

**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

Since the outbreak of the coronavirus disease (COVID-19), there is an exploding interest in psychological factors that determine how people respond to the novel threatening situation and the preventive measures. In the present research, we assessed the role of a comprehensive list of 22 psychological variables from the domain of *emotion* (trait anxiety, fear of COVID-19, fear of death), *cognition* (COVID-19 specific and general conspiracy beliefs, paranormal beliefs, mistrust in science, faith in intuition), *motivation* (self-control, regulatory focus) and more *traditional personality traits* (Big 5, locus of control, optimism/pessimism) on the acceptance and adherence to the preventive measures. The survey took place during the second wave in Switzerland (Nov. 2020-March 2021;  $N = 374$ ). Fear of COVID-19, prevention regulatory focus and social norm compliance were positively associated with both acceptance and adherence to the preventive measures, while the opposite was true for COVID-19 specific conspiracy beliefs, mistrust in science, conspiracy mentality, and paranormal beliefs. From these latter variables, mistrust in science was still a significant predictor when COVID-19 specific conspiracy beliefs were considered as mediator. Interestingly, none of the Big 5 variables was associated with acceptance. However, when controlling for acceptance, agreeableness and openness (together with self-control and prevention regulatory focus) were still positively associated with adherence. Finally, more right-wing political orientation was associated with lower acceptance and adherence to the preventive measures. Our results highlight the importance of fighting (conspiratorial) misinformation and increasing the perceived credibility of science in reducing the spread of the coronavirus. Furthermore, self-control and prevention regulatory focus seem important motivational aspects for the actual preventive behaviour.

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

## Introduction

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 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), or the Big 5 personality traits agreeableness, openness, and conscientiousness (e.g., Brouard et al., 2020; Krupić et al., 2021; Wright et al., 2021) are associated with higher adherence to the COVID-19 preventive measures. The opposite is true for high levels of impulsiveness, mistrust in science or the government, or political conservatism (e.g., Plohl & Musil, 2021; Reinders Folmer et al., 2020; Rothgerber et al., 2020).

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 relationship among them. The aim of the current study was to provide a more comprehensive picture of the psychological landscape behind the response to the preventive measures by including a wide variety of different psychological variables from the domain of emotion (fear, anxiety), cognition (irrational beliefs, faith in intuition), motivation (self-control, regulatory focus), and also from the more traditional personality psychology (Big 5, locus of control, optimism/pessimism). Moreover, while most previous studies focused either on *acceptance*

or *adherence* to the preventive measures, the present study will assess the role of the different psychological variables on both of these aspects separately within the same individuals (see also Zajenkowski et al., 2020), allowing for a more in depth understanding of the direct or indirect effects of said variables on one or both of these aspects. The separation of *adherence* and *acceptance* also is of particular relevance when motivational variables are assessed, as the level of adherence might vary depending on self-regulatory processes that underly the actual behaviour ((e.g., Higgins et al., 1997; Kuhl, 1987)). Each set of variables and their presumed effect on acceptance and adherence to the preventive measures is elaborated in the following sections.

## Emotional aspects: Anxiety and fear

Anxiety and fear are closely related: Both reflect inherent adaptive psychological and biological mechanisms related to the protection from injury (e.g., flight or fight response). In general, fear is considered as a reaction to a specific (real or imagined) threat, while anxiety is considered to be a more diffuse, unfocused or objectless type of fear (Barlow, 2002; Byrne, 2000). Moreover, anxiety can be conceptualized as state or trait (Spielberger, 1972). 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). Since this study focuses on interindividual differences, only trait anxiety will be assessed. Specifically, the influence of trait anxiety as well as the more specific fear of getting infected with SARS-CoV-2 and the fear of one's own death on the response to the preventive measures is investigated. Increased fear of getting infected with SARS-CoV-2 is assumed to have a positive effect on adherence to the preventive measures (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 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). For the purpose of the present study, it was hypothesized that a higher level of trait anxiety would be associated with a

higher level of the more specific fear of getting infected with SARS-CoV-2 and also with a higher level of 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.

### **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., 2020; Bierwiazzonek et al., 2020; Constantinou et al., 2021; Earnshaw et al., 2020; Freeman et al., 2020; 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 in the context of acceptance and adherence to preventive measures.

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 judgments 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., 2018, 2020; Drinkwater et al., 2012; Foster & Kokko, 2009; Irwin, 2009; Leonard & Williams, 2019; Lindeman & Aarnio, 2007; Matute et al., 2011; Musch & Ehrenberg, 2002; Pennycook et al., 2012; Rizeq et al., 2021; Ståhl & van Prooijen, 2018; van Prooijen, Douglas, et al., 2018). Once unwarranted beliefs are established, counterfactual evidence is often ignored or integrated into the prior beliefs (Aaronovitch, 2010; Boudry & Braeckman, 2012; Irwin, 2004; Stanovich et al., 2013; Sutton & Douglas, 2014). For example, in case of conspiracy beliefs, counterfactual evidence can be incorporated into the conspiracy as “part of the plot” with the purpose to conceal the secret intention. Obviously, the inherent resistance to falsification of such unwarranted beliefs poses a great challenge when trying to convince individuals of the importance of preventive measures.

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 contradictory (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., 2020; Bierwaczzonek et al., 2020; Constantinou et al., 2021; Earnshaw et al., 2020; Freeman et al., 2020; 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, 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 have a direct association with acceptance and adherence when controlling for the indirect effect of specific COVID-19 conspiracy beliefs. Moreover, the role of intuition as a common underlying processing style (e.g. Denovan et al., 2020; see above) will also be further investigated.

#### **Motivational aspects: Self-control and regulatory focus**

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. Self-control is a critical factor of adaptive behaviour (Duckworth, 2011), and can be defined as the capacity to overcome competing responses, habitual behaviours and resist hedonism and boredom-induced urges in order to reach a goal (Wolff et al., 2020). In the context of COVID-19, a strict adherence to preventive measures requires people to abstain from participating in entertaining social activities and to abruptly change routines such as shaking hands or otherwise getting into close contact with others. Therefore, we expect people with low trait self-control to be less likely to adhere to the preventive measures (Wolff et al., 2020; Xu & Cheng, 2021), independent of their attitude towards it.

Related to self-control, previous motivational-emotional theories suggests 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.

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.

#### **Classical personality-related variables: Big 5, locus of control, optimism-pessimism**

Further 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 variables of interest described so far. 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 conspiracies (e.g. Abalakina-Paap et al., 1999; Hamsher et al., 1968).

Related to locus of control is the expectation whether future events will turn out positively or negatively (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.

## Materials and Method

### Participants

Participants were recruited through the participants pool of UniDistance Suisse and of the University of Bern, and also 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%) of participants were undergraduate students. About half of 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

### 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). 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 affective, cognitive-evaluative and motivational factors outlined above on both the acceptance and adherence to the preventive measures.

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-construed 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 on a 7-point Likert scale their agreement with the statements describing compliant behaviour (ranging from 1 = does not apply at all to 7 = applies completely).

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 also Cronbach's alpha was high, both for acceptance,  $\alpha = .92$ , 95% CI [.91, .93], and adherence,  $\alpha = .85$ , 95% CI [.83, .87].

Table 1

Item	Acceptance			Adherence		
	<i>M</i>	<i>SD</i>	<i>r</i> <sub>IR</sub>	<i>M</i>	<i>SD</i>	<i>r</i> <sub>IR</sub>
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	-

Items of COVID-19 preventive measures

*Note.* *M* = Mean, *SD* = Standard deviation, *r*<sub>IR</sub> = correlation between the item and the rest of the scale (item discrimination).

### 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.

**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 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").

**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".

**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."

**COVID-19 conspiracy beliefs.** Similar to Šrol et al. (2021), a selection of typical COVID-19 specific

conspiracy beliefs were selected 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 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”.

**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; Schultze & 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). We therefore consider the ProPara as valid, brief alternative to the established scales. The full list of items is provided in the Appendix 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”.

**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”

**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”).

Table 2

Summary of the different psychological variables.

Psychological variables	Likert scale	N Items	Cronbach’s Alpha [95% CI]	M	SD
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
Fear of COVID-19	1-5 <sup>B</sup>	7	.78 [.75, .81]	1.89	1.04
Mistrust in science	1-11 <sup>C</sup>	5	.87 [.85, .89]	4.54	1.83
Conspiracy mentality	1-11 <sup>C</sup>	5	.84 [.82, .87]	6.18	1.96
COVID-19 conspiracy	1-11 <sup>C</sup>	5	.86 [.84, .88]	3.55	2.07
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
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
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
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.

## 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 relevant 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 some 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 (i.e., the baseline model).

**Assessment of psychological variables.** Each psychological variable was entered separately into the baseline models for acceptance and adherence. The standardised regression coefficients of each psychological variable and its associated change in  $R^2$  was reported. We

used standardised regression coefficients because they allow for a better comparison of regression weights across different Likert scales. 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. Moreover, within the contaminated mindset variables, we assessed the possible mediating role of COVID-19 conspiracy beliefs (see Introduction).

For the analyses described so far (except for the mediation analysis), the role of each psychological variable was assessed independent from the others. This guaranteed that the regression weights of the psychological variables were not biased by multicollinearity. Nevertheless, it is important to consider the intercorrelations among the psychological variables. We therefore also computed 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., fear-related, contaminated mindset; see Introduction) would form separate sub-clusters. Moreover, the results from the previous analyses were summarised by an integrative path model 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 were integrated into the path

model, and a direct path to acceptance was allowed unless mediation effects were identified in case of the contaminated mindset variables. Moreover, variables were selected as predictors for adherence when they had an exclusive association with adherence, or in case they were associated with acceptance and adherence, when their effect on adherence was not fully mediated by acceptance (according to the mediation analysis described above). The path model showed how the results from the separate analyses were modified when all relevant variables were integrated into the model.

## Results

### Defining relevant 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 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 to guarantee a balanced comparison. The baseline models accounted for 3.5% of variance in acceptance, and for 5.2% of variance in adherence.

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 <sup>+</sup>	.02	—		
5. Risk group	.22***	.19***	.22***	-.05	-.12*	-.04	—	
6. Knowing tested positive acquaintances	.00	-.06	-.08	.05	.12*	.10 <sup>+</sup>	-.07 <sup>+</sup>	—
7. Seriously affected	.12*	.10 <sup>+</sup>	-.03	-.02	.09 <sup>+</sup>	.08	.01	.15**

*Note.* Values represent zero-order Spearman's rho correlation coefficients. Sex is coded as 0 = male and 1 = female. <sup>+</sup>  $p < .10$ , \*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$

### **Assessment of psychological variables**

Figure 1 shows the intercorrelations and cluster structures of the predictors. 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) and also 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).

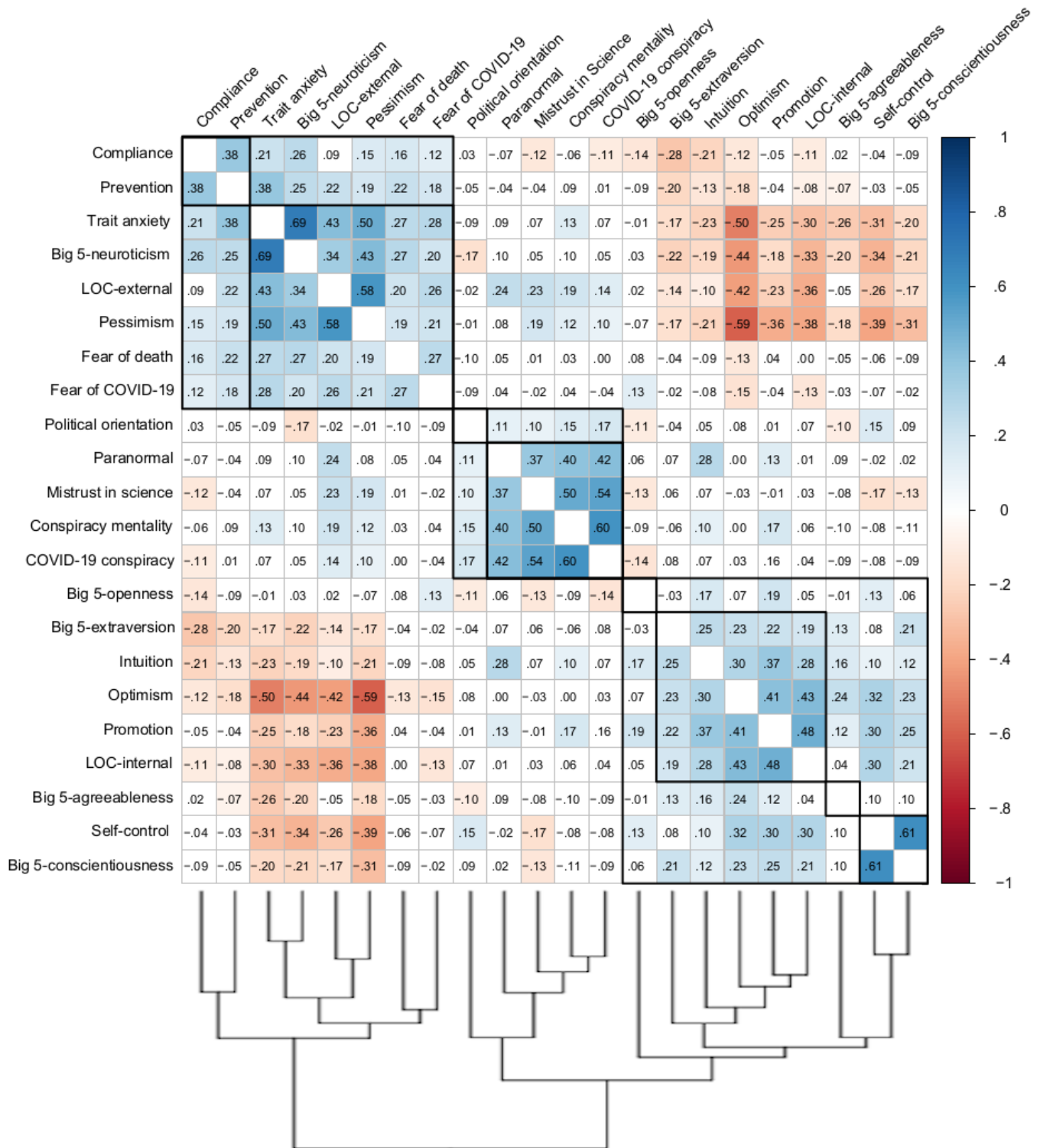


Figure 1. Zero-order correlations (Spearman's rho) between predictors. Blue and red colours indicate positive and negative associations respectively. White colors indicate no significant correlations ( $p > .05$ ). The big three squares indicate three superior clusters of predictors, and the inner squares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

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. 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. There were also significant associations for some of the remaining variables either with acceptance (optimism and intuition; both negative) or adherence (Big 5 agreeableness, Big 5 openness, and self-control; all positive). Finally, there were trends for associations between acceptance and trait anxiety (positive) and internal locus of control (negative), as well as between adherence and pessimism (positive) and Big 5 extraversion (negative).

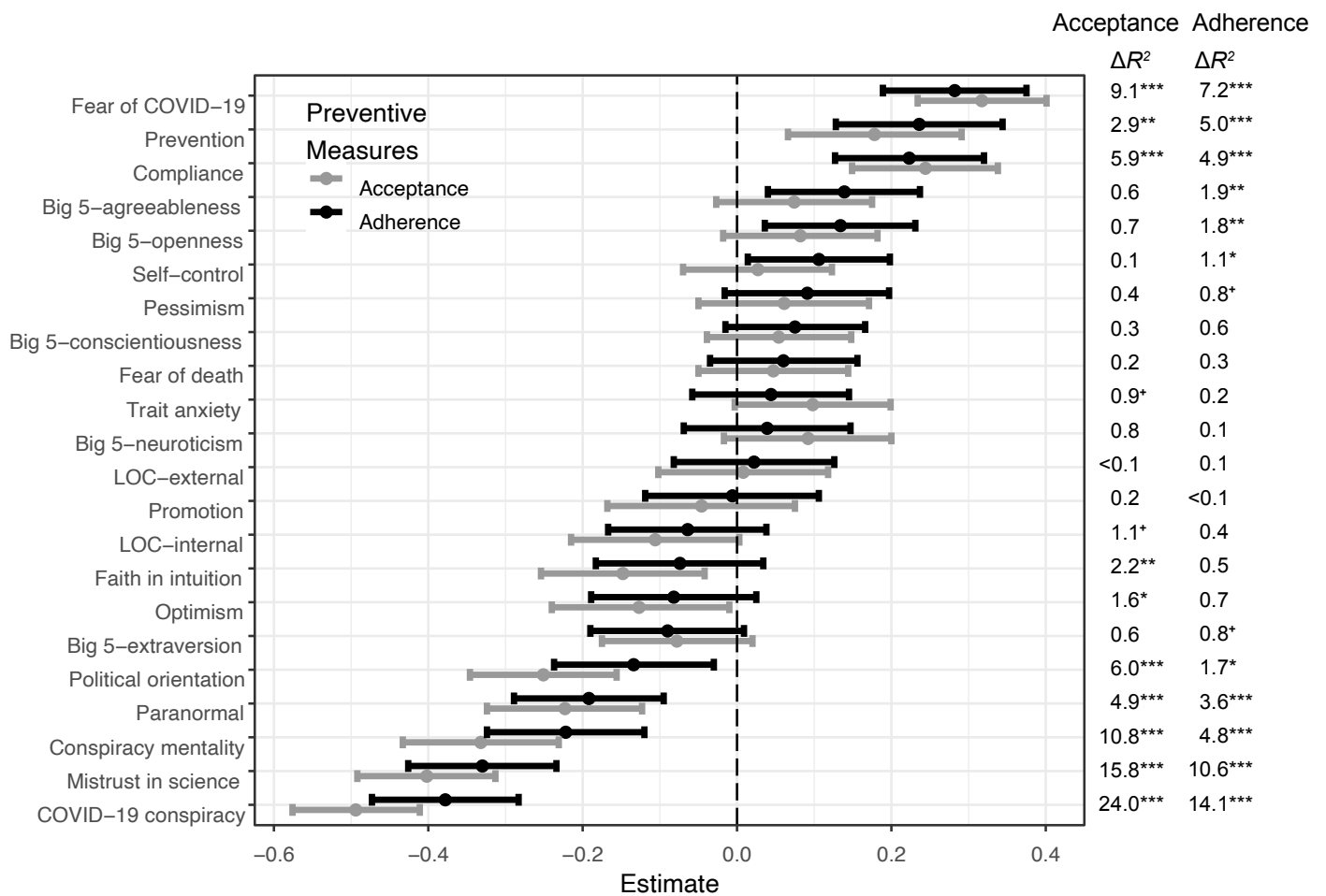


Figure 2. Graphical overview of effects sizes (standardized regression weights) of the 22 predictors for acceptance (grey) and adherence (black) to the COVID-19 preventive measures. Predictors are ordered according to the regression weights for adherence. Error bars represent 95% confidence interval. An effect was considered significant when the 95% confidence interval did not include zero. Values on the right show change in  $R^2$  (in %). \*  $p < .10$ , \*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$ .

In order to better understand these significant associations, a series of mediator analyses was conducted (see data analysis). The results are summarised in Table 4. 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 suggest that the

remaining variables in the first place influence the attitude towards the preventive measures, which in turn determines adherence. This is for example 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.

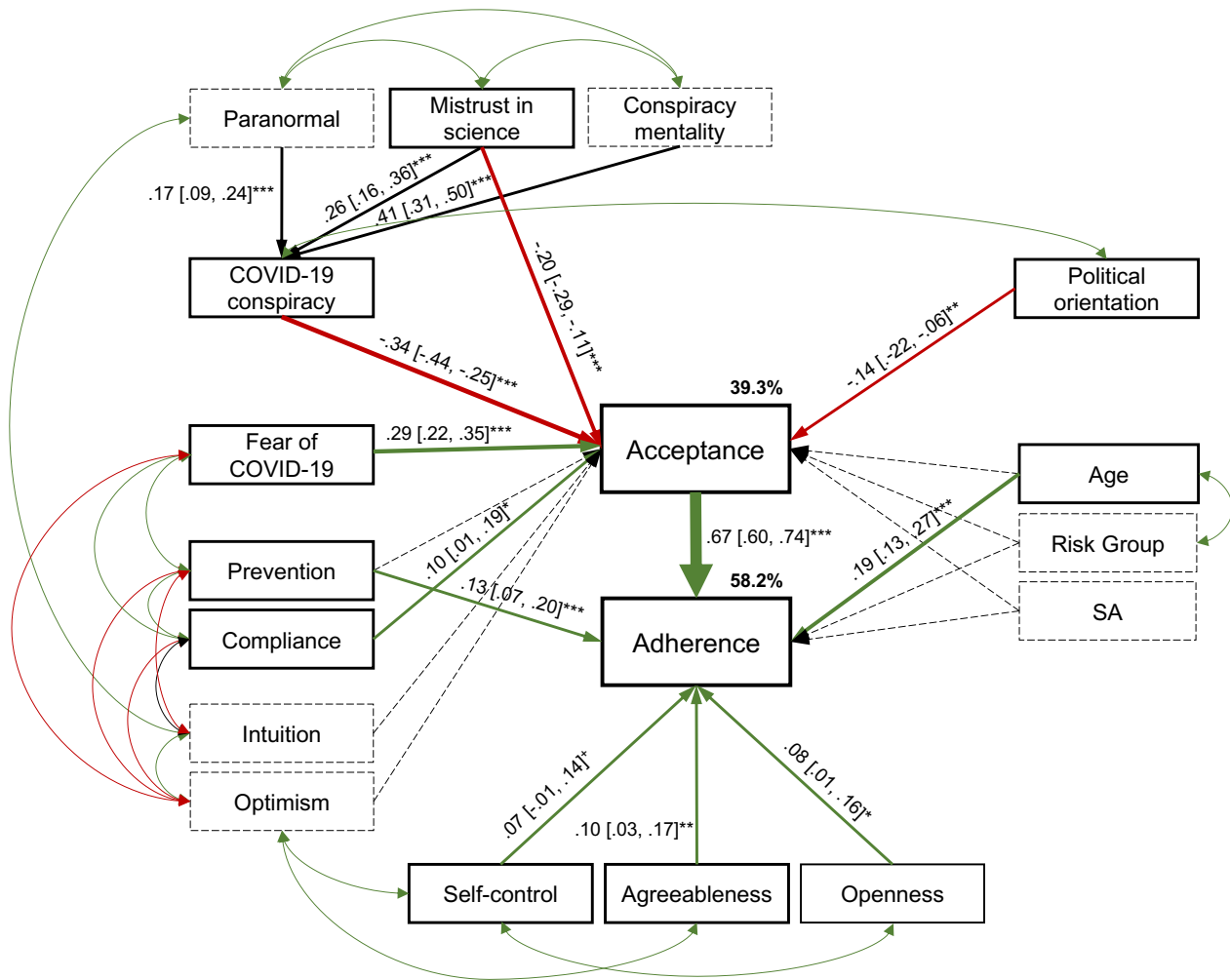
Table 4. Results of mediator analyses.

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. \*\* $p < .01$ , \*\*\*  $p < .001$ .

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 were entered into the path model, and a direct path to acceptance was allowed except for conspiracy mentality and paranormal beliefs, whose

effects were fully mediated by COVID-19 conspiracy beliefs. Moreover, all variables that had an exclusive association with adherence (self-control, Big 5 agreeableness, Big 5 openness) were selected as predictors for adherence, and a direct path between preventive regulatory focus and adherence was allowed because its association was not fully mediated by acceptance.



**Figure 3.** Path model including the relevant predictors for acceptance, and for adherence when controlling for acceptance. Covariances were allowed in the path model between variables that showed a high zero-order correlation and/or that are theoretically meaningful. Green lines represent positive, and red lines represent negative associations. Dotted paths represent associations that turned out to be insignificant in the context of the other variables. SA = Seriously affected. +  $p < .10$ , \*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$

The path model revealed that 39.3% of variance in acceptance was explained by the relevant variables. It can be concluded that the attitude towards the preventive measures is influenced by four main sources. The most influential source is the belief in COVID-19 conspiracies and mistrust in science, followed by fear of COVID-19. The third source are the interrelated variables prevention regulatory focus and social norm (although in combination, only social norm compliance is significantly associated with acceptance, while prevention regulatory focus is associated with adherence). The final source turned out to be political orientation. In combination with these variables, the remaining initially relevant variables

intuition and optimism no longer show significant associations. For optimism, this might be due to its negative relationship with fear of COVID-19 and social norm compliance which are strongly associated with acceptance. When controlling for acceptance, the variables self-control, Big 5 agreeableness and Big 5 openness were (besides prevention regulatory focus) associated with adherence (although self-control only by trend,  $p = .053$ ). Thus, it seems that classical personality traits and motivational factors play an important role for adhering to the preventive measures, irrespective of acceptance.



### 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,  $b = -.47$ , 95% CI  $[-.58, -.35]$ ,  $p < .001$ . The results for the second group also revealed a near-significant negative association,  $b = -.14$ , 95% CI  $[-.28, .01]$ ,  $p = .059$ . The results from the second group 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 emotion (e.g., fear of COVID-19, trait anxiety), cognitive evaluation (e.g., conspiracy beliefs, intuitive processing style), motivation (self-control, regulatory focus) and personality psychology (Big5, locus of control, optimism/pessimism) on the acceptance and adherence to the COVID-19 preventive measures.

In line with previous findings, we found that the specific fear of COVID-19 is strongly associated with high acceptance and adherence to the preventive measures (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.

Early in the COVID-19 pandemic emergence, the WHO Director General 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 low acceptance and adherence to the preventive measures. To the best of our knowledge, only one previous study distinguished between acceptance and adherence and found that the belief in COVID-19 specific conspiracies is related to lower acceptance but not adherence to the preventive measurements (Earnshaw et al., 2020). These findings together with ours could be interpreted in the sense that COVID-19 conspiracy beliefs first and foremost determine the attitude towards the preventive measures, but that the actual adherence to these measures may also be influenced by other factors (e.g., agreeableness). Focusing only on adherence to the preventive measures therefore may only tell half of the story. Despite the possible involvement of further variables in the link between attitude and behaviour, it is a striking finding that COVID-19 conspiracy beliefs had – of all variables – the strongest direct association with adherence as well. Our results therefore add to a growing body of recent evidence for the significant impact of unwarranted beliefs and mistrust in science in the fight against the pandemic (Allington et al., 2020; Bierwaczzonek et al., 2020; Bruder & Kunert, 2021; Constantinou et al., 2021; Earnshaw et al., 2020; Freeman et al., 2020; Gratz et al., 2021; Imhoff & Lamberty, 2020; Pavela Banai et al., 2020, 2020; Plohl & Musil, 2021; Pummerer et al., 2021; Reinders Folmer et al., 2020; Romer & Jamieson, 2020; Šrol et al., 2021; Teovanović et al., 2021, 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 and adherence 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 directed towards groups of conspiracy believers only, but rather the general population.

In line with the contaminated mindware approach, our results confirm a strong association between 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 higher-level 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. These results have important implications: Interventions should not only focus on fighting against conspiracy-related misinformation but also aim at modifying the more general perception of science as an objective and trustworthy tool to gain knowledge.

Given the relevance of conspiracy beliefs and mistrust in science in the context of COVID-19, it is also interesting to examine which other variables were related to these variables. It has been 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, although it did not fall into the same cluster. 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.

Besides fear of COVID-19, the two conceptually related variables prevention regulatory focus and social norm compliance were 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 (although social norm compliance was only associated with acceptance but not adherence, and vice versa for acceptance, when both variables were included in the model). Given that these individual characteristics are most relevant for a high motivation to adhere to preventive measures, it is surprising that this study was, to the best of our knowledge, the first that linked dispositional prevention regulatory focus to interindividual responses to COVID-19. Prevention regulatory focus was also positively related to the anxiety and fear-related variables (including Big 5 neuroticism), external locus of control and pessimism, and negatively associated with internal locus of control, optimism, intuition, Big 5 extraversion and agreeableness, while the opposite was true for promotion regulatory focus (see also Klenk et al., 2011; Schmalbach et al., 2017). Interestingly, promotion regulatory focus was additionally also related to conspiracy mentality. These results are in line with a previous finding which suggested that it is not prevention but rather promotion regulatory focus that is associated with conspiracy beliefs (Whitson et al., 2019). However, while Whitson et al. (2019) found that promotion focus

dampens conspiracy beliefs, we found a positive association between promotion focus and conspiracy mentality. Whitson et al. (2019) argued that promotion focus reduces conspiratory patterns of cognition by activating a sense of personal control. Our results are partially in line with such an explanation, since we also found that promotion focus is linked to high internal and low external locus of control, and external locus of control in turn was as well positively associated with conspiracy beliefs. The different result with regards to the direct link between promotion focus and conspiracy beliefs in our and the previous study might be related to the different operationalisation approaches. Whitson et al. (2019) mainly focused on *situational* regulatory focus and induced a promotion (vs. prevention) focus by priming. In a further experiment in the same study, they also measured dispositional regulatory focus but with a different scale. They also did not measure the higher-level conspiracy mentality but rather specific bank or military-related conspiracy beliefs. The conflicting results highlight the need for future research to explain the links between (dispositional and situational) regulatory focus and generalized and specific conspiracy beliefs.

Related to motivational aspects of behaviour, individuals with high self-control adhere more to the preventive measures (see also Wolff et al., 2020). The finding that self-control tended to be positively associated with adherence when controlling for acceptance highlights that self-control plays an important role in the implementation and maintenance of preventive behaviour after intentions have been made. This might have some implications for intervention programs. For example, individuals could be trained to use specific action control strategies in the context of preventive measures in order to change routines and resist distractions (Kuhl & Beckmann, 2012).

Regarding Big 5, none of the personality traits was associated with acceptance of the preventive measures. However, agreeableness and openness were 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). We showed that agreeableness and openness were still associated with adherence when controlling for acceptance. Thus, agreeable and open individuals do not necessarily strongly believe that the

preventive measures are justified, but they nevertheless adhere more to them. While an explanation regarding agreeableness is straightforward (e.g., these individuals believe in the good of people, care for others and concern for social harmony), an explanation for openness might be less obvious. Stadler et al. (2020) also found a positive relationship between openness and preventive behaviour and argued that openness might be related to willingness to deal with complex information, which is beneficial for executing reasonable behaviours. In a similar vein, Bogg und Milad (2020) found that openness was associated with endorsement of guideline-related social cognition about health consequences.

Beside these direct effects on preventive measures, some of the Big 5 variables were associated with other critical variables. Neuroticism and openness were positively associated with fear of COVID-19. While the association with neuroticism was expected (e.g., Caci et al., 2020; Lippold et al., 2020; Montag et al., 2021), the latter was rather surprising but can be related to the increased perception of health consequences mentioned above (Bogg & Milad, 2020). Moreover, social norm compliance was positively associated with neuroticism and negatively with openness and extraversion. Not surprisingly, open-minded people and extraverts are less likely to adhere to social norms, but these general tendencies do not seem to apply to the COVID-19 situation, as openness was positively related with adherence. Finally, mistrust in science was negatively associated with openness and conscientiousness, and COVID-19 conspiracy beliefs (but not conspiracy mentality) was negatively associated with openness. The latter finding contrasts with previous findings that openness is positively associated with conspiracy beliefs (e.g., Bruder et al., 2013; Goreis & Voracek, 2019; Swami et al., 2010, 2013). While other studies also did not find evidence for a positive relationship between openness and conspiracy beliefs (Galliford & Furnham, 2017; Orosz et al., 2016; Wood & Gray, 2019), our study is to the best of our knowledge the first to report a negative relationship. Our finding fits the explanation above that openness is associated with an increased willingness to deal with complex information (Stadler et al., 2020), which in turn might reduce conspiracy beliefs. The mixed findings highlighting that the exact relationship between the Big 5 variables and conspiracy beliefs remains controversial (Bowes et al., 2021; Brotherton et al., 2013).

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 & Milićević, 2020; Kelly et al., 1990; Olagoke et al., 2021; Steptoe & Wardle, 2001; Weiss & Larsen, 1990). In the present study, there was even a tendency found for a reduced acceptance of the preventive measures for high internal locus of control and optimism. 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 estimated probability that one could get seriously affected by the virus and consequently these individuals show reduced preventive behaviour. Such an explanation is in line with the finding that optimism and internal locus of control was negatively associated 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 can not 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 wellbeing of all, social justice and collectivism. More research is needed to understand the link between political orientation, preventive behavior, 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 39% of variance in the acceptance of the COVID-19 preventive measures (while age and pre-existing health conditions only account for 3.5% from this percentage). Reduced adherence 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 situation and consequently on the general population. Our results highlight the importance of fighting (conspirational) misinformation and fake news about COVID-19, and also of increasing the credibility of science. Moreover, we identified some variables that were exclusively related to adherence of the preventive measures such as self-control or Big 5 agreeableness. This implies that interventions aiming at increasing preventive behaviour should not only focus on modifying attitude

towards COVID-19 preventive measures but also consider basic motivational aspects of behaviour.

### **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.) in the response to the preventive measures and in 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). Third, as in most previous studies, adherence measurements were self-reported. Future studies should confirm the results with more objective measures of actual preventive behaviour (e.g., Gollwitzer et al., 2021).

Furthermore, 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 (Frías-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., 2020). 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).

### **Conflict of interest statement**

The authors declare that there is no conflict of interest.

## Appendix

### 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 1X.

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 sub-scale “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 60-137 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 (Fisseni, 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 2X). 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.

Table 1X. Items of the ProPara

German	English	<i>M</i>	<i>SD</i>	Diff.	$r_{IR}$	$r_{MI}$
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	7. There are ways of predicting the future or obtaining hidden information that go beyond previously explainable approaches	2.80	1.79	0.30	0.65	0.37

bisher erklärbare Zugänge hinausgehen (z.B. mittels Horoskope, Kartenlegen, Eingebungen, Pendeln).	(e.g. by means of horoscopes, card reading, epiphany, pendulum)						
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	
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,  $r_{IR}$  = correlation between the item and the rest of the scale (item discrimination),  $r_{MI}$  = Mean inter-item correlation.

Table 2X.

Mean scores and item difficulty, skew and correlations among the different scales

Scale	Scale Mean	Item Difficulty (%)	Symmetry	Correlations (Spearman's rho)			
	<i>M (SD)</i>	<i>M (SD)</i>	Skew	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

*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.

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