



## Research article

# Which profile of people tends to ignore preventive measures against COVID-19? The role of intelligence and the big five personality traits

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## ABSTRACT

Although a considerable amount of research has been done on the role of personality traits in the prediction of compliance with COVID-19 preventive measures, the possible role of intelligence has been studied far less. For this reason, the main goal of the current study was to determine what the predictive role of intelligence is when considered together with the Big Five personality traits. A total of 404 participants answered three instruments: the Overall Personality Assessment Scale (OPERAS), which assesses personality traits, the Compliance with pandemic COmmands Ability Resource (ICAR Sample Test). The results show that all variables are correlated with compliance, although the weight of emotional stability on compliance was not significant. The only variable negatively related to compliance was extraversion. The results of the structural equation modelling suggest that intelligence has a direct relationship with compliance, and an indirect relationship through openness to experience. According to the results, intelligence is an important variable that should be considered in the prediction of compliance with these preventive measures.

## 1. Introduction

In December 2019, the new SARS-CoV-2 virus was detected in the city of Wuhan and spread rapidly to other countries, causing more than 500, 000, 000 COVID-19 infections and more than 6,000,000 deaths [1]. To limit the number of infections and deaths, the governments of various countries and the World Health Organization have proposed a series of recommendations and measures such as social distancing, hand hygiene, mask use, lockdown, etc. However, not all citizens respected these measures and recommendations even though they were necessary to contain the transmission of COVID-19 [2]. At present, these measures have been relaxed in many countries, thanks to the positive effect of vaccines, but some countries have low vaccination rates, and the virus is still a health hazard for the population. Preventive measures are therefore still being taken to reduce the number of infections and deaths. What is more, some future mutations of the virus may become resistant to vaccines, making preventive measures necessary again worldwide. For this reason, it is important to understand which variables are related to the tendency not to comply with these preventive measures so that the problem can be mitigated in possible future stages of the pandemic, and even in other pandemics. In fact, several authors have warned about the high probability of future zoonotic pandemics because climate change, illegal trade in animals and disruptive

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patterns of exploitation of nature are increasing the transmission of viruses from animals to humans [3,4]. Therefore, knowing which profiles of people tend not to comply with preventive measures may also be helpful to better control the evolution of future pandemics.

Several studies have been carried out in various countries to determine which profiles of people tend not to comply with these preventive measures. They show that men are less likely to comply than women [5–7]. Likewise, young, single people tend to report lower levels of compliance [5,6,8]. On the other hand, people with children tend to be more compliant, possibly because of their concern for the family [7]. Other important variables are the lack of trust in government, science and the health system, which have also been related to the tendency not to comply with these measures [7,9]. Furthermore, a study carried out by Morales-Vives et al. [5] in Spain shows a positive relationship between considering social distancing, hand hygiene, mask-wearing, time restrictions and mobility restrictions as useful precautions and compliance with COVID-19 preventive measures. Likewise, the study carried out by Clark et al. [10] with an international sample shows the importance of believing that preventive measures are useful for avoiding COVID-19. In contrast, other studies show that people who believe in COVID-19 conspiracy theories tend to report lower levels of compliance [11,12]. According to Pavela et al. [12], these COVID-19 conspiracy beliefs have a direct relationship with compliance, and an indirect relationship via the trust in government officials. In fact, people who believe in these conspiracy theories tend to report lower levels of trust in government officials.

Other studies have focused on the role of personality characteristics in compliance with COVID-19 preventive measures. These studies show that impulsive people, who tend to take speedy and irreflexive decisions, are less likely to comply with those measures related to social distancing and hygiene [13,14]. Furthermore, people with characteristics related to psychopathy (low empathy, disregard for others, callousness, reduced guilt, etc.) also tend to be less compliant [15,16]. The Big Five personality traits have also been studied in relation to compliance with COVID-19 preventive measures. In fact, before the pandemic, some studies had already related these traits with rule breaking. For example, the meta-analysis carried out by Clarke & Robertson [17] showed that low levels of conscientiousness and agreeableness are predictors of participation in traffic accidents, partly due to non-compliance with road regulations. The studies that analyzed compliance with the COVID-19 restrictions also show the relevance of the Big Five in breaking these restrictions and rules. Lower levels of agreeableness and conscientiousness have been related to lower compliance [18–20]. More specifically, the trait Agreeableness, which is related to being kind, compassionate, altruistic, and cooperative, is the strongest predictor in several studies [15,21,22]. High scores in conscientiousness involve a general tendency to follow rules, as it is related to greater dutifulness, order and self-discipline [23], so it is not surprising that it is also related to compliance with COVID-19 preventive measures [19,24]. In fact, the meta-analysis carried out by Bogg & Roberts [25] before the pandemic showed that individuals high on conscientiousness are less likely to engage in unhealthy behaviors such as drug abuse or risky sexual relationships, and they report more positive and healthy practices such as diet and exercise.

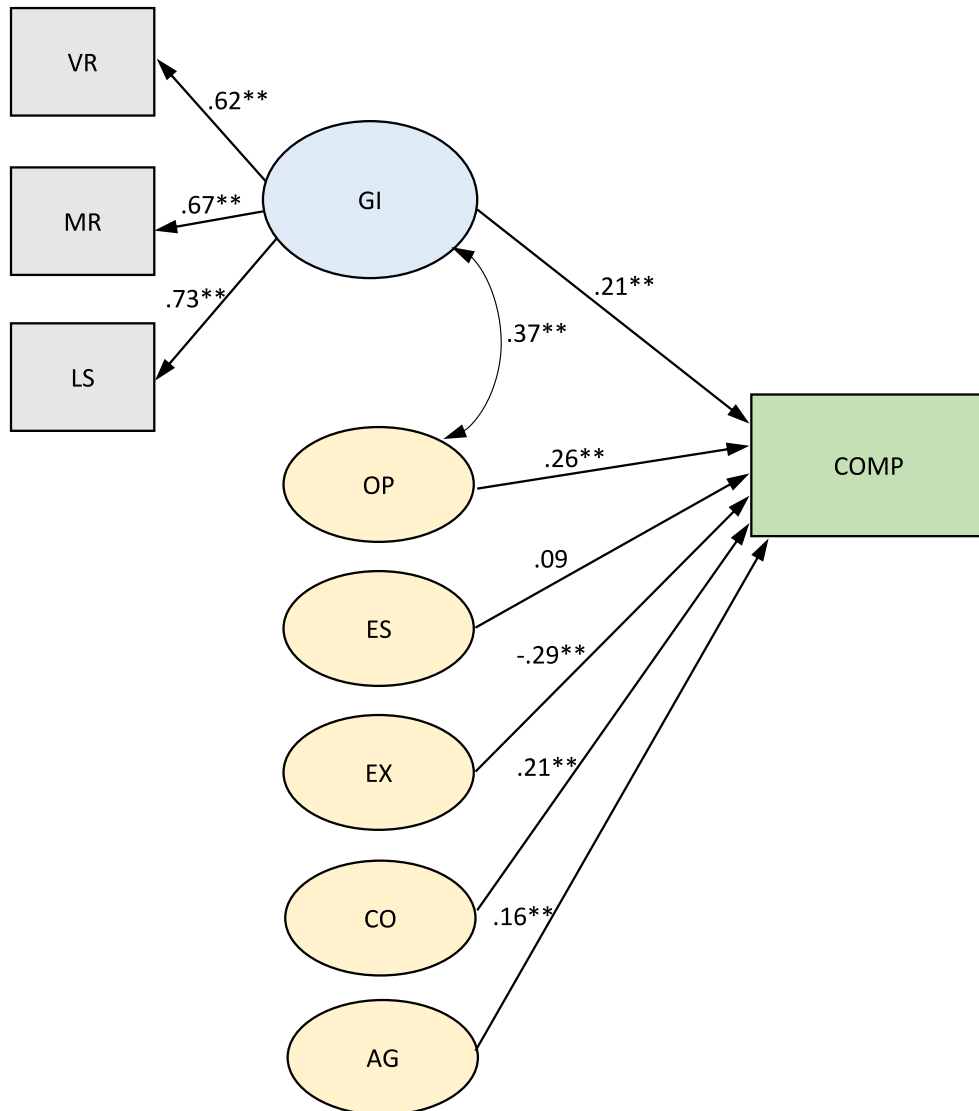
Several studies have also found that people with high scores on the trait openness tend to follow COVID-19 containment measures to a greater extent [18,20,26,27]. In fact, this trait is related to better acute risk perception [28], which may facilitate better perception of the risks associated with COVID-19 and a greater adherence to preventive measures. However, other studies have not found a significant relationship between openness to experience and adherence to guidelines such as social distancing or hygiene [19,29]. Results regarding the trait emotional stability are contradictory: while some studies have found a positive relationship between this trait and compliance with COVID-19 preventive measures [26,30], others found no significant relationship [19,27] or a negative relationship [18,20,29,31]. In fact, before the pandemic, Weston & Jackson [32] found that lower emotional stability could have both a positive and a negative effect on health depending on how individuals deal with their anxiety and their levels of conscientiousness. On the one hand, it seems that people with lower emotional stability can engage in such unhealthy behaviours as smoking or drinking to find emotional relief and cope with stress [33], but, on the other hand, lower levels of emotional stability can also lead to greater concern and vigilance over health, illnesses, and treatments [34]. Therefore, these different response patterns associated with this personality trait may explain the contradictory results on adherence to preventive measures to control COVID-19. Several authors have reported a negative relationship between extraversion and adherence to COVID-19 guidelines, which suggests that extroverted people tend to have greater difficulty following these measures, especially those related to social distancing [18,19,27,31]. However, Abdelrahman [29] did not find a significant relationship between extraversion and compliance with these measures.

Although a considerable amount of research has been done on the role of sociodemographic variables and personality traits in compliance with COVID-19 preventive measures, the possible role of intelligence in predicting compliance has been studied far less. However, it seems logical to assume that intelligence could play a role, given that reasoning and comprehension skills may help to understand the risks associated with the infection and the need to adopt preventive measures, thus facilitating compliance with these measures. In fact, Xie et al. [35] carried out a study at the beginning of the pandemic which shows that a greater working memory capacity predicts individual differences in social-distancing compliance. According to these authors, working memory is key in the process of comparing multiple pieces of potentially conflicting information regarding social distancing, a step that is necessary to make a decision based on the merits and costs of social distancing. Their study also shows that fluid intelligence and the personality traits agreeableness and openness to experience are related to higher levels of compliance with social-distancing. However, Xie et al. [35] used a very narrow measure of compliance, based on social distancing, and did not include other relevant preventive measures such as the use of masks, hand hygiene, etc. Neither did they assess crystallized intelligence, although it might also play a role in the prediction of compliance. More recently, the study by Morales-Vives et al. [36] assessed the role of intelligence, dysfunctional impulsivity and the dark triad in compliance with COVID-19 preventive measures, using a wide measure of compliance and both fluid and crystallized intelligence. Their results suggest that intelligence has an indirect relationship with compliance, through its relationship with dysfunctional impulsivity and the dark triad personality traits (narcissism, Machiavellianism and psychopathy). So, the two studies mentioned point out the importance of cognitive variables to the prediction of compliance. Apart from these, however, as far as we know no other studies on the possible role of intelligence exist. For this reason, the main goal of the current study was to determine if

intelligence can be regarded as a direct predictor of compliance with COVID-19 preventive measures, and what its predictive role is when considered together with the Big Five personality traits, in a scenario which uses (a) a wide measure of compliance that includes different types of preventive measures, and (b) a measure of intelligence that includes both fluid and crystallized intelligence.

Apart from the potentially complex relations between the intervening variables, the main problem in a predictive study such as the present one is that the relations obtained are based on fallible measures (test and scale scores) that contain sizable amounts of measurement error [37]. So, the best approach for empirically assessing the possible network of relations discussed above is to test a structural equation model in which all the potential predictors are modelled as unreliable indicators of latent constructs. This model is displayed in Fig. 1.

The structural model in Fig. 1 can be viewed as a hybrid that combines a latent variable specification with an error-in-variables specification. In more detail, the general intelligence measure consists of three scale scores (see below) that can be modelled as indicators of an identifiable general intelligence factor, which is indeed free from measurement error. For this reason, these three indicators are depicted as squares in Fig. 1. The Big Five personality measures, however, are scale scores, each of which indicates a single



Note. \*\*  $p < .001$ ; GI: General intelligence; VR: Verbal reasoning; MR: Matrix reasoning; LS: Letter series; OP: Openness to experience; EX: Extraversion; ES: Emotional stability; CO: Conscientiousness; AG: Agreeableness; COMP: Compliance

Fig. 1. Structural equation model.

construct. So, they cannot be meaningfully modelled as multiple indicators that define a common factor. Even so, unbiased, error-corrected standardized path estimates for this part of the model can still be obtained if the regression coefficients are corrected by using the reliability estimates of the scores [38]. For this reason, the personality measures are not represented as squares (i.e. fallible indicators) but as circles (i.e. error-corrected latent variables) in Fig. 1, as these measures are now interpreted as if they were 'true' measures of the corresponding latent variable. The conceptual interpretation would then be that each predictor is viewed as a latent common factor defined by a single indicator.

Finally, as can be seen in the model in Fig. 1, the constructs of intelligence and openness to experience are allowed to correlate because this personality trait has been shown to be related to cognitive ability [39,40].

## 2. Materials and methods

### 2.1. Participants

A total of 404 participants answered the battery of questionnaires (61.4% women). They were resident in Spain and aged between 15 and 69 years old ( $M = 30.6$ ,  $S.D. = 15.0$ ). Of this sample, 61.1% were single, 33.9% were married, 4.7% were divorced or separated, and 0.3% were widowed. Only 8.2% had been vaccinated against COVID-19.

A total of 0.2% of participants had not completed primary education, 3.2% had primary education studies, 38.4% had secondary education studies, 40.6% had finished a degree and 17.6% had postgraduate studies. Furthermore, a total of 50.5% of participants self-identified as students, 41.3% as employees, 2.7% as unemployed, 0.5% as temporarily out of work, and 5.0% as being in other situations.

With regards to the reported household income, 6.7% of the sample reported it to be lower than 1000 euros; 46.3% between 1000 and 2499; 28.2% between 2500 and 3999; 12.6% between 4000 and 5,499, and, finally, a 6.2% reported an income higher than 5500.

### 2.2. Measures

*Compliance with pandemic COmmands Scale (COCOS)* [5]. This questionnaire measures compliance with a wide range of preventive measures associated with COVID-19: use of masks, social distancing, not sharing food or drinks, hand hygiene, avoiding crowded places, not travelling without a justified reason, isolation in case of infection or having been in contact with an infected person, etc. This questionnaire is made of 27 Likert-type items with response categories ranging from 1 = completely disagree to 5 = completely agree, and provides scores free of acquiescence bias by using the procedures developed by Ferrando et al. [41] and Lorenzo-Seva and Ferrando [42]. The marginal reliability of the content factor score estimates in this sample was  $\rho_{\theta\theta} = 0.92$ .

*Overall Personality Assessment Scale (OPERAS)* [43]. This scale assesses the Big Five personality traits: agreeableness, extraversion, conscientiousness, openness to experience, and emotional stability. It consists of 40 items on a Likert 5-point scale (1 = Fully disagree, 5 = Fully agree). It also controls acquiescence and social desirability biases, and provides scores free of these biases by using the procedures developed by Ferrando et al. [41] and Lorenzo-Seva and Ferrando [42]. In the current sample, the marginal reliability of the content factor score estimates were  $\rho_{\theta\theta} = 0.90$  for extraversion,  $\rho_{\theta\theta} = 0.86$  for emotional stability,  $\rho_{\theta\theta} = 0.83$  for conscientiousness,  $\rho_{\theta\theta} = 0.75$  for agreeableness, and  $\rho_{\theta\theta} = 0.87$  for openness to experience.

*International Cognitive Ability Resource (ICAR Sample Test)* [44]. This instrument is a brief cognitive ability measure that includes subscales of fluid and crystallized intelligence, and provides an overall score of general intelligence. It includes 4 letter series items, 4 items of verbal reasoning, 4 items of matrix reasoning, and 4 items of three-dimensional rotation. According to Cattell [45], fluid intelligence refers to the ability to solve abstract problems in novel situations (in this test, the progressive matrices and three-dimensional rotation subscales), while crystallized intelligence refers to knowledge and skills acquired through experience and education (in this test, letter series items and verbal reasoning subscales). General intelligence refers to the ability for reasoning, problem solving, and learning, integrating cognitive functions such as perception, attention, memory, language, or planning [46]. In the current study, we decided not to include the 4 items of three-dimensional rotation because they were too difficult. In fact, in the pilot study, we observed that participants tended to drop out when they reached these items, complaining about the difficulty and the time it took to answer them. For this reason, we only included the items involving letter series, verbal reasoning, and matrix reasoning. Letter series items consist of short sequences of letters, and participants are requested to identify the next position in the sequence from among six choices. Matrix reasoning items consists of  $3 \times 3$  arrays of geometric shapes with one of the nine shapes missing. Participants are asked to identify which of the six geometric shapes presented as response choices will best complete the stimuli. Verbal reasoning items include a variety of logic, vocabulary and general knowledge questions. There is no time limit for solving these items.

### 2.3. Procedure

The Research and Innovation Ethics Committee (CEIPSA) of Universitat Rovira i Virgili (CEIPSA-2021-PR-0002) assessed and approved this study. We also obtained informed consent from all participants, in accordance with the Declaration of Helsinki.

Questionnaires were administered online from February to April 2021. Candidates for participation were excluded from the study if they did not provide informed consent, if they were under 15 years old, or if they were not resident in Spain. Participants were informed that participation was voluntary and that questionnaires were anonymous. Data protection was also guaranteed.

To achieve a heterogenous sample, we used various procedures to disseminate the survey. Moreover, the website allowed participants to share the survey with their contacts on the social networks (for example, Facebook or WhatsApp). More specifically, the

survey was disseminated through several Spanish associations, the mass media (press and radio), and social networks (WhatsApp groups, Facebook and Twitter). We also asked high schools from various regions in Spain to disseminate the survey through their students over 14 years old. According to Spanish law, parental consent is not required for adolescents over 14 years of age to participate in a study of this type (Organic Law March 2018 of 5 December, article 7). Considering this law and the pandemic situation at that time, we decided not to go to the schools in person and not ask for parental consent. Moreover, part of the adolescents accessed the survey through the social networks, what also made it difficult to obtain parental consent.

### 2.4. Data analysis

The analysis proceeded in two steps. In the first step, univariate statistics (means and standard deviations of items) and bivariate statistics (first-order product-moment correlations) were obtained for all the measures included in the study. Furthermore, reliability estimates for the single scale personality scores were obtained in order to correct the paths in which these indicators were involved for error. These reliabilities are reported above, in the Measures section.

The structural model described above in Fig. 1 was fitted in the second step. The across-sample stability and sub-population invariance of the model structure and results were first checked by using (a) bootstrap re-sampling, and (b) a double cross-validation schema in which the total sample was randomly split into two sub-samples (stability assessment), and testing the strong invariance condition in groups defined by gender and age (invariance assessment). If the estimates were judged to be stable and invariant across groups, the results are reported only for the full sample.

As the measurement units in the model were all test or sub-test scores, all the measures were treated as continuous, and the model was fitted using the Robust Maximum Likelihood (RML) criterion. Apart from the basic chi-squared test of fit statistic, three different facets of model-data fit were assessed: absolute fit (SRMR index), relative fit per degree of freedom (RMSEA index), and comparative fit with respect to the null independence model (CFI index). Finally, the power of the test statistic for detecting model misspecifications was assessed with the approach proposed by Lee, Cai, and MacCallum [47].

There was no missing data in this study because the survey did not allow participants to move on to one item without answering the previous one.

Statistical analyses were carried out using SPSS 28 and Mplus v8.8.

### 3. Results

Table 1 shows the descriptive statistics for the COCOS, ICAR and OPERAS scores and the corresponding correlations. It can be observed that the intelligence scores do not correlate significantly with personality scores except with openness to experience; and the COCOS scores have significant relationships with all the potential predictors, although extraversion and emotional stability are the least related.

We now move on to discuss the results for the structural equation model in the second step. As for the across-sample stability checks, the bootstrap estimates of variability were close to the nominal standard errors, and the estimates and measures of model-data fit were highly stable under cross-validation. And, with regards to strong-invariance assessments, the strong-invariance solution fitted the data for both grouping variables very well, which suggests that the model we proposed for the general population also holds with the same structural relations and measurement properties in sub-populations defined by gender and age. So, from now on, results are only reported for the full sample (results for all the preliminary checks can be requested from the authors).

The outcome of the strong invariance solution makes it possible to statistically assess mean differences in the groups defined by the grouping variables (gender and age in this case). As for gender, although the estimated mean compliance for men was lower than for women (32.7 vs. 36.3) the difference did not reach statistical significance. Mean compliance levels increased substantially with age, and the mean differences were statistically significant in the three age groups that were compared. Finally, the correlation age-compliance was .41 ( $p < .001$ ), which indeed agrees with the increasing means in the age groups.

**Table 1**  
Descriptive statistics and correlation matrix between scale scores.

Instruments	Variables	M (S.D.)	COCOS		ICAR			OPERAS			
			COMP	VR	MR	LS	EX	ES	CO	AG	
COCOS	COMP	49.62 (8.52)									
ICAR	VR	2.25 (1.25)	.19**								
	MR	1.50 (1.40)	.23**	.44**							
	LS	1.83 (1.25)	.25**	.44**	.48**						
OPERAS	EX	46.53 (11.27)	-.13*	-.04	.03	-.06					
	ES	46.49 (11.74)	.14*	.09	.10	-.02	.51**				
	CO	48.16 (10.80)	.29**	-.01	.08	.04	.25**	.46**			
	AG	48.60 (10.42)	.25**	.06	.08	.03	.16**	.40**	.29**		
	OP	51.39 (10.89)	.42**	.18**	.23**	.31**	-.03	.08	.27**	.19**	

Note. COMP: Compliance with COVID-19 preventive measures; VR: Verbal reasoning; MR: Matrix reasoning; LS: Letter series; EX: Extraversion; ES: Emotional stability; OP: Openness to experience; AG: Agreeableness; CO: Conscientiousness.

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

With regards to the goodness of model-data fit, results were:  $\chi^2 (df = 16) = 24.707$ ,  $p = .0752$ ; CFI = 0.979; RMSEA (90% confidence interval) = 0.037 (0.00, 0.064), and SRMR = 0.036. All these results systematically point in the same direction and suggest an excellent degree of model-data fit [48–50]. Finally, the estimated amount of power was  $Beta = 0.87$ , which can be considered sufficient to detect even moderate misspecifications had they existed.

The standardized weight estimates for the fitted model are included in Fig. 1 together with their corresponding path. As a summary, it is first noted that the three intelligence subscale scores (Verbal reasoning, Matrix reasoning, and Letter series) exhibit positive manifold and clearly define the latent intelligence factor. At the construct level, there is a significant relationship between Intelligence and Openness to experience, and these two variables also have a positive relationship with the COCOS scores. The personality traits conscientiousness and agreeableness are positively related to the COCOS scores, while extraversion is negatively related. Emotional stability is the only personality trait that is not related to the COCOS scores. Finally, although the Big Five personality traits are assumed to be orthogonal [51,52], in this study some relationships were observed between these traits. This could reflect a method effect rather than a real relationship, although it should be noted that some authors have already pointed out that these traits are frequently correlated [53,54]. In any case, considering the contradictions in the literature about the possible relationships between these traits, and also considering that these relationships were not part of the objective of this study, we opted to leave them free and not impose any restriction on them. As these relationships are not the focus of the present study, for the sake of simplicity they are not shown in Fig. 1. In other words, covariances among personality traits are not depicted in Fig. 1, although they were estimated in the model. Finally, we also obtained the proportion of explained variance of the compliance scores accounted for by the full model in Fig. 1, as well as the corresponding proportion when the intelligence measures were not included. In the first case, the explained proportion was 35%, which dropped to 33% when intelligence was omitted.

#### 4. Discussion

Although a considerable amount of research has been done on the relationship between personality and compliance with COVID-19 preventive measures, the possible role of intelligence in predicting this compliance has been little studied. For this reason, the main goal of the current study was to determine if intelligence plays a leading role, and what its predictive role is when considered together with the Big Five personality traits. In fact, previous studies have already shown that the Big Five are related to compliance with measures that prevent COVID-19 contagion. The results of the current study again suggest that the traits of openness to experience, agreeableness, conscientiousness, and extraversion are important. Emotional stability was the only trait without a significant path in the results of structural equation modelling. The results of previous studies on this personality trait have been contradictory: some of them report a positive relationship [26,30] or a negative relationship [18,20,29,31], while others do not find a significant relationship of any sort [19,27]. Although the results of the current study suggest that this trait is correlated to compliance with a small effect size, it does not explain additional variance of compliance to that already explained by the rest of the personality traits and intelligence. This result may be partly explained by the fact that emotional stability has an ambivalent relationship with compliance since, to deal with emotional distress, some people with poor emotional stability tend to engage in more risky behaviors with negative health consequences [33], while others tend to report considerable concern and vigilance over health, illnesses, and treatments [34]. The results of the current study suggest that agreeableness, conscientiousness and openness to experience have a positive relationship with compliance, as was expected from the results of previous studies. In fact, the meta-analysis by Clarke & Robertson [17] before the pandemic had already found that low levels of conscientiousness and agreeableness are related to non-compliance with road regulations. Furthermore, several studies during the pandemic found that low levels of these traits are related to lower compliance with COVID-19 preventive measures [18–20]. In fact, as agreeableness is related to altruism and compassion, it is understandable that lower levels of this trait are associated with a greater tendency not to comply. Likewise, as conscientiousness is related to responsibility, cautiousness and self-discipline, the positive relationship with compliance was also expected. Several studies also found a positive relationship between openness to experience and compliance during the pandemic [18,20,26,27], but others found no significant relationship of any sort [19,29]. Therefore, the present study supports the results found in previous studies and suggests that this trait is important for the prediction of compliance. In fact, it is the personality trait with the highest first-order correlation with compliance. With regard to extraversion, like other studies we found a negative relationship with compliance [18,19,27,31]. In fact, some authors have stated that a high level of extraversion can make it more difficult to observe compliance with preventive measures, especially social distancing measures.

The study by Xie et al. [35] suggests that working memory capacity and fluid intelligence are related to social-distancing compliance. However, this study did not include important preventive measures other than social distancing (for example, the use of masks or hand hygiene) and the instrument used to assess intelligence did not include a subscale of crystallized intelligence. The current study also suggests that intelligence is an important variable that should be taken into account, as higher levels of intelligence are related to higher compliance, not only with social-distancing as in Xie et al. [35], but in a far broader way. Furthermore, in the current study the assessment of intelligence includes both fluid and crystallized intelligence. However, it should be taken into account that most of the predictive power is in the personality variables and the contribution of intelligence is less important. Because higher intelligence may give rise to better understanding of the risks associated with the disease and the need to adopt preventive measures, greater compliance was an expected result. More specifically, our results show that this variable has a direct relationship with compliance, and also an indirect relationship through openness to experience. They also suggest that intelligence explains additional variance of compliance beyond that explained by personality traits.

A recent study by Morales-Vives et al. [36] suggests that intelligence has an indirect relationship with compliance, through its relationship with the negative personality traits dysfunctional impulsivity and the dark triad. Therefore, had these negative personality

traits been included in the current study, together with the Big Five personality traits and intelligence, the direct relationship that we observed here would probably not have been obtained either. In fact, according to the authors of this previous recent study, individuals with lower levels of empathy and reduced guilt, higher impulsivity and narcissistic characteristics, and a tendency to manipulate others are less likely to engage in preventive behaviours, possibly because they are more self-centered and do not care much about the wellbeing of others. Intelligence, on the other hand, might modulate the relationship between the negative personality traits and compliance. For this reason, it would be interesting in future studies to assess all these variables together, in order to better understand their joint relationship with compliance, although the resulting model would be of great complexity.

The results of this study could be helpful to design more effective communication and prevention policies. If intelligence has a role in predicting these behaviors, it is important that the messages sent by official institutions are very simple and easy to understand. These messages should facilitate the understanding of the need for these measures and their benefits at the individual level. This type of messages will be particularly useful for those people with more comprehension difficulties, and they will also be useful for disproving possible hoaxes or misunderstandings about these measures.

Of course, our study has limitations. More research is needed to understand what the predictive role of intelligence is when considered together with other personality traits that are expected to be substantially related to compliance with COVID-19 preventive measures (for example, impulsivity or psychopathy). Along the same lines, we did not assess some relevant attitudinal and beliefs variables related to compliance (for example, lack of trust in science and experts, the tendency to believe in conspiracy theories, or the belief that preventive measures are useful). Therefore, further studies are clearly needed to gain greater insight into the predictive role of intelligence when all these potentially relevant variables are also considered. Moreover, we focused on general intelligence because we hypothesized that reasoning and comprehension skills are important for compliance with COVID-19 measures, since they may be helpful in understanding the risks associated with the infection and the need to adopt preventive measures. However, there may be other relevant cognitive processes that have not been included in this study, such as memory, language, etc. Therefore, further studies should also focus on other cognitive processes. Furthermore, more studies are also needed in other countries and cultures, to determine whether the same results are obtained in different contexts. Finally, the limitations of structural equation models such as the one used in this study must also be considered. Although these models allow us to determine the extent to which a variable can be predicted from other variables, they are not sufficient to explain the nature of the relationships, or whether they are cause-effect relationships. Although further research is warranted, however, the current study is submitted to fill a gap in the literature about this issue and provide valuable initial information about the possible role of intelligence in the prediction of compliance with COVID-19 preventive measures.

#### Author contribution statement

Fabia Morales-Vives: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper. Pere J. Ferrando: Analyzed and interpreted the data. Andreu Vigil-Colet: Conceived and designed the experiments. Ana Hernández-Dorado: Analyzed and interpreted the data; Wrote the paper.

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#### Data availability statement

Data will be made available on request.

#### Declaration of interest's statement

The authors declare no competing interests.

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