forms’, the Australian Sheep-Goat Scale (ASGS; Thalbourne & Delin, 1993) and the Magical Ideation Scale (MIS; Eckblad & Chapman, 1983). Seventy-five participants (68%) completed the ProPara items a second time (mean temporal delay = 82 days, ranging from 60 to 137 days).

The results show that the ProPara has a high internal consistency, Cronbach’s alpha = .88, 95% CI [.85, .91], and high test-retest reliability,  $r = .89$ , 95% CI [.84, .93]. Item discrimination ( $r_{IR}$ ) and mean inter-item correlation  $r_{MI}$  were in a good range (Fisssen, 2004).

Moreover, ProPara scores were highly correlated with the three established scales (RPBS:  $r = .839$ ; MIS:  $r = .702$ ; ASGS:  $r = .833$ ; and with all subscales of the RPBS, all  $ps < .001$ ; see Table A2). As intended, the mean difficulty of the ProPara ( $M = 39\%$ ) was higher than that of the RPBS, ASGS and MIS. Consequently, ProPara-scores were considerably less skewed (skew = 0.10) when compared to the other scales. ProPara scores were the only that did not deviate significantly from normal distribution as revealed by Shapiro-Wilk tests (ProPara:  $p = .251$ , all other scores:  $p < .001$ ).

Based on these results, we consider the ProPara as a valid, brief alternative to the established scales.

*Note.* ProPara = Proneness to the Paranormal, RPBS = Revised Paranormal Belief Scale, ASGS = Australian Sheep and Goat Scale, MIS = Magical Ideation Scale, TPB = Traditional Paranormal Beliefs, NAP = New Age Philosophy. Item difficulty and symmetry of the RPBS subscales was not computed due to the low number of items.

**Table A1.** Items of the ProPara.

German	English	M	SD	Diff	rIR	rMII
1. Manchmal spüre ich es, wenn jemand an mich denkt	1. Sometimes I feel it when someone is thinking about me	2.90	1.63	0.32	0.51	0.39
2. Geschehnisse können durch die Kraft der Gedanken auf bisher unerklärbare Weise beeinflusst werden	2. Events can be influenced by the power of thoughts in a way that is not yet explainable	3.69	1.69	0.45	0.57	0.38
3. Meine Intuition sagt mir manchmal, dass gewisse Ereignisse oder Gegenstände eine spezielle Bedeutung haben, auch wenn es dafür keine Erklärung gibt	3. My intuition sometimes tells me that certain events or objects have a special meaning, even if there is no explanation for it	4.45	1.80	0.58	0.69	0.37
4. Manche Entscheidungen oder Geschehnisse in unserem Leben werden von Erfahrungen beeinflusst, die wir in einem früheren Leben gemacht haben	4. Some decisions or events in our lives are influenced by experiences we have had in a previous life	3.00	1.95	0.33	0.58	0.38
5. Es gibt gute und böse Kräfte, welche unser Leben beeinflussen (z.B. göttliche Wesen, Geister, Schutzengel)	5. There are good and evil forces that influence our lives (e.g. divine beings, spirits, guardian angels)	3.21	2.00	0.37	0.50	0.39
6. Der Vollmond hat eine bisher unerklärte Wirkung auf die Psyche	6. The full moon has a not yet explainable effect on people's minds	4.07	1.69	0.51	0.35	0.41
7. Es gibt Möglichkeiten, die Zukunft vorherzusagen oder an verdeckte Informationen zu gelangen, die über bisher erklärbare Zugänge hinausgehen (z.B. mittels Horoskope, Kartenlegen, Eingebungen, Pendeln)	7. There are ways of predicting the future or obtaining hidden information that go beyond previously explainable approaches (e.g. by means of horoscopes, card reading, epiphany, pendulum)	2.80	1.79	0.30	0.65	0.37
8. Manchmal fallen mir ungewöhnliche Ereignisse oder Zeichen auf, die sonst niemandem auffallen	8. Sometimes I notice unusual events or signs that nobody else notices	3.09	1.78	0.35	0.73	0.36
9. Manche Menschen haben eine übersinnliche Fähigkeit, Gedanken von anderen zu lesen oder auf andere zu übertragen	9. Some people have an extrasensory ability to read the thoughts of others or transfer them to others	3.16	1.85	0.36	0.71	0.37

(continued)

**Table A1.** (continued)

German	English	M	SD	Diff	r <sub>IR</sub>	r <sub>MII</sub>
10. Ich beschäftige mich gerne mit esoterischen oder spirituellen Themen	10. I like to engage in esoteric or spiritual topics	2.95	1.79	0.33	0.54	0.39
11. Manchmal habe ich das Gefühl, Energie zu empfangen oder zu verlieren, wenn bestimmte Menschen mich anschauen oder berühren	11. Sometimes I have the feeling of receiving or losing energy when certain people look at me or touch me	3.59	2.08	0.43	0.61	0.38
12. Bestimmte Gegenstände (z.B. Amulette, Steine) oder Rituale bringen Glück	12. Certain items (e.g. amulets, stones) or rituals bring good luck	3.45	1.96	0.41	0.53	0.39

Note. Diff = item difficulty, r<sub>IR</sub> = correlation between the item and the rest of the scale (item discrimination), r<sub>MII</sub> = Mean inter-item correlation.

**Table A2.** Mean Scores and Item Difficulty, Skew and Correlations Among the Different Scales.

Scale	Scale Mean M (SD)	Item Difficulty (%) M (SD)	Symmetry Skew	Correlations (Spearman's rho)			
				ProPara	RPGS	ASGS	MIS
ProPara	3.36 (1.21)	39 (8)	0.10	—	—	—	—
RPBS	2.24 (0.96)	21 (13)	1.03	.84	—	—	—
ASGS	1.27 (0.93)	25 (14)	0.71	.83	.84	—	—
MIS	0.29 (0.16)	29 (17)	0.95	.70	.57	.64	—
RPBS Subscales	—	—	—	—	—	—	—
Religiosity	2.72 (1.42)	—	—	.65	.82	.66	.35
Precognition	2.16 (1.16)	—	—	.79	.86	.79	.57
Psi	2.30 (1.23)	—	—	.63	.74	.67	.45
Spiritualism	2.93 (1.47)	—	—	.72	.84	.70	.55
Superstition	1.34 (0.67)	—	—	.45	.46	.40	.37
Witchcraft	1.77 (1.20)	—	—	.61	.75	.65	.44
TPB	2.33 (1.05)	—	—	.71	.87	.71	.47
NAP	2.04 (1.13)	—	—	.80	.92	.79	.58

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## Supplemental Material

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