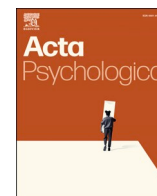




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# Personality in a naturally occurring strong situation: Unique effects of HEXACO traits on COVID-19 mitigation

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## ABSTRACT

The first Italian lockdown during COVID-19 pandemic constituted an example of strong situation. Under this context, we investigated associations of HEXACO personality with COVID-19 mitigation behaviors (self-reported hygiene, distancing, going out). We tested unique associations through regularized regressions and out-of-sample prediction after establishing the best level of analysis (HEXACO traits, facets, items). Personality always explained out-of-sample variance over and above demographics, COVID-related knowledge, concern, impacts, and goals. Hygiene and distancing were best predicted by HEXACO traits, whereas facets constituted the best level for the prediction of going out. In general, honesty-humility (trait or facets) was the clearest predictor of safer behaviors. Results corroborate the relevance of personality even in strong situations, as well as its importance for COVID-19 mitigation.

## 1. Introduction

The coronavirus disease 2019 (COVID-19), caused by the Severe Acute Respiratory Syndrome CoronaVirus 2 (SARS-CoV-2), became pandemic in early 2020. At that time, the most effective strategies to mitigate the virus diffusion were based on individual behaviors such as washing hands and keeping safety distance in social interactions. Also, periods of lockdown were enforced to reduce social contacts and contain the pandemic. In Italy, a lockdown began on the 9th of March 2020.<sup>2</sup> It was not until the 3rd of May that the government initiated a loosening of the restrictions. This period, referred to as “Phase 1”, was a national extension of the restrictions that had been initially selectively applied to several specific areas of northern Italy since the end of February. During the national lockdown, most activities were subject to a complete shutdown. Schools, universities, restaurants, cafes, and most retailers were closed or inactive. Gatherings of people in public places were forbidden, as was meeting with relatives or friends at home. Going out was only permitted for substantiated and compelling reasons (i.e., health- and work-related reasons or need for supplies). Market places or pharmacies (with the related production chains) were among the few

functioning business activities, ensuring basic services to the citizenship. Yet, access to such places was limited and subject to the use of protective devices (e.g., masks). Law enforcement authorities were instructed to sanction any deviation from the rules.

Overall, the lockdown was characterized by clear indications to stay at home. Such indications were enforced by law. They uniformly came from media, government, and scientific agencies, and a violation of those indications could have led to legal and health-related consequences. Characteristics of clarity and consistency of the information, presence of constraints, and specific consequences in case of inconsistent behavior (Meyer et al., 2020) have been described as key attributes of the so-called “strong situations”. We argue that the lockdown constituted a prototypical example of a strong situation. In particular, a situation is strong when it is characterized by the ability to induce uniform expectancies and behaviors, ultimately reducing the behavioral expression of individual differences such as personality traits and motives (Meyer et al., 2020). Although strong situations have been investigated through experimental paradigms (Cooper & Withey, 2009), they are not easy to observe systematically in ecological contexts among a broad population. In a way, the lockdown represented one of the

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<sup>2</sup> E.g., see <https://lab24.ilsole24ore.com/storia-coronavirus/>.

“strongest” collective situations experienced in Italy in the last 70 years.

Despite the negative psychological consequences of the lockdown (Preti et al., 2020; Viviani et al., 2021), compliance with the restrictive measures has been high on average, Italians being among the most diligent in international samples (Barari et al., 2020; Clark, Davila, Regis, & Kraus, 2020). Nonetheless, evidence showed some variability in the compliance with mitigation norms despite the high situational strength. For instance, studies found higher rates of self-reported compliance among women and healthier participants (Barari et al., 2020; Clark et al., 2020; Zettler et al., 2021), as well as more educated and informed individuals (Harper, Satchell, Fido, & Latzman, 2020). Several studies in the social and behavioral sciences investigated the impact of personality on enacted behaviors during the pandemic (Van Bavel et al., 2020; Preti, Di Pierro, Fanti, Madeddu, & Calati, 2020). The HEXACO (Lee & Ashton, 2004) honesty-humility dimension stood out among the most important correlates of self-reported compliance with mitigation measures (Zettler et al., 2021). Dark personality features (e.g., psychopathy), which largely correspond to the opposite pole of honesty-humility (Hodson et al., 2018), were also frequently related to mitigation compliance (Blagov, 2020; Zettler et al., 2021; Zettler, Schild, Lilleholt, & Böhm, 2020).

Other traits, such as agreeableness and conscientiousness, were also associated with protective self-reported behaviors across different samples in the USA, France, Brazil, and mixed international samples (Blagov, 2020; Brouard, Vasilopoulos, & Becher, 2020; Carvalho, Pianoski, & Gonçalves, 2020; Clark et al., 2020), as well as in preliminary meta-analyses (Zettler et al., 2021). On the other hand, extraversion was generally related to lower compliance with mitigation measures (Blagov, 2020; Brouard et al., 2020; Carvalho et al., 2020; Clark et al., 2020). Emotionality and neuroticism were positively related to protective self-reported behaviors in most studies (Blagov, 2020; Clark et al., 2020; Zettler et al., 2020), despite some exceptions (Brouard et al., 2020). A relationship of mitigation-compliance with openness to experience found little empirical support (Zettler et al., 2021).

Personality traits are multifaceted constructs, and facets subsume more specific indicators of behaviors, cognitions, and emotions, represented by individual items in personality measures. There is evidence that facets can outperform higher-order traits, as domain scales can obscure linkages at more specific levels of analysis (Paunonen & Ashton, 2001; Pletzer, Oostrom, Bentvelzen, & de Vries, 2020). At an even lower level, items detect personality nuances that may add predictive validity to specific outcomes (Möttus, Kandler, Bleidorn, Riemann, & McCrae, 2017). For instance, HEXACO emotionality includes aspects of negative affectivity and hyper-vigilance (i.e., fearfulness, anxiety) but also encompasses more general predispositions toward emotional sensitivity (i.e., sentimentality), being quite heterogeneous. The specific effects of facets or nuances on an outcome are almost certainly missed if personality is considered exclusively in terms of broader traits. Focusing on finer-grained levels provides more detailed information for predictive and explanatory purposes (Costantini & Perugini, 2016; Möttus et al., 2020). However, the cost of increasing specificity is a decrease in parsimony and ease of interpretability, with the best trade-off between generality and specificity varying from situation to situation.

In a study with a broader sample<sup>3</sup> (Costantini et al., 2021), we investigated the motivational and behavioral aspects related to COVID-19 mitigation. We identified three classes of behaviors (hygiene, distancing, going out) and two classes of goals (being free and being

safe) that people ascribe to those behaviors. We further demonstrated how goals had incremental and meaningful associations with behaviors after controlling for several variables, including demographics and COVID-related aspects (i.e., knowledge of the virus, impact due to the pandemic, and concern for the situation). Here, we focus instead on the role of personality traits.

The main aim of this study was to investigate the predictive value of personality over behaviors relevant to COVID-19 mitigation during the first lockdown in Italy, which offered an example of a strong situation that arguably constitutes a worst-case scenario for predictions based on personality and individual differences in general (Meyer et al., 2020). In particular, we examined the extent to which personality could improve the prediction of behaviors after controlling for more direct predictors (e.g., demographic variables, knowledge of COVID-19) and personal goals related to COVID-19. We considered different personality hierarchy levels – traits, facets, or items – to investigate the relative predictive performance of different levels for COVID-related behaviors. We relied on the HEXACO model of personality structure, as strong evidence supports its utility compared to alternatives (Ashton & Lee, 2020). Given our interest in facet- and item-level analyses, we employed a methodology that allowed us to control for overfitting and inspect the true out-of-sample predictive value of goals and personality variables, an approach that is seldom used in personality psychology (Möttus et al., 2020) despite its utility (Yarkoni & Westfall, 2017).

## 2. Materials and methods

### 2.1. Participants and procedure

Data were collected between the 17<sup>th</sup> and the 30<sup>th</sup> of April 2020, during the lockdown imposed by the Italian government (the so-called “Phase 1” lockdown). Participants completed online self-report questionnaires on the Qualtrics website (<https://www.qualtrics.com/it/>), after providing informed consent. The Qualtrics link was disseminated online and by word of mouth. The study was approved by the Ethics Committee in charge. Inclusion criteria were being in Italy when the questionnaire was completed and being above 18 years old. An item to detect careless responding was included to filter out participants (Meade & Craig, 2012): 22 participants self-reported careless responding and were excluded from all analyses. The final sample size was 577 (418 females, 155 males, 1 self-identified as transsexual, and 3 self-identified as “other”), with a mean age of 31.18 years ( $SD = 11.96$ , range: 18–74).

### 2.2. Measures

Measures were presented in this order:

#### 2.2.1. Knowledge of COVID-19

Participants were asked ten questions investigating their knowledge of COVID-19 (e.g., “COVID-19 always causes symptoms”) with a three-option response format (*true/false/I don't know*) and only one correct option. Correct responses were summed to compute an index of accuracy of knowledge around COVID-19.

#### 2.2.2. Goals

Participants indicated the extent to which each of 25 goals related to COVID-19 was important to them, using a scale ranging from 1 (*not at all important*) to 5 (*extremely important*). Goals were generated in a pilot study and subsequently administered to a wide community sample, including but not limited to the sample of this study (see Costantini et al., 2021). An oblimin-rotated Principal Component Analysis (PCA) suggested a two-component structure explaining 40% of the variance, with goals to be safe (e.g., “Stay safe, even if giving up getting what I want”) and goals to be free from restrictions (e.g., “Have fun, even if it means taking a few more risks”). The two components were correlated ( $r = -0.50$ ). Item loadings ranged between 0.68 and 0.75 for the first

<sup>3</sup> This paper reports results from a subsample of participants involved in a wider project on individual differences during COVID-19 pandemic. During the lockdown, participants completed a number of common measures. A subset of them also underwent an assessment of HEXACO personality traits. Results regarding measures other than personality traits in the whole sample are detailed in a different manuscript (Costantini et al., 2021). For the purpose of this paper, we will focus only on HEXACO completers.

component and between 0.40 and 0.78 for the second. Scores for each scale were computed as the mean of the items with the highest loadings on the factor. Cronbach's alphas in this study were 0.88 and 0.85 for goals to be safe (12 items) and free (13 items), respectively (McDonald's omegas = 0.91 and 0.92, respectively). Full details about the construction of this scale are reported elsewhere (Costantini et al., 2021).

### 2.2.3. Behaviors

Behaviors related to COVID-19 were self-reported through a questionnaire, asking participants to indicate the frequency with which they enacted each of 18 behaviors. Behaviors were rated on a scale from 1 (*Never or almost never*) to 5 (*Always or almost always*). In a previous study (Costantini et al., 2021), a PCA with oblimin rotation suggested a three-component structure, with hygiene (e.g., "Wash my hands frequently"), distancing (e.g., "Avoid people gatherings"), and risky behaviors related to going out (e.g., "Look for any reason to leave the house, even if it's not really necessary"). The three components explained 43% of the variance, with loadings ranging from 0.40 to 0.79, from 0.36 to 0.71, and from 0.45 to 0.71, respectively. Correlations between the three components ranged from  $-0.22$  to  $0.19$ . Scores for each scale were computed as the mean of the items loading on the factor, with Cronbach's alphas in this study being 0.66 for distancing (6 items) and going out (5 items) and 0.74 for hygiene (7 items) ( $\omega$  range: 0.70–0.80). Full details about this scale are reported elsewhere (Costantini et al., 2021).

### 2.2.4. Concern (Conway, Woodard, & Zubrod, 2020)

This 6-item measure assesses concern for the coronavirus disease (e.g., "Thinking about the coronavirus (COVID-19) makes me feel threatened"). Items were rated on a 5-point scale ranging from 1 (*completely false for me*) to 5 (*completely true for me*). This and the following scale were translated into Italian through back-translation. Cronbach's alpha for the scale was 0.86 in our sample ( $\omega = 0.90$ ).

### 2.2.5. Impacts (Conway et al., 2020)

This 9-item questionnaire assesses the financial and psychological impact of the coronavirus disease and the difficulty in obtaining necessary resources during the lockdown. Participants used a 5-point Likert scale ranging from 1 (*completely false for me*) to 5 (*completely true for me*). Reliabilities were good (financial scale:  $\alpha = 0.92$ ,  $\omega = 0.93$ ; psychological scale:  $\alpha = 0.83$ ,  $\omega = 0.85$ ; resource scale:  $\alpha = 0.80$ ,  $\omega = 0.82$ ).

### 2.2.6. Personality (Ashton & Lee, 2009; Lee & Ashton, 2004)

The HEXACO-Personality Inventory (HEXACO-PI) is a 200-item measure assessing personality traits in a six-factor perspective (Honesty-Humility, Emotionality, eXtraversion, Agreeableness, Conscientiousness, Openness). Each trait can be further decomposed into 4 facet scales, with 8 additional items investigating the interstitial facet of altruism. Responses are based on a 5-point scale ranging from 1 (*completely disagree*) to 5 (*completely agree*). In this study, Cronbach's alphas ranged from 0.86 to 0.91 for the six domains (omegas range: 0.92–1.00).<sup>4</sup> As to facet scales, alphas ranged from 0.65 to 0.87 (omegas range: 0.69–0.90).

## 2.3. Data analysis

The focus of our analyses was predicting the three COVID-related mitigation behaviors while investigating the incremental validity of personality traits and facets. First, we explored correlations between

behaviors, personality, and other predictors. Then, we used a stepwise procedure and performed six regression analyses of increasing complexity (Models 1–6) for each mitigation behavior as a dependent variable. Model 1 only included age, education, and gender as predictors (participants identified as transsexual or "other" were not included due to paucity of data). Model 2 added COVID-specific variables (COVID knowledge, impacts, and concern scales). Model 3 added the two goal classes (safe and free). Model 4 added the six HEXACO personality traits. Finally, Models 5 and 6 substituted traits with facets (24 facets plus altruism) and items, respectively. Hence, we considered the level of traits, facets, and items separately. All variables were standardized. Since we were interested in the true out-of-sample predictive utility of our estimates (as opposed to in-sample explained variance), we combined an out-of-sample prediction strategy with *lasso* regularized regressions, employing a nested cross-validation approach (James, Witten, Hastie, & Tibshirani, 2013; Yarkoni & Westfall, 2017). The analytic procedure is described in detail in Supplementary Materials. Two model fit measures, the Root Mean Square Error (RMSE) and  $R^2$ , were estimated for each model and used to compare their predictive performance. Lower RMSE and higher  $R^2$  values indicate a better ability of the model to predict new data.

## 3. Results

### 3.1. Descriptive statistics and zero-order correlations

On average, participants reported higher frequencies for protective (versus risky) behaviors. Mean scores for hygiene and distancing were respectively  $M = 4.04$  ( $SD = 0.67$ ) and  $M = 4.69$  ( $SD = 0.49$ ), whereas the mean for going out was  $M = 1.21$  ( $SD = 0.38$ ). Table S1 presents other descriptive statistics and correlations of all variables with the three mitigation behaviors (including HEXACO traits and facets), whereas the full correlation matrix is in Table S2. HEXACO traits showed weak-to-moderate correlations with several behaviors. In particular, honesty-humility and conscientiousness correlated with safer behaviors, and a similar pattern was observed for most of their facets. The three behavior classes also correlated with each other. Hygiene and distancing were positively related ( $r = 0.26$ ,  $p < .001$ ), and going out negatively related to both hygiene ( $r = -0.12$ ,  $p < .001$ ) and distancing ( $r = -0.28$ ,  $p < .001$ ).

### 3.2. Predictive performance of models 1–6

Table 1 shows RMSE and  $R^2$  values for each model. When predicting hygiene and distancing, there was a clear progressive improvement in prediction from Model 1 to Model 4, as shown by a decrease in RMSE and an increase in  $R^2$ . Models 5 and 6, on the other hand, did not represent an improvement over Model 4. In other words, the best fitting model was represented by a model including demographics, COVID knowledge, impacts and concern scales, goal classes, and the six

**Table 1**  
Out-of-sample predictive performance of *lasso* regression models.

	Hygiene	Distancing	Going out
	RMSE ( $R^2$ )		
Model 1	0.983 (0.032)	1.000 (–0.003)	0.998 (0.003)
Model 2	0.944 (0.108)	0.987 (0.025)	0.991 (0.016)
Model 3	0.933 (0.129)	0.977 (0.044)	0.943 (0.108)
Model 4	0.909 (0.172)	0.960 (0.077)	0.937 (0.121)
Model 5	0.911 (0.168)	0.964 (0.069)	0.933 (0.128)
Model 6	0.910 (0.171)	0.967 (0.064)	0.940 (0.115)

*Note.* Analyses are performed on males and females only ( $N = 573$ ). Independent variables are as follows: **Model 1** = age, education, gender; **Model 2** = Model 1 + knowledge, impacts, concern; **Model 3** = Model 2 + goals; **Model 4** = Model 3 + HEXACO personality domains; **Model 5** = Model 3 + HEXACO facets; **Model 6** = Model 3 + HEXACO items.

<sup>4</sup> For HEXACO traits, we also considered the  $\omega_{ho}$  reliability coefficient (Flora, 2020), a variant of omega estimated on second-order factor models. These coefficients were estimated by means of packages lavaan and semTools (Jorgensen, Pornprasertmanit, Schoemann, & Rosseel, 2021; Rosseel, 2012) and ranged between 0.68 and 0.82, indicating acceptable to good reliability.

HEXACO personality traits as predictors (Model 4). As to going out, both RMSE and  $R^2$  indicated that Model 5, which included facets instead of traits, showed the best fit. In no case, item-level analyses predicted behaviors better than traits or facets.

### 3.3. Model coefficients

Table 2 reports regularized coefficients of Model 4, predicting hygiene and distancing, respectively. Results revealed that gender, age, and education predicted hygiene. Being woman, older, and less educated were uniquely associated with reporting more frequent hygienic practices. Focused hygiene was also more common for those who reported more correct information regarding COVID-19, those who were more concerned about it, and those reporting higher financial impact due to the pandemic. Goal classes had additional unique effects: Motives to be safe were related to increased hygiene, whereas the opposite was true for goals to be free. As to personality traits, extraversion, conscientiousness, and to a lower extent, honesty-humility and openness were positively associated with the reported frequency of hygienic practices.

The pattern for distancing was similar, with some specificities. Among demographic variables, only education was related to self-reported distancing behaviors. Unlike hygiene, results suggest that safety distancing was higher for higher levels of education. Again, COVID knowledge and concern were positively linked to self-reported social distancing. Goal classes also predicted distancing in sensible directions, safety goals being positively related to it, and freedom goals being negatively related. Among personality traits, only honesty-humility and conscientiousness were positively associated with self-reported distancing behaviors.

Results of the best-performing model predicting going out (Model 5) are presented in Table 3. As shown, going out more often was related to being male and older. Concern and resource impact were associated with a tendency to go out less, whereas goals predicted going out in expected and opposite directions. Among personality facets, the strongest unique effect emerged for fairness (in the honesty-humility domain), associated with reduced going out. Smaller but similar effects emerged for modesty (H), fearfulness (E), perfectionism and prudence (C), as well as creativity (O). On the opposite side, few facets were associated with increased reports of going out behaviors. It was the case of dependence (E), followed by liveliness and sociability (X), and organization (C).

**Table 2**  
Regularized and standardized regression coefficients for Model 4 (best-performing model, trait-level predictors).

IV/DV	Hygiene	Distancing
Gender	-0.014	-
Age	0.118	-
Education	-0.051	0.046
Knowledge	0.107	0.062
Concern	0.118	0.049
Financial impact	0.010	-
Resource impact	-	-
Psych. impact	-	-
Goal: safe	0.098	0.044
Goal: free	-0.016	-0.076
Honesty-humility	0.046	0.138
Emotionality	-	-
eXtraversion	0.121	-
Agreeableness	-	-
Conscientiousness	0.115	0.086
Openness	0.041	-

Note.  $N = 577$ ; IV = Independent variables; DV = Dependent variables; Gender: 0 = females, 1 = males. Coefficients shrunk to zero are not reported; analyses are performed on males and females only ( $N = 573$ ).

**Table 3**  
Regularized coefficients for Model 5 (best-performing, facet-level predictors).

IV/DV	Going out
Gender	0.009
Age	0.024
Education	-
Knowledge	-
Concern	-0.060
Financial impact	-
Resource impact	-0.022
Psych. impact	-
Goal: safe	-0.065
Goal: free	0.193
Altruism (interstitial)	-
Fairness (H)	-0.127
Greed avoidance (H)	-
Modesty (H)	-0.019
Sincerity (H)	-
Anxiety (E)	-
Dependence (E)	0.071
Fearfulness (E)	-0.050
Sentimentality (E)	-
Expressiveness (X)	-
Liveliness (X)	0.015
Social boldness (X)	-
Sociability (X)	0.002
Flexibility (A)	-
Forgiveness (A)	-
Gentleness (A)	-
Patience (A)	-
Diligence (C)	-
Organization (C)	0.005
Perfectionism (C)	-0.001
Prudence (C)	-0.056
Aesthetic (O)	-
Creativity (O)	-0.011
Inquisitiveness (O)	-
Unconventionality (O)	-

Note.  $N = 577$ ; IV = Independent variables; DV = Dependent variables; Gender: 0 = females, 1 = males. Coefficients shrunk to zero are not reported; Analyses are performed on males and females only ( $N = 573$ ).

## 4. Discussion

We aimed at examining the performance of personality in predicting COVID-19 mitigation behaviors within a naturally occurring strong situation. The study explored which level of abstraction (traits, facets, or items) was the best in predicting three different mitigation behaviors: hygiene, distancing, and going out. Our sample perfectly exemplified the strong situation hypothesis with high mean scores for protective behaviors and low mean scores for going out.

A first general observation is that significant predictors emerged within our models, indicating room for individual differences. More specifically, models that included goals and personality features (regardless of their level of specificity) performed best in predicting behaviors. Hence, both goals and personality played an important role, even within a scenario that constrains behavioral choices and flattens individual differences. In this sense, our results are in line with more recent and nuanced descriptions of the situational strength theory (Schmitt et al., 2013). Furthermore, one could have imagined that specificity would dominate over generality: The distal influence of basic personality traits (e.g., conscientiousness) could have affected proximal specific variables (e.g., concern for COVID-19), leaving little to no additional variance explained in behaviors. On the contrary, personality traits clearly provided additional direct information on COVID-19 mitigation, confirming the incremental utility of personality (Roberts, Kuncel, Shiner, Caspi, & Goldberg, 2007) even in a naturally occurring strong situation.

Our study suggests that trait/domain personality variables represent

an informative and parsimonious level to understand two of our behavior classes (hygiene and distancing). However, the intermediate level of HEXACO facets improved the prediction of going out. Facets can often provide important insights into blurred higher-order associations (Paunonen & Ashton, 2001; Pletzer et al., 2020). For example, trait conscientiousness was related to generally safer behaviors but organization, one of its facets, predicted going out. We can speculate about the reasons behind this fine-grained association. As a tendency to seek order and plan ahead (Lee & Ashton, 2009), organization may lead people out for various reasons, spanning from stockpiling (Garbe, Rau, & Toppe, 2020) to lower abilities to adapt to a changing reality (e.g., a form of rigidity). As to extraversion, our study suggests that risky going-out behaviors were driven by its components of energy (i.e., liveliness, sociability), rather than self-confidence. Finally, facets of dependence and fearfulness in the emotionality domain had opposite associations with going out, suggesting that only dependent individuals may have been seeking support from friends and relatives during the lockdown.

Two more findings are noteworthy. Honesty-humility had meaningful effects on all behavioral classes, both at the trait- and facet-level, whereas agreeableness was mostly unrelated to them. In general, honesty-humility refers to the prosocial tendency to refrain from exploitation (Ashton et al., 2004; Ashton & Lee, 2007), a “pro-active” prosocial tendency. By contrast, HEXACO agreeableness captures the tendency to tolerate and be patient (Ashton et al., 2004; Ashton & Lee, 2007; Ashton, Lee, & de Vries, 2014). Unlike previous meta-analytic findings including Big Five measures (Zettler et al., 2021), our study suggests that this dimension of pro-sociality is much less relevant in COVID-19 mitigation, with the HEXACO model offering more accurate discrimination between different prosocial tendencies (Ashton & Lee, 2020).

This study, as any other, has some additional limitations. First, self-report responses may be biased when health-related risky behaviors are assessed (e.g., Schroder, Carey, & Vanable, 2003). Moreover, albeit our sample size was larger than the typical sample sizes in the field (Fraley & Vazire, 2014), estimating complex models (e.g., involving single items) might need even larger samples (Möttus et al., 2020).

The epidemiological parameters and the social context have now changed relative to when the study was carried out, with new relevant behaviors gaining importance for the mitigation of the pandemic (e.g., undergoing vaccination). Yet, some of the old behavioral indications are still valuable (e.g., washing hands), and most of them could be important again in the near future (Fan, Jamison, & Summers, 2018). Hence, a cautious generalization of our results to a more general understanding of norm-adhesion in pandemics may also be a starting point to derive practical implications from our findings. When looking at previous research, studies demonstrated the importance of personalizing persuasive messages. For instance, personality traits are associated with increased positive ratings of an advertisement only if the advertisement emphasizes aspects coherent with the personality trait itself (Hirsh, Kang, & Bodenhausen, 2012; Matz, Kosinski, Nave, & Stillwell, 2017). Albeit our study did not address persuasion directly, our results can nonetheless inform future research on this topic. For example, our results suggest the importance of considering trait honesty-humility, which has been often neglected in past research (Ashton & Lee, 2020). Take the example of fairness, the honesty-humility facet that was found to inhibit going out. A way to capitalize on this finding could be emphasizing fairness-related implications of mitigation behaviors in persuasion attempts. For example, this could be implemented by showing that doing what is necessary to slow down the pandemic leads to equal opportunities for everyone (e.g., health-related opportunities for more fragile individuals; economic-related opportunities for those who would suffer the most in case of restrictions; etc.). Facets such as sociability or dependence predicted risky behaviors: Acknowledgment of social and relational needs, along with invitations to be responsible in managing those personal needs, could ensure congruence between public messages and extraversion- or emotionality-related content that

tends to be associated with risky behaviors, thus buffering their harmful impact. Future targeted intervention studies may test these more specific hypotheses, overcoming the limits of our cross-sectional design and shedding more light on the causal processes underlying the connections that we have identified (Costantini & Perugini, 2018; Stieger et al., 2020).

## 5. Conclusions

Our study offers clear indications that personality traits allow predicting COVID-19 mitigation behaviors, over and above demographic variables and specific variables related to COVID-19. The evolution of the COVID-19 pandemic provides a natural laboratory to study interactions between persons, situations, and behaviors. Being characterized by clear and consistent extra-individual circumstances that posed constraints to behavior with important consequences for transgressors, the lockdown offered an uncommon example of a strong situation occurring on a global-scale (Meyer et al., 2020). Even if unable to manipulate the strength of the situation (Cooper & Withey, 2009), our study capitalized on this naturally-occurring event with incomparable ecological validity. Honesty-humility and its facets showed the clearest links with each of three relevant mitigation behaviors, thus corroborating the importance of considering this trait as part of the personality system (Ashton & Lee, 2020).

## Preregistration

The study is based on a preregistered protocol (available at <https://aspredicted.org/43rr6.pdf>).

## CRediT authorship contribution statement

GC: Conceptualization, Formal analysis, Data curation, Writing - review & editing; MDS: Conceptualization, Writing - original draft, Writing - review & editing; EP, JR: Conceptualization, Writing - review & editing; MP: Conceptualization, Writing - review & editing, Supervision. MDS and GC equally contributed to the work.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.actpsy.2022.103529>.

## References

- Ashton, M. C., & Lee, K. (2007). Empirical, theoretical, and practical advantages of the HEXACO model of personality structure. *Personality and Social Psychology Review, 11* (2), 150–166. <https://doi.org/10.1177/1088868306294907>
- Ashton, M. C., & Lee, K. (2009). The HEXACO-60: A short measure of the major dimensions of personality. *Journal of Personality Assessment, 91*(4), 340–345. <https://doi.org/10.1080/00223890902935878>
- Ashton, M. C., & Lee, K. (2020). Objections to the HEXACO model of personality structure—And why those objections fail. *European Journal of Personality, 34*(4), 492–510. <https://doi.org/10.1002/per.2242>
- Ashton, M. C., Lee, K., & de Vries, R. E. (2014). The HEXACO Honesty-Humility, Agreeableness, and Emotionality Factors: A review of research and theory. *Personality and Social Psychology Review, 18*(2), 139–152. <https://doi.org/10.1177/1088868314523838>
- Ashton, M. C., Lee, K., Perugini, M., Szarota, P., de Vries, R. E., Di Blas, L., Boies, K., & De Raad, B. (2004). A six-factor structure of personality-descriptive adjectives: Solutions from psycholinguistic studies in seven languages. In , Vol. 86. *Journal of Personality and Social Psychology* (pp. 356–366). American Psychological Association. <https://doi.org/10.1037/0022-3514.86.2.356>. Issue 2.

- Barari, S., Caria, S., Davola, A., Ivchenko, A., Jachimowicz, J., King, G., Kraft-todd, G., Ledda, A., & MacLennan, M. (2020). Evaluating COVID-19 public health messaging in Italy: Self-reported compliance and growing mental health concerns. <https://j.mp/39btyT2>.
- Blagov, P. S. (2020). Adaptive and dark personality traits in the COVID-19 pandemic: Predicting health-behavior endorsement and the appeal of public-health messages. *Social Psychological and Personality Science*. <https://doi.org/10.31234/osf.io/chgkn>
- Brouard, S., Vasilopoulos, P., & Becher, M. (2020). Sociodemographic and psychological correlates of compliance with the COVID-19 public health measures in France. *Canadian Journal of Political Science*. <https://doi.org/10.1017/S0008423920000335>
- Carvalho, L. d. F., Pianowski, G., & Gonçalves, A. P. (2020). Personality differences and COVID-19: are extroversion and conscientiousness personality traits associated with engagement with containment measures? *Trends in Psychiatry and Psychotherapy*, 1–6. <https://doi.org/10.1590/2237-6089-2020-0029>, 00(0).
- Clark, C., Davila, A., Regis, M., & Kraus, S. (2020). Predictors of COVID-19 voluntary compliance behaviors: An international investigation. *Global Transitions*, 2, 76–82. <https://doi.org/10.1016/j.glt.2020.06.003>
- Conway, L. G., Woodard, S. R., & Zubrod, A. (2020). *Social psychological measurements of COVID-19: Coronavirus perceived threat, government response, impacts, and experiences questionnaires*. <https://doi.org/10.31234/osf.io/z2x9a>
- Cooper, W. H., & Withey, M. J. (2009). The strong situation hypothesis. *Personality and Social Psychology Review*, 13(1), 62–72. <https://doi.org/10.1177/1088868308329378>
- Costantini, G., & Perugini, M. (2016). The network of conscientiousness. *Journal of Research in Personality*, 65, 68–88. <https://doi.org/10.1016/j.jrp.2016.10.003>
- Costantini, G., & Perugini, M. (2018). A framework for testing causality in personality research. *European Journal of Personality*, 32(3), 254–268. <https://doi.org/10.1002/per.2150>
- Costantini, G., Di Sarno, M., Preti, E., Richetin, J., & Perugini, M. (2021). Would You Rather Be Safe or Free? Motivational and Behavioral Aspects in COVID-19 Mitigation. *Frontiers in Psychology*, 12, Article 635406. <https://doi.org/10.3389/fpsyg.2021.635406>
- Fan, V. Y., Jamison, D. T., & Summers, L. H. (2018). Pandemic risk: How large are the expected losses? *Bulletin of the World Health Organization*, 96(2), 129–134. <https://doi.org/10.2471/BLT.17.199588>
- Flora, D. B. (2020). Your coefficient alpha is probably wrong, but which coefficient omega is right? A tutorial on using R to obtain better reliability estimates. *Advances in Methods and Practices in Psychological Science*, 3(4), 484–501. <https://doi.org/10.1177/2515245920951747>
- Fraley, R. C., & Vazire, S. (2014). The N-pact factor: Evaluating the quality of empirical journals with respect to sample size and statistical power. *PLOS ONE*, 9(10), Article e109019. <https://doi.org/10.1371/journal.pone.0109019>
- Garbe, L., Rau, R., & Toppe, T. (2020). Influence of perceived threat of COVID-19 and HEXACO personality traits on toilet paper stockpiling. *PLoS ONE*, 15(6), 1–12. <https://doi.org/10.1371/journal.pone.0234232>
- Harper, C. A., Satchell, L. P., Fido, D., & Litzman, R. D. (2020). Functional fear predicts public health compliance in the COVID-19 pandemic. *International Journal of Mental Health and Addiction*. <https://doi.org/10.1007/s11469-020-00281-5>
- Hirsh, J. B., Kang, S. K., & Bodenhausen, G. V. (2012). Personalized persuasion: Tailoring persuasive appeals to recipients' personality traits. *Psychological Science*, 23(6), 578–581. <https://doi.org/10.1177/0956797611436349>
- Hodson, G., Book, A., Visser, B. A., Volk, A. A., Ashton, M. C., & Lee, K. (2018). Is the Dark Triad common factor distinct from low Honesty-Humility? *Journal of Research in Personality*, 73, 123–129. <https://doi.org/10.1016/j.jrp.2017.11.012>
- James, G., Witten, D., Hastie, T., & Tibshirani, R. (2013). *An introduction to statistical learning*. New York: Springer. <https://doi.org/10.1007/978-1-4614-7138-7>
- Jorgensen, T. D., Pornprasertmanit, S., Schoemann, A., & Rosseel, Y. (2021). *semTools: useful tools for structural equation modeling. R package version 0.5-4*.
- Lee, K., & Ashton, M. C. (2004). Psychometric properties of the HEXACO personality inventory. *Multivariate Behavioral Research*, 39(2), 329–358. [https://doi.org/10.1207/s15327906mbr3902\\_8](https://doi.org/10.1207/s15327906mbr3902_8)
- Lee, K., & Ashton, M. C. (2009). The HEXACO personality inventory - Revised. <https://hexaco.org/scaledescriptions>.
- Matz, S. C., Kosinski, M., Nave, G., & Stillwell, D. J. (2017). Psychological targeting as an effective approach to digital mass persuasion. *Proceedings of the National Academy of Sciences*, 114(48), 201710966. <https://doi.org/10.1073/pnas.1710966114>
- Meade, A. W., & Craig, S. B. (2012). Identifying careless responses in survey data. *Psychological Methods*. <https://doi.org/10.1037/a0028085>
- Meyer, R. D., Kelly, E. D., Bowling, N. A., Meyer, R. D., Kelly, E. D., & Bowling, N. A. (2020). Situational strength theory. In , 78–95. *The Oxford handbook of psychological situations*. <https://doi.org/10.1093/oxfordhb/9780190263348.013.7>
- Möttus, R., Kandler, C., Bleidorn, W., Riemann, R., & McCrae, R. R. (2017). Personality traits below facets: The consensual validity, longitudinal stability, heritability, and utility of personality nuances. *Journal of Personality and Social Psychology*, 112(3), 474–490. <https://doi.org/10.1037/pspp0000100>
- Möttus, R., Wood, D., Condon, D. M., Back, M. D., Baumert, A., Costantini, G., Epskamp, S., Greiff, S., Johnson, W., Lukaszewski, A., Murray, A., Revelle, W., Wright, A. G. C., Yarkoni, T., Ziegler, M., & Zimmermann, J. (2020). Descriptive, predictive and explanatory personality research: Different goals, different approaches, but a shared need to move beyond the big few traits. *European Journal of Personality*. <https://doi.org/10.31234/osf.io/hvk5p>
- Paunonen, S. V., & Ashton, M. C. (2001). Big Five factors and facets and the prediction of behavior. In , Vol. 81. *Journal of Personality and Social Psychology* (pp. 524–539). American Psychological Association. <https://doi.org/10.1037/0022-3514.81.3.524>. Issue 3.
- Pletzer, J. L., Oostrom, J. K., Bentvelzen, M., & de Vries, R. E. (2020). Comparing domain- and facet-level relations of the HEXACO personality model with workplace deviance: A meta-analysis. *Personality and Individual Differences*, 152, Article 109539. <https://doi.org/10.1016/j.paid.2019.109539>
- Preti, E., Di Mattei, V., Perego, G., Ferrari, F., Mazzetti, M., Taranto, P., ... Calati, R. (2020). The psychological impact of epidemic and pandemic outbreaks on healthcare workers: Rapid review of the evidence. *Current Psychiatry Reports*, 22(8), Article 43. <https://doi.org/10.1007/s11920-020-01166-z>
- Preti, E., Di Pietro, R., Fantì, E., Madeddu, F., & Calati, R. (2020). Personality disorders in time of pandemic. *Current Psychiatry Reports*, 22(12), 80. <https://doi.org/10.1007/s11920-020-01204-w>
- Roberts, B. W., Kuncel, N. R., Shiner, R., Caspi, A., & Goldberg, L. R. (2007). The power of personality: The comparative validity of personality traits, socioeconomic status, and cognitive ability for predicting important life outcomes. *Perspectives on Psychological Science*, 2(4), 313–345. <https://doi.org/10.1111/j.1745-6916.2007.00047.x>
- Rosseel, Y. (2012). lavaan: An R package for structural equation modeling. *Journal of Statistical Software*, 48(2), 1–36. <http://www.jstatsoft.org/v48/i02/> <http://www.jst.atsf.org/v48/i02/>.
- Schmitt, M., Gollwitzer, M., Baumert, A., Blum, G., Gschwendner, T., Hofmann, W., & Rothmund, T. (2013). Proposal of a Nonlinear Interaction of Person and Situation (NIPS) model. *Frontiers in Psychology*, 4(AUG), 1–9. <https://doi.org/10.3389/fpsyg.2013.00499>
- Schroder, K. E. E., Carey, M. P., & Vanable, P. A. (2003). Methodological challenges in research on sexual risk behavior: II. Accuracy of self-reports. *Annals of Behavioral Medicine*, 26(2), 104–123. [https://doi.org/10.1207/S15324796ABM2602\\_03](https://doi.org/10.1207/S15324796ABM2602_03)
- Stieger, M., Wepfer, S., Rieger, D., Kowatsch, T., Roberts, B. W., & Allemand, M. (2020). Becoming more conscientious or more open to experience? Effects of a two-week smartphone-based intervention for personality change. *European Journal of Personality*, 34(3), 345–366. <https://doi.org/10.1002/per.2267>
- Van Bavel, J. J., Baicker, K., Boggio, P. S., Capraro, V., Cichocka, A., Cikara, M., Crockett, M. J., Crum, A. J., Douglas, K. M., Druckman, J. N., Drury, J., Dube, O., Ellemers, N., Finkel, E. J., Fowler, J. H., Gelfand, M., Han, S., Haslam, S. A., Jetten, J. Willer, R., ... (2020). Using social and behavioural science to support COVID-19 pandemic response. *Nature Human Behaviour*, 4(5), 460–471. <https://doi.org/10.1038/s41562-020-0884-z>
- Viviani, M., Crocamo, C., Mazzola, M., Bartoli, F., Carrà, G., & Pasi, G. (2021). Assessing vulnerability to psychological distress during the COVID-19 pandemic through the analysis of microblogging content. *Future Generation Computer Systems*, 125, 446–459. <https://doi.org/10.1016/j.future.2021.06.044>
- Yarkoni, T., & Westfall, J. (2017). Choosing prediction over explanation in psychology: Lessons from machine learning. *Perspectives on Psychological Science*, 12(6), 1100–1122. <https://doi.org/10.1177/1745691617693393>
- Zettler, I., Schild, C., Lilleholt, L., & Böhm, R. (2020). *Individual differences in accepting personal restrictions to fight the COVID-19 pandemic: Results from a Danish adult sample*. <https://doi.org/10.31234/osf.io/pkm2a>
- Zettler, I., Schild, C., Lilleholt, L., Kroencke, L., Utesch, T., Moshagen, M., Böhm, R., Back, M., & Geukes, K. (2021). The role of personality in COVID-19-related perceptions, evaluations, and behaviors: Findings across five samples, nine traits, and 17 criteria. *Social Psychological and Personality Science*. <https://doi.org/10.1177/19485506211001680>