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Psychological precursors of individual differences in COVID-19 lockdown adherence: Moderated-moderation by personality and moral cognition measures

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ABSTRACT
The COVID-19 pandemic forced the worldwide introduction of containment measures. This emergency scenario produced a conflict between personal freedom and public health, highlighting differences in individual behaviours influenced by psychological traits and moral considerations. In this context, a detailed characterisation of the psychological variables predicting adherence to containment measures is crucial to enhance public awareness and compliance.

During the first virus outbreak in Italy, we assessed whether adherence to government measures was explained by the interacting effects of personality traits and moral dispositions. Through an online questionnaire, we collected data on individual endogenous variables related to personality traits, locus of control, and moral dispositions, alongside the tendency to breach the lockdown for outdoor physical activity. The results showed that individual measures of novelty-seeking, harm-avoidance and authority concerns interacted in driving the adherence to the national lockdown: MFQ-Authority moderated the facilitatory effect of novelty-seeking on lockdown violation, but this moderation was itself moderated by higher TCI-harm-avoidance. By assessing a model forecasting the likelihood of violating restrictive norms, these findings show the potential of personality and moral foundation assessments in informing prevention policies and emergency interventions by political and scientific institutions.

1. Introduction
The COVID-19 pandemic forced the sudden introduction of measures limiting freedom of movement and social interactions (Chaudhry, Dranitsaris, Mubashir, Bartoszko, & Riazi, 2020), raising a heated debate concerning the conflict between individual rights and collective well-being. This emergency therefore represented a “natural experiment” for behavioural scientists, allowing both to investigate the attitudes and choices of single individuals facing their possible consequences, and to assess the effectiveness of strategies aimed to favour socially-oriented adaptive behaviours (Bavel et al., 2020).

A pandemic scenario, with its global health implications, is indeed expected to enhance the role of different variables in shaping people’s willingness to make collective well-being prevail over personal interests (Shi, Qi, Ding, Liu, & Shen, 2020; Zaki, 2020). The individual endogenous variables shaping behavioural intentions, and thus possibly modulating behavioural responses to emergency situations (e.g. compliance with containment measures; Miguel, Machado, Pianowski, & Carvalho, 2021), include relatively stable dimensions such as personality traits (Cloninger, Przybeck, Svrakic, & Wetzel, 1994; Zajenkowski, Jonason, Leniarska, & Kozakiewicz, 2020), the perceived degree of control over events (Locus of control; Craig, Franklin, & Andrews, 1984) and moral dispositions (Theory of Moral Foundations; Haidt, 2008; Qian & Yahara, 2020). Identifying the psychological precursors of choices involving conflicts between utilitarian vs. prosocial consideration is not only relevant for behavioural research (to unveil the drivers of individual differences in decision-making attitudes), but it might also inform targeted public health interventions and communication strategies aiming at increasing awareness and compliance in the population (Bavel et al., 2020).

To this purpose, we used conditional process analysis on the outcome of well-established psychometric scales to explore the variables
modulating behavioural intentions during the lockdown in Italy. We
decided to focus on the intended behaviour of leaving home to perform
outdoor individual physical activity; this behaviour was, in fact, exem-
plary of a situation in which participants had a certain degree of control,
as it was neither strictly necessary (e.g. purchasing essential goods) nor
externally mandated (e.g. going to work). Data were collected through
an online questionnaire detecting demographic information and indi-
vidual endogenous variables related to personality traits, locus of con-
trol, and moral dispositions, alongside the tendency to respect vs. violate
the lockdown. We focused on the psychological dimensions that, based
on the available literature, seemed more likely to influence people's
behavioural intentions during the lockdown. One such dimension is
novelty-seeking, which is known to reflect a marked tendency to cheerful
and euphoric states, promoting exploration, avoidance of routine and
monotony, and low resistance in case of persistent frustrations (Mardaga
& Hansen, 2007). It was indeed shown that novelty-seeking contrib-
uted to shaping attitudes in multiple ways during COVID-19 home
quarantine (Liang et al., 2020), i.e. by promoting the need for high levels
of stimulation to avoid boredom, impulsive decision-making, and
dysfunctional coping strategies (Bettelheim et al., 2021), while concur-
tently helping to manage difficulties and preserve mental health (Li, Yu,
Miller, Yang, & Rouen, 2020). Based on this evidence, we expected
novelty-seeking to be a predictor of a higher disposition to leave home
for outdoor physical activity despite possible negative consequences.
Furthermore, we anticipated that this effect might be mediated by the
perceived degree of control over events (i.e. locus of control). We
additionally hypothesized that the effect of novelty-seeking on intended
lockdown violation might be moderated by fearful attitudes towards
countagion and disease consequences (i.e. harm-avoidance personality
trait; Cloninger, 1993; Mardaga & Hansen, 2007) as well as by moral
dispositions towards compliance with rules (i.e. respect for authority;
O’Grady, Vandegrift, Wolek, & Burr, 2019; Qian & Yahara, 2020).
Importantly, the limitation to individual outdoor physical activity was
strongly debated in Italy (Camporesi, 2020) because of its unclear link
with other restrictions (e.g. social distancing and use of face masks,
predicted by caring and fairness in Chan, 2021), but still largely met by
the population and strictly enforced by competent authorities. Among
the moral foundations (Haidt, 2008), we thus predicted a role for au-
thority, which encompassed adherence to rules and the refusal to break
them to avoid being sanctioned. Based on the nature of both harm-
avoidance and respect for authority, we anticipated interactive effects
of these moderating variables, which were assessed through a
moderated-moderation model (Hayes, 2017) after checking for their
contribution to the dependent variable.

2. Materials and methods

Further details are reported in Supplementary materials.

2.1. Participants

465 participants completed the survey during the first full national
lockdown in Italy. Eleven subjects were excluded either because they
reported a previous COVID-19 contamination (n = 10) or because they
were identified as outliers based on Mahalanobis distance (n = 1). The final
sample included 318 females and 136 males, aged 18–82 years old
(Supplementary Table 1).

2.2. Study design

Data were collected online with LimeSurvey (https://www.lime
survey.org/en/). Participants were recruited through online advertise-
ments on social networks (Twitter, Facebook, LinkedIn), and word of
mouth. Participants were required to be aged >18, and native or pro-
cient Italian speakers. The experimental protocol was approved by the
local Ethics Committee of the University of Pavia (Italy) prior to the
beginning of data collection. When entering the survey, participants
were provided the general aims of the survey and related procedures
(data anonymisation, analyses, future use and sharing), and asked to
give their informed consent to the procedure.

2.3. Baseline predictors of compliance with the lockdown

2.3.1. Socio-demographic data and COVID-19-related attitudes and
behaviours

The first part of the survey collected data regarding age, gender,
education level and contact with COVID-19 cases. Then, via a slider with
hidden numerical values, participants reported the likelihood of leaving
home, in the following week, for the purpose of outdoor physical
activity.

2.3.2. Locus of control

Participants were administered the Italian translation (Farma &
Cortinovis, 2001) of Craig et al.’s (1984) scale, consisting of two sub-
 scales for internal vs. external Locus of control. The difference between
the two subscales was used as a synthetic measure of internal (vs.
external) Locus of control.

2.3.3. Moral cognition

We assessed the personal sensitivity to different facets of moral
cognition with the Italian translation (Bobbio, Nencini, & Sarrica, 2011)
of the Moral Foundation Questionnaire (MFQ; Graham, Haidt, & Nosek,
2008), a self-report measure assessing individual priorities among five
domains: harm/care (protecting vulnerable individuals from harm),
fairness/reciprocity (concern about fairness and social justice), ingroup/
loyalty (concern for self-sacrifice for the group), authority/respect
(concern for obedience, leadership, and protection), and purity/sanctity
(concern for purity and protection from contamination).

2.3.4. Personality

We assessed different facets of personality using the Italian trans-
lation (Fossati et al., 2007) of the reduced Temperament and Character
Inventory (TCI-56; Adan, Serra-Grabulosa, Caci, & Natale, 2009). In
particular, we focused on TCI’s four temperament dimensions: harm-
avoidance, novelty-seeking, reward-dependence, and persistence,
reflecting behavioural inhibition/punishment, behavioural activation/
reward, social reinforcement/sensitivity to social stimuli, and the ten-
dency to maintain behaviour in extinction conditions, respectively
(Adan et al., 2009).

2.4. Statistical analyses

Preliminary simple regression analyses confirmed that the tendency
to leave home for physical activity was positively predicted by novelty-
seeking, and negatively predicted by harm-avoidance and MFQ-
Authority (p < 0.05, one-tailed). No significant relationship was
observed with any of the locus of control measures. A multiple regres-
sion model showed that the dependent variable was not predicted by
novelty-seeking and locus of control, which led to reject a model in
which the latter variable mediates the effect of novelty-seeking. We thus
included the remaining variables in simple moderation models to assess
whether the effect of novelty-seeking on lockdown violation is moder-
ated by MFQ-authority and/or TCI-harm-avoidance. Since only the
former variable was a significant moderator (3.2), we assessed a
moderated-moderation model in which the moderation, by MFQ-
authority, of the effect of novelty-seeking on lockdown violation is it-
self moderated by TCI-harm-avoidance. Age, educational level and
COVID-19 cases among acquaintances were modelled as nuisance vari-
able. We used the PROCESS macro (v.3.5) for SPSS (IBM, v.23), after
checking assumptions concerning multicollinearity, linearity of the
relationship between dependent and independent variables, indepen-
dence of residuals, and homoscedasticity. Conditional process analysis
was run based on Ordinary Least Squares regression, using bootstrapping resampling (50,000 samples) to estimate 95% confidence intervals. The statistical threshold was set at \( p < 0.05 \) (two-tailed).

The internal consistency and structure of the TCI-temperament subscale and MFQ were assessed with Cronbach’s alpha and an exploratory factorial analysis with oblique rotation, respectively. Factor extraction was guided by a minimum eigenvalue of 0.7 (Jolliffe, 1972) and scree plot examination. In addition to theoretical considerations concerning the items’ conceptual meaning, we assessed the latent structure by setting a threshold of factor loading \( \geq 0.40 \).

3. Results

3.1. Socio-demographic and personality variables

The socio-demographic and psychological characteristics of the sample are reported in Supplementary Table 1.

3.2. Moderated-moderation

The facilitatory effect of TCI-novelty-seeking on leaving home for physical activity was significantly moderated by MFQ-Authority (\( F(1,447) = 7.405, p = 0.007 \)), but not by TCI-harm-avoidance (\( F(1,447) = 1.838, p = 0.175 \)). We thus assessed a moderated-moderation model in which the moderation, by MFQ-authority, of the effect of novelty-seeking on lockdown violation is itself moderated by TCI-harm-avoidance. A significant model (\( F(10,443) = 4.424, p < 0.00001 \)), explaining about 9% of the variance of the dependent variable, showed that higher novelty-seeking predicted a larger tendency to violate the lockdown for physical activity (\( p = 0.042 \), Fig. 1). Even though MFQ-Authority and harm-avoidance were not significantly related to the dependent variable, the three-way interaction among these three variables was significant (\( F(1,443) = 13.746, p = 0.0002 \)) (Fig. 1, Table 1). Namely, we observed a significant two-way interaction between novelty-seeking and MFQ-Authority (\( p = 0.039 \)), which, however, depends on harm-avoidance. This interaction was indeed significant at low (-1 SD; \( p < 0.00001 \)) and medium (\( p = 0.039 \)) harm-avoidance, when higher MFQ-Authority moderates, by inhibiting it, the positive relationship between novelty-seeking and the tendency to violate the lockdown. Instead, no significant interaction between novelty-seeking and MFQ-Authority was found at higher harm-avoidance levels (+1 SD; \( p = 0.341 \)).

3.3. Internal consistency

We observed adequate reliability and internal structure for both the temperament subscale of TCI-56 and MFQ (Supplementary results). An exploratory factorial analysis confirmed that the structure of TCI-temperament and MFQ was explained by 4 and 5 factors, respectively, with minimum eigenvalue = 0.86. For all the variables modelled in statistical analyses, the resulting factors generally confirmed the item-dimension association as in the original scales.

4. Discussion

The COVID-19 pandemic has dramatically revealed the effects of individual actions on virus spread, and therefore their impact on collective well-being (Brooks et al., 2020). In this context, public awareness and compliance with containment measures might be greatly enhanced by a detailed characterisation of the psychological variables predicting the adherence to lockdown. We pursued this goal by assessing the extent to which participants’ adherence to restrictive norms was explained by the interacting effects of moral dispositions and personality traits such as novelty-seeking and harm-avoidance. We selected these variables in light of their mutual relationship and previous findings that behavioural adaptations to emergency situations reflect cautious attitude, but also other-regarding moral dispositions (O’Grady et al., 2019). Supporting this view, the interaction among these variables predicted individual differences in the tendency to violate lockdown measures.

A few recent studies assessed the impact of psychometric

Fig. 1. The conceptual model shown in the top-right figure sector depicts the moderated-moderation (three-way interaction) pattern displayed in the other panels, with respect for authority inhibiting the facilitatory effect of novelty-seeking on leaving home for exercise, but only at low and medium levels of harm-avoidance.
demographic measures on the compliance with the rules in different countries during the pandemic, particularly during the first lockdown (Clark, Davila, Regis, & Kraus, 2020; Koostira & Rooij, 2020). According to research using personality scales, particularly the Big Five Inventory (BFI, McCrae & Costa, 1987; McCrae & John, 1992), compliance with the restrictions was directly related to neuroticism and inversely related to extraversion. This result appeared to be cross-cultural and irrespective of specific governmental restrictions (Götz et al., 2021). Other studies showed that extraverted individuals might be more reluctant to comply with social distancing (Han, 2021), and high extraversion negatively predicted both social distancing and reduced mobility (Chan et al., 2020; Krupić, Zaro, & Krupić, 2021). High levels of neuroticism, instead, were associated with fear of developing diseases and avoidance of germs (Duncan, Schaller, & Park, 2009), and with the avoidance of settings that may lead to infection (Oosterhoff, Shook, & Iyer, 2018), thus resulting in increased compliance with COVID-19 restrictions (Kohút, Kohútová, & Halama, 2021). In the present study we additionally considered the moral foundation of authority, based on the notion that neuroticism leads to a more sensitive reaction to punishment and threat cues (Blüml et al., 2013). Importantly, both extraversion and neuroticism are positively correlated with the TCI traits included in our model, i.e. novelty-seeking and harm-avoidance respectively (De Fruyt, Van De Wiele, & Van Heeringen, 2000), strengthening the hypothesis that some BFI factors and TCI traits overlap.

As to the trade-off between individual and collective well-being, we expected that oppositely directed personality traits as novelty-seeking and harm-avoidance might predict individual differences in this direction (Mardaga & Hansenne, 2007). In line with this hypothesis, novelty-seeking was a significant predictor of the intention to leave home for physical activity. When strict lockdown measures are in place, and thus sources of external stimulation and social contacts are limited, outdoor sport activities might emerge as the main outlet to seek novel sensations and overcome impending boredom (Liäng et al., 2020; McCourt, Gurerra, & Cutter, 1993). The effect of novelty-seeking was moderated by the individual sensitivity to authority, which overall decreased its facilitating effect on breaking the confinement for outdoor sports. Even though it does not predict spontaneous prosocial behaviour (O’Grady & Vandegrift, 2019), the legitimacy of authority is an inherent precursor of compliance with rules, particularly with weak motives for acting differently. Importantly, however, such a moderating effect was itself moderated by harm-avoidance, likely reflecting the fear of contagion and its consequences regardless of one’s own sensitivity to authority. This temperament trait, characterised by excessive caution, apprehension, and pessimism (De Fruyt et al., 2000), is indeed typically associated with higher unconscious emotional responses (Yoshino, Kimura, Yoshida, Takahashi, & Nomura, 2005), pain perception (Pud, Eisenberg, Sprecher, Rogowski, & Yarnitsky, 2004) and subsequent anticipatory avoidance behaviour. By showing that higher levels of respect for authority are required, for lockdown adherence, at lower levels of harm-avoidance, the present findings highlight two interacting drivers of behavioural attitudes concerning health-related choices during the pandemic. These results might thus inform public health policies (Soofi, Najafi, & Karami-Matin, 2020), and contribute to develop public interventions tailored to different target groups promoting appropriate behaviours (Bavel et al., 2020). In particular, our results highlight the importance of adapting strategies to different personalities: for instance, by developing initiatives promoting respect for authority in groups characterised by low harm-avoidance, of which extreme sports practitioners represent an exemplary case (Monasterio et al., 2016), while taking into consideration that threats and sanctions may lead to opposite effects (Houdek, Koblovský, & Vranova, 2021). Instead, for those lacking trust in authorities, such as individuals with higher psychological entitle tement (Harvey & Martinko, 2009) who tend to prioritise their own health when taking decisions (Daddis & Brunell, 2015), compliance might be enhanced by clearer and non-contradictory information on the risks for their own health in case of infection (Zitek & Schlu, 2021). Considering the age of our sample, however, it should be examined whether these recommendations would also apply to more vulnerable age groups.

Despite promising results, we also acknowledge that online studies have some inherent limitations compared to laboratory settings. First, this approach required simplified procedures for assessing participants’ attitudes and intentions, possibly resulting in decreased data quality and smaller effect sizes. We addressed this issue by performing a formal inspection of consistency/reliability of the data resulting from psychometric scales. From an applied standpoint, however, it is worth noting that even relatively small effects can have major implications in the occurrence of global scale events (Götz et al., 2021). Second, online surveys typically involve inhomogeneous samples that, by favouring young adults over elderly, cannot be considered representative of the whole population. However, while elderly participants are those at the highest risk for severe health consequences, young adults constitute a highly informative sample: while being a likely vehicle of under-traced virus spread due to their higher work and social commitments (Dowd et al., 2020), they might also represent the ideal target for disseminating and incentivising correct health behaviours, such as the use of masks, specifically because of their central social role (Bavel et al., 2020) and proximity to parents and older relatives.

5. Conclusions

We highlighted a multifaceted set of psychological variables predicting compliance with the lockdown during the first virus outbreak in Italy. Personality traits, such as novelty-seeking and harm-avoidance,
and the authority moral foundation, were shown to play interacting roles in the adherence to containment measures. By assessing a model whose aim was to forecast the likelihood of violating restrictive norms, whose aim was to forecast the likelihood of violating restrictive norms, the present findings provide novel insights that might extend beyond the current pandemic context. From a broader perspective, these results show how personality and moral foundation assessments can inform prevention policies and emergency interventions by political and scientific institutions.

CRediT authorship contribution statement

Sara Lo Presti: Conceptualization, Data curation, Writing – original draft, Writing – review & editing. Giulia Mattaveilli: Conceptualization, Formal analysis, Writing – original draft, Writing – review & editing. Nicola Canessa: Conceptualization, Formal analysis, Writing – original draft, Writing – review & editing. Claudia Gianelli: Conceptualization, Formal analysis, Writing – original draft, Writing – review & editing.

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Appendix A. Supplementary data
Supplementary data to this article can be found online at https://doi.org/10.1016/j.paid.2021.110909.

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