Personality and Social Psychology

To vaccinate or not: The relationship between conscientiousness and individual attitudes toward vaccination in real-life contexts

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Despite the availability of a safe and effective vaccine being well-recognized as a critical tool to end the COVID-19 pandemic, many individuals remain vaccine hesitant for various reasons. In the literature, one well-established finding is that skeptical attitudes towards vaccination are higher amongst individuals low in conscientiousness. However, no research is available to corroborate whether the relationship between conscientiousness and intention to vaccinate has force in real life. The present research investigated whether, in addition to self-reported conscientiousness, objectively observable index of conscientiousness behaviors is related to individual perception of vaccination. Based on self-reported data, Study 1 fully replicated prior findings that higher levels of conscientiousness are associated with more positive attitudes towards vaccination in a Chinese student sample. Using the time of arrival for an appointment as a proxy measure for conscientiousness behaviors, Study 2 revealed that non-student adults who arrived early to appointments showed stronger COVID-vaccine uptake intentions than those who arrived late to appointments. Moving beyond vaccination intention to actual behavior, Study 3 found that the arrival punctuality rates of vaccinated participants were higher than those of unvaccinated participants. Overall, our research highlights the important role of conscientiousness-related traits in individuals' COVID-19 vaccination attitudes and behavior.

Key words: COVID-19, conscientiousness, self-report, behavioral measure, vaccination attitudes, vaccination behavior.

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INTRODUCTION

The global coronavirus pandemic has led to a dramatic loss of human life and caused negative impacts on all segments of the population (Li & Cao, 2021; Miller, 2021; Pietromonaco & Overall, 2020; Verma & Prakash, 2020). Currently, the positive development of the COVID-19 vaccines brings the world more hope to defeat the pandemic. However, some countries are raising concerns about the safety and efficacy of COVID-19 vaccines (Dror, Eisenbach, Taiber *et al*., 2020; Motta, 2021; Rosenbaum, 2021; Sallam, 2021). For instance, there are some reported cases of atypical blood clots after vaccination, which has caused some stubborn concerns about coronavirus vaccine side effects (Mahase, 2021). In addition, pseudoscientific misinformation without any evidential bias, such as anti-vaccine websites and Andrew Wakefield's fraudulent research linking autism to childhood vaccines, has caused people's anxiety regarding vaccinations especially childhood immunizations (Bean, 2011; Deer, 2011). Since intention to vaccinate is a key determinant of vaccination behavior and the success of vaccination programs, it is important to investigate factors that may affect individuals' attitudes towards vaccination (Lee, Duck & Sibley, 2017; Paul, Steptoe & Fancourt, 2021).

In recent years, a rapidly expanding literature has shown that people's intention to receive a vaccination against COVID-19 is associated with a wide range of demographic, health, and psychological factors (Caserotti, Girardi, Rubaltelli, Tasso & Gavaruzzi, 2021; Hornsey, Harris & Fielding, 2018; Ward, Alleaume, Peretti-Watel & COCONEL Group, 2020; see Brewer, Chapman, Rothman, Leask & Kempe, 2017 for a comprehensive review). To date, however, only a limited number of studies have examined the association between different dimensions of personality and vaccination intention (Hughes & Machan, 2021; Li & Cao, 2022a). For instance, Browne, Thomson, Rockloff and Pennycook (2015) tested how personality factors were associated with evaluations of national public vaccination program in a large sample of Australians (N = 1256). It was found that there was a positive link between openness to experience and anti-vaccination attitudes towards childhood vaccination. This is possibly because individuals high in openness show more tolerance for diverse worldviews and reject authoritarianism sources knowledge. Building on these findings, Lee *et al*. (2017) further investigated the roles of Big Five personality traits in predicting skepticism about the safety of standard childhood vaccination in New Zealand. It was found that people who exhibited higher levels of conscientiousness and agreeableness but lower levels of openness displayed stronger confidence in the vaccines. In a more recent study, Lin and Wang (2020) evaluate the effect of Big Five personality traits on individual perceptions of vaccination for school-age children in the US. Consistent with previous findings, they found that the traits of conscientiousness and agreeableness were significantly correlated with positive attitudes toward vaccination even controlling for social and demographic variables. The similar relationship between personality traits and vaccine uptake intentions is also observed during the pandemic. For example, recent contributions in the literature have shown that British and Irish participants with more COVID-19 vaccine hesitancy tended to evidence a lower level of conscientiousness (Murphy, Vallières, Bentall *et al*., 2021). These findings suggest that disposition factors such as personality traits may play a role in explaining individuals' health attitudes and behavior in the context of the COVID-19 pandemic.

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Despite prior work providing converging evidence for the robust association between personality traits such as conscientiousness and vaccination inclination, data and sampling bias may present limitations to our understanding of individuals attitudes toward vaccination. First, the existing research has typically been conducted among people from Western, educated, industrialized, rich, and democratic (WEIRD) societies (e.g., USA, Australia, and the Netherlands) (Henrich, Heine & Norenzayan, 2010). It is still an open question whether these findings can generalize to non-WEIRD populations. Second, prior studies have all relied on the use of self-report data regarding personality traits, which introduced a bias related to measurement uncertainty into the conclusions about the relationship uncovered. Thus, it is unclear whether these observed connections can generalize outside of the laboratory and have the same force in real-life contexts (Fast & Funder, 2008; Li & Cao, 2019). Third, COVID-19 vaccines are different from other vaccines already in existence in many different aspects, such as the approval process and global health concerns. Thus, it would be valuable to investigate the link between personality traits and intention to vaccination against COVID-19 and to apply these findings to policy. Additionally, only participants who had not been get vaccinated were surveyed in prior work. More efforts should be made to determine whether these findings can move beyond vaccination intention to actual vaccination behavior by sampling vaccinated individuals.

The current research fills these significant gaps in the literature. Building on the well-established findings regarding the relationship between conscientiousness-related traits and vaccination, we conducted three studies to investigate individual attitudes toward vaccination against COVID-19 in real-life contexts. In Study 1, we sought to replicate previous findings that conscientiousness is positively associated with intention to vaccination using an independent Chinese student population sample. Study 2 extended beyond self-reports and assessed conscientiousness in Chinese non-student adults using a measure of real-life behavior, namely, punctuality. Punctuality behavior has been demonstrably related to personality trait of conscientiousness across a number of studies (Duffy, Feist & McCarthy, 2014; Li & Cao, 2019). For example, in a study conducted by Back, Schmukle and Egloff (2006), they investigated the relationship between self-reported conscientiousness and behavioral indicators of punctuality in a real-life setting. It was found that conscientiousness was related to all aspect of punctuality implied by time of arrival, earliness, and lateness for a scheduled appointment. These findings suggest that punctuality is an objective behavioral indicator of procrastination and conscientiousness. Finally, moving beyond vaccination intention to actual behavior, Study 3 compared the arrival punctuality rates between vaccinated and unvaccinated participants.

STUDY 1: METHOD

Participants

The study took place in January 2021. A total of 281 undergraduate and graduate students voluntarily from a central university in China took part in this survey in exchange for a financial reward. Six participants had obtained the first dose of the COVID-19 vaccination and 275 participants had not at the time of data collection. Given that vaccinated individuals might have conscientiousness and intention scores which are higher than that measured in the unvaccinated individuals, we excluded the former from the main study. Of those unvaccinated participants, 128 participants were males and 147 were females. The average age of participants was 21.1 (SD = 2.5). All potential participants were approached on the campus in dining halls, libraries, sports fields, and teaching buildings.

Materials and procedure

The research assistants greeted each person and asked a single dichotomous question regarding their COVID-19 vaccine behavior ("Did you receive a COVID-19 vaccine at any time?"). Individuals who answered *No* were then asked if they would be willing to complete a short survey. After providing informed consents, participants completed a paper-and-pencil task. In the first part of the test, participants responded to nine statements which were used to measure the personality dimension of conscientiousness, from a Chinese version of the Big Five Inventory (Leung, Wong, Chan & Lam, 2012; Li & Cao, 2019). Previously published studies have demonstrated sufficient psychometric properties of the scale in measuring conscientiousness traits. The Cronbach alpha reliability estimate was 0.79, which reflected good internal consistency in the current research. Participants indicated the extent of their agreement using a five-point Likert scale (1 = *Strongly disagree*, 5 = *Strongly agree*). Sample items include "Makes plans and follows through with them" and "Perseveres until the task is finished."

In the second part of the test, participants were asked to complete a time management survey which is unrelated to the main hypothesis of the study. The third part of the questionnaire consisted of a two-item measure assessing vaccination intention, which was adapted from Huynh and Senger (2021). The items were: (1) "How likely is it that you would get a Corona Virus (COVID-19) shot if one were available?"; and (2) "If you were faced with the decision to get a Corona Virus (COVID-19) shot today, how likely is it that you would do so if one were available?" Participants indicated their intentions to receive a vaccine on a seven-point Likert scale, ranging from 1 = *not at all likely* to 7 = *extremely likely*. This two-item survey is a unidimensional scale which demonstrates sufficient psychometric quality in measuring individual attitudes toward vaccination across diverse cultures and populations including Chinese people as shown in several published studies (Cao & Li, 2022; Huynh & Senger, 2021). Thus, the results from the two items were averaged to create a single aggregate measure, with higher average score representing stronger agreement of the corresponding statements. Following recommendations from Eisinga, Te Grotenhuis and Pelzer (2013), we computed the reliability of the two-item scale using the Spearman-Brown formula. The Spearman-Brown estimate was 0.80, which reflected good internal consistency in the current research. Finally, participants provided some basic demographic information such as age and gender and were thoroughly debriefed by offering an opportunity to say about the key hypotheses of the study.

Results and discussion

The responses of research participants in the debriefing process indicated that no participants voiced any suspicion about the true nature or purpose of the study. As we expect, conscientiousness scores (M = 3.33, SD = 0.42) were positively associated with COVID-19 vaccination intentions (M = 5.41, SD = 0.98), r = 0.46, 95% confidence interval [CI, 0.3614, 0.5484], p < 0.001. To further test our hypothesis, a regression model was tested. Gender and age were entered simultaneously into the model. The model as shown in Table 1 explained 14.6% of the variance in vaccination intention, F (3, 271) = 15.87, p < 0.001, adj. R^2 = 0.146. When controlling for all variables, conscientiousness was still a significant predictor for vaccination intention (β = 0.386). In concordance with previous findings on Western populations, we found that Chinese participants who evidenced a higher level of conscientiousness expressed higher intention to get vaccinated against COVID-19.

Study 1 replicated previous findings regarding the positive relationship between conscientiousness and individual attitudes toward vaccination in a Chinese student population. Yet, it may be limited by the use of self-report data which can be influenced by social desirability bias and error in the retrieval processes from past memories. To provide an objectively observable real-world reflex of conscientiousness, Study 2 made use of the time of arrival for a scheduled appointment data as a proxy measure for conscientiousness behaviors (Duffy *et al*., 2014; Li & Cao, 2019). In addition, Study 2 recruited a more diverse population to increase the generalizability of the findings.

STUDY 2: METHOD

Participants

The study took place in February 2021. Participants were recruited through printed flyers and electronic advertisements in Chongqing municipality, Southwest China. A total of 151 non-student participants voluntarily took part in this survey in exchange for a financial reward. At the time of data collection, seven participants had obtained the first dose of the COVID-19 vaccination and 144 participants had not. Given that vaccinated individuals might have conscientiousness and intention scores which are higher than that measured in the unvaccinated individuals, we excluded the former from the main study. Of those unvaccinated participants, 62 participants were males and 82 were females. 38.2% percent of participants had high school diplomas, 41.7% earned bachelor's degrees, and 20.1% obtained master's degree. The average age of participants was 32.1 (SD = 10.8).

Table 1. *Vaccination intention regressed on gender, age, and conscientiousness in Study 1*

	B	*β*	*p*-value
Age	0.009	0.023	0.721
Gender	−0.003	−0.001	0.982
Conscientiousness	0.905	0.386	<0.001

Materials and procedure

To take part in the study, participants were asked to contact the experimenter in advance via Wechat, a popular social media in China. Participants were requested that they should arrive at the meeting point within the required time allocated to them. When the study took place, the research assistant recorded the arrival time of each participant without getting their attention. Following calculation formulas used in Duffy *et al*. (2014: Experiment 3), the average lateness was measured by delayed minutes between the time slot scheduled for the appointment by the experimenter and the actual arrival time for each participant. The average earliness was measured by time-lag minutes between the time slot scheduled for appointment by the experimenter and actual arrival time for each participant multiplied by −1 (cf. Back *et al*., 2006). According to the equation, positive scores should be considered as an indication of late arrival and negative scores should denote early arrival (e.g., 1 min = late; 0 min = on time; −1 min = early). Upon arrival at the meeting point, participants were asked to complete the time management survey and the two-item measure assessing the intention to take COVID-19 vaccine (the Spearman-Brown estimate was 0.57) as Study 1.

Results and discussion

Participants' arrival time ranged from 14 min early to 19 min late. On average, participants arrived at the laboratory 1.7 min prior to their appointment (SD = 7.33). Ninety-eight participants were early, 0 were exactly on time, and 46 were late. As we expected, participants who arrived early for their appointment showed more positive attitudes toward the COVID-19 vaccination (M = 5.33, SD = 1.05) than participants who arrived late for their appointment (M = 4.87, SD = 1.13), t (142) = 3.44, p = 0.001, d = 0.58, 95% CI = [0.2812, 1.0409] (Table 2). Thus, these findings suggest that there is a positive link between conscientious behaviors and vaccination intentions as observed in a real-life context.

Additionally, we conducted a correlation analysis to determine whether punctuality is associated with stronger vaccination intentions. The results showed that there was a negative correlation between lateness and intention to vaccinate against COVID-19, r = −0.58, 95% CI [−0.6756, −0.455], p < 0.001. To further test our hypothesis, a regression model was tested. Gender, age, and education level were entered simultaneously into the model. The model as shown in Table 3 explained 32.7% of the variance in vaccination intention, F (4, 139) = 20.05,

Table 2. *Descriptive statistics for Study 2*

	Time of arrival (min)		Vaccination intentions	
	M	*SD*	*M*	*SD*
Participants arrived early for the appointment	−5.71	3.69	5.53	1.05
Participants arrived early for the appointment	6.87	5.59	4.87	1.13

Table 3. *Vaccination intention regressed on gender, age, education level, and conscientiousness in Study 2*

	B	*β*	*p*-value
Age	0.016	0.157	0.027
Gender	0.037	0.017	0.818
Education level	−0.136	−0.090	0.238
Conscientiousness	−0.096	−0.633	<0.001

$p < 0.001$, adj. $R^2 = 0.327$. When controlling for all variables, conscientiousness was still a significant predictor for vaccination intention ($\beta = -0.633$).

Extending beyond self-assessment regarding conscientiousness traits, Study 2 focused on individual differences in punctuality as observed in real world and employed a more diverse sample. We replicated the findings that conscientiousness-related personality traits were positively related to vaccination intentions in a Chinese non-student population. However, all participants in Studies 1 and 2 had not received their coronavirus vaccine when the studies took place. Since there might be a striking disconnection between vaccination intention and behavior, more efforts should be made to determine whether these findings can be generalized into actual vaccination behavior. To address this issue, Study 3 examined whether there was also a link between conscientiousness and actual vaccination behavior.

STUDY 3: METHOD

Participants

The study took place in April 2021. Participants were recruited through printed flyers and electronic advertisements in Sichuan province, Southwest China. A total of 198 non-student adults voluntarily took part in this survey in exchange for a financial reward. Ninety-five participants were males and 103 were females. The average age of participants was 33.7 (*SD* = 10.7). Ninety-four participants reported that they had already obtained the vaccine against COVID-19 as confirmed by their vaccination certificates. The remaining participants had not received COVID-19 vaccine when the study took place. There were no differences in age and gender between vaccinated and unvaccinated individuals (all *p*s > 0.52).

Materials and procedure

As in Study 2, participants were asked to contact the experimenter in advance via Wechat, a popular social media in China. Participants were requested that they should arrive at the lab room within the required time allocated to them. When the study took place, the research assistant recorded the arrival time of each participant without getting their attention. Upon arrival at the meeting point, participants were asked to complete the time management survey and the two-item measure assessing the intention to take COVID-19 vaccine (the Spearman-Brown estimate was 0.53) as Studies 1 and 2.

Results and discussion

Unsurprisingly, participants who had received the vaccine showed stronger vaccination intentions ($M = 5.71$, $SD = 1.09$) than did participants who had not received the vaccine against COVID-19 ($M = 5.07$, $SD = 1.19$), $t\,(196) = 3.92$, $p < 0.001$, $d = 0.56$, 95% CI = [0.3183, 0.9617]. Participants' arrival time ranged from 15 min early to 16 min late. On average, participants arrived at the laboratory 0.13 min prior to their appointment (*SD* = 8.07). To determine whether there was a significant difference in conscientiousness between vaccinated and unvaccinated participants, we applied an independent sample *t* test to compare their time of arrival. The results showed that vaccinated participants ($M = -1.30$, $SD = 8.30$) arrived at the lab earlier than unvaccinated participants ($M = 1.45$, $SD = 7.66$), $t\,(196) = -2.41$, $p = 0.017$, $d = 0.35$, 95% CI [−0.3044, −0.0314] (Table 4). This pattern of results suggests that punctuality, a reliable behavioral indicator of conscientiousness, can predict people's actual vaccination behavior in the context of COVID-19.

We conducted a correlation analysis to determine whether punctuality is associated with stronger vaccination intentions. In line with our predictions, the results showed that there was a negative correlation between lateness and intention to vaccinate against COVID-19 in both vaccinated ($r = -0.43$, 95% CI [−0.5819, −0.2491], $p < 0.001$) and non-vaccinated populations ($r = -0.52$, 95% CI [−0.6483, −0.3630], $p < 0.001$), respectively. To further test our hypothesis, a regression model was tested for vaccinated and unvaccinated participants separately. Gender and age were entered simultaneously into the model. The model for vaccinated individuals as shown in Table 5 explained 17.8% of the variance in vaccinated individuals' vaccination intention, $F\,(3, 90) = 8.71$, $p < 0.001$, adj. $R^2 = 0.178$, and 26.3% of the variance in unvaccinated individuals' vaccination intention (Table 6), $F\,(3, 99) = 13.12$, $p < 0.001$, adj. $R^2 = 0.263$. When controlling for all variables, conscientiousness was still a significant predictor for vaccination intention in vaccinated ($\beta = -0.436$) and unvaccinated participants ($\beta = -0.499$). Thus, these findings provide evidence that conscientious behaviors are positively related to vaccination intentions and actual vaccination behavior.

GENERAL DISCUSSION

To date, an increasing number of studies have consistently shown that there is a relationship between the personality trait of conscientiousness and individual attitudes toward vaccination (Lee *et al*., 2017; Lin & Wang, 2020). Yet, these studies have

Table 4. *Descriptive statistics for Study 3*

	Time of arrival (min)		Vaccination intentions	
	M	*SD*	*M*	*SD*
Vaccinated individuals	−1.30	8.30	5.71	1.09
Unvaccinated individuals	1.45	7.66	5.07	1.19

Table 5. *Vaccination intention regressed on gender and age in vaccinated individuals in Study 3*

	B	*β*	*p*-value
Age	0.018	0.179	0.057
Gender	0.163	0.075	0.423
Conscientiousness	−0.057	−0.436	<0.001

Table 6. *Vaccination intention regressed on gender and age in unvaccinated individuals in Study 3*

	B	*β*	*p*-value
Age	−0.010	−0.089	0.317
Gender	0.213	0.090	0.294
Conscientiousness	−0.077	−0.499	<0.001

relied primarily on participants' self-reports regarding personality traits and vaccination attitudes. Hence, it is unclear whether these associative patterns are predictive of people's real-life behavior. Building on findings that individual differences in self-reported conscientiousness facets are positively related to stronger intention to take COVID-19 vaccine, we sought to examine whether these relationships can exert the same force in real-life contexts. Across three studies, we investigated whether, in addition to self-reported measures of conscientiousness, there is a link between conscientious behaviors and COVID-19 vaccination intention, as well as actual vaccination behavior.

In Study 1, we found that Chinese university student participants who scored higher on conscientiousness demonstrated more positive attitudes towards vaccination. Such findings replicated previous research showing that high degrees of self-reported conscientiousness are demonstrably related to positive perceptions toward vaccination in non-WEIRD populations and thus enhance their generalizability. In Study 2, we moved beyond self-assessment of conscientiousness, exploring the association between objectively observable on-time behavior and vaccination attitudes. Consistent with prior findings based upon self-report data, we found that individuals who arrived early to appointments showed stronger COVID-vaccine uptake intentions than participants who arrived late to appointment, thereby extending previous research to encompass more objectively measurable conscientiousness behaviors. In Study 3, we examined the relationship between conscientiousness and intention to vaccinate in both vaccinated and unvaccinated individuals. The results showed that vaccinated participants met their obligations early on average than unvaccinated participants. The fact that we provided consistent evidence in support of our hypotheses across diverse populations (students and non-student adults from many different geographic areas of China) and complementary measures of conscientiousness (self-report and behavioral measure) highlights the robustness of the relationship between conscientiousness and vaccination attitudes, as well as actual vaccination behavior.

The present research contributes to the existing literature in several important ways. First, our findings advance our understandings of personality roots of individual attitudes toward vaccination. A handful of studies suggest that conscientiousness ranks the most important personality traits highly correlated with intention to vaccinate (Lin & Wang, 2020). This is because conscientiousness reflects the tendency to meet obligations dutifully, to finish tasks on track, and to comply with social norms (Jackson *et al*., 2010). For instance, Fiddick, Brase., Ho, Hiraishi, Honma and Smith (2016) found that people displayed lower levels of conscientiousness showed a greater tendency to break social contracts and to breach social restrictions. Since massive vaccination can control, eliminate, and eradicate infectious diseases such as COVID-19 and benefit the society from the perspectives of health, economy, as well as social fabric, individuals high in conscientiousness would be more likely to view vaccination as a responsibility and obligation and thus be more willing to get a COVID-19 vaccine.

Second, we supplemented self-reports with measures which illuminating naturally occurring conscientiousness behavior. In the field of personality psychology, questionnaires have become the de facto means of measuring individual differences (Duffy & Evans, 2017; Li, 2021). However, it is unclear whether self-report measurement is reflective of people's actual behavior (Holden, 2008; Li & Cao, 2022b). Some evidence in moral and cognitive psychology suggests that there might be some striking dissociation between hypothetical judgement and real-life behavior (Li, 2020). For instance, Bostyn, Sevenhant and Roets (2018) found that despite psychopathy meaningfully being associated with consequentialist reasoning in traditional trolley-style dilemmas, there was no relationship between anti-social personality and participants' behavior on the real-life version of the dilemma. These findings suggest that some personality and individual differences may not impact subjects' moral judgement and decision-making in real-life situations.

Thus, despite previous research based on self-report data providing validation for the correlation between conscientiousness and vaccination intention, it is plausible that some of these associative patterns are only artefacts of specific questionnaires. Additionally, since previous studies have primarily relied on participants who had not obtained a COVID-19 vaccine (Kreps, Prasad, Brownstein *et al*., 2020), the relationship between personality traits and individual attitudes toward vaccination may be specific to vaccination attitudes rather than actual behavior. To address these issues, on the one hand, we complemented self-reports with an objectively observable real-world reflex of conscientiousness. On the other hand, we sampled both vaccinated and unvaccinated participants to eliminate the possibility that some members of the intended population are overrepresented. A consistent finding across the three studies was that individual differences in conscientiousness were indeed associated with vaccination attitudes and behavior in both self-reports and naturally occurring conscientious behaviors. Thus, these results take previous laboratory-based findings to field conditions and provide researchers more confidence in the relationships uncovered.

Finally, the current research has practical implications for the implementation of mass vaccination campaigns in the context of COVD-19. For instance, based on the finding regarding the strong link between social norms and vaccination, giving special importance to norm-abiding behavior would motivate highly

conscientious people to be more willing to accept a COVID-19 vaccine. By contrast, people with lower levels of conscientiousness might not think of herd immunity achieved by massive vaccination as beneficial. Thus, institutions, organizations, and corporations must ensure that they adopt and enforce appropriate systems to monitor personality dynamics in organizational behavior since vaccine hesitancy and resistance have a rippling detrimental impact on a community. Much evidence has shown that behavioral nudges, such as highlighting the value of making vaccination easy and focusing on a community interest, can significantly increase COVID-19 vaccine uptake intentions (Dai, Saccardo, Han *et al*., 2021; James, Bokemper, Gerber, Omer & Huber, 2021). Drawing on this literature, exposure to vaccine public information that highlights prosocial benefits may motivate individuals low in conscientiousness to undergo vaccination.

The current research has several limitations, which may inform practice and future research. First, though we made special efforts to sample a broad cross-section of society with regard to age, gender, and education attainment in Studies 2 and 3. More strict measure of sample representativeness should be implemented in future studies. The second limitation is that conscientiousness is a multifaceted personality construct (Roberts, Lejuez, Krueger, Richards & Hill, 2014). Punctuality only represents a single conceptualization factor of conscientiousness. Future studies are needed to explore whether other facets such as self-efficacy, achievement striving, self-discipline, and cautiousness are associated with intention to vaccinate against COVID-19 and to determine which dimension is the strongest predictor. Third, and relatedly, promptness could be also related to other aspects of personality, such as agreeableness and neuroticism (Back *et al*., 2006). A use of a greater range of predictors including sociodemographic characteristics, personality factors, and other forms of individual difference, would improve the properties of the full model and allow to inform the psychological roots of vaccination attitudes. Finally, the cross-section design of the present research is observational in nature, which did not permit researchers to draw causal inferences. Since therapeutic interventions that change personality traits do not seem ethical nor feasible, large-scale longitudinal surveys can be conducted in future research.

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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