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Personality correlates of COVID-19 infection proclivity: Extraversion kills[☆]

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ABSTRACT

The current research sought to shed light on the behavioral science that underlies the spread of SARS-CoV-2. We tested the *extraversion hypothesis*, which suggests that the sociability facet of extraversion may predispose people to becoming infected with the coronavirus via greater human-to-human contact. Since extraverts seek out social opportunities and seem less likely to follow containment measures related to social distancing, we hypothesized that people who have previously become infected would exhibit greater extraversion than would those who have not contracted the virus. We measured overall extraversion and three of its facets—sociability, assertiveness, and energy levels—as well as political orientation. We collected data from 217 adults, aged 40 and older, from the US and the UK, of whom 53 had had the virus at some point prior to the study, and 164 had not. Participants who had had COVID-19 were more dispositionally sociable and were also more conservative-leaning compared to participants who had never had COVID-19. Implications regarding the behavioral science underlying the current pandemic are discussed.

1. Introduction

At the time of writing this paper, COVID-19 has killed more than a million people across the world and has infected more than 80 million, with the numbers still growing (WHO, 2020). Scientists from a broad range of fields, including biochemistry (Aloisio et al., 2020), genetics (Carter-Timothe et al., 2020; Jacob, 2020), and immunology (Brüssow, 2020) have been working to better understand this virus, largely with an eye towards stopping it in its tracks via the development of effective vaccines. Because every human is a possible SARS-CoV-2 carrier, and because humans are social animals, understanding the behavioral science behind the virus is essential in stopping its propagation. To date, some important advances regarding the behavioral science of COVID-19 have been made. For instance, we now know that the spread of SARS-CoV-2 within a population is in large part due to “superspreader events”, where infected individuals contribute to an outsized number of cases (Frieden & Lee, 2020; Wong & Collins, 2020). We also know that social and physical distancing significantly decrease the spread (Thu et al., 2020).

While several recent studies have assessed the influence of personality traits on COVID-19-related measures (Han et al., 2021; Makhanova & Shepherd, 2020; Zajenkowski et al., 2020), the current research

focuses on group differences in extraversion between individuals who have contracted COVID-19 at some point versus individuals who have not. Because superspreader events are social gatherings, and extraverted people tend to be relatively outgoing and sociable, to the point Zajenkowski et al. (2020) found extraversion to be positively related to situational perceptions of social opportunities even during the pandemic, extraverts would be more likely to contribute to superspreader events and less likely to comply with social distancing and quarantine measures. Indeed, studies have found a negative association between extraversion and both overall and physical distance-related COVID-19 compliance measures (Han, 2021; Nofal et al., 2020).

Carvalho et al. (2020) assessed the association between extraversion—specifically the maladaptive variants of need for attention and intimacy avoidance—and engagement with COVID-19 containment measures in a sample of Brazilian adults. They, too, found that higher scores on extraversion were associated with lower scores on thinking that social distancing is an important measure. Interestingly, extraversion did not influence engagement with hand washing, suggesting that extraverts are not refusing to abide by containment measures across the board, but just the ones that prohibit sociability. These findings highlight the difficulty in reducing sociability and social proximity in extraverted people, as well as the importance of studying specific facets of

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extraversion, since the maladaptive variants underscored the tendency for extraverts to circumvent social distancing.

1.1. Extraversion as a ubiquitous predictor variable

Extraversion and its subdimensions or facets have emerged as robust and reliable constructs since the inception of early models of personality (e.g., Cattell, 1943; Costa & McCrae, 1985; Eysenck & Wilson, 1991). While earlier scales have several facets for all Big Five traits (e.g., the revised NEO personality inventory has six subdimensions for extraversion; Costa & McCrae, 1985), new models, such as the more contemporary Big Five Inventory-2 (BFI-2; Soto & John, 2017a), seek to enhance predictive power while decreasing the number of facets in the interest of parsimony. In the case of extraversion, this new model identifies three facets—sociability, assertiveness, and energy level—that closely align with extraversion facets proposed in previous research. Sociability is defined as the desire to approach and engage with others; assertiveness is the willingness to communicate thoughts and ideas in social situations; and energy level relates to experiencing positive affect and aroused states like enthusiasm and excitement.

Research has found extraversion to be a significant predictor of a wide range of outcomes, such as the formation of intimate relationships (Jain & Singh, 2019), the likelihood of divorce (Sayehmiri et al., 2010), salary in one's career (Sutin et al., 2009), and even one's lifespan (Turiano et al., 2015). Several of these life outcomes (e.g., romantic satisfaction, peer status and peers' acceptance, occupational commitment, and financial security, etc.) are replicated when implementing the BFI-2 (Soto, 2019), suggesting that past literature on extraversion and the Big Five is reasonably accurate.

Regarding the specific BFI-2 extraversion facets, evidence points to different facets having unique and stronger relationships with certain outcomes. For example, life satisfaction, health, and well-being are mostly driven specifically by energy level (Margolis et al., 2020; Rammstedt, Danner, et al., 2018). The gradient between education and extraversion over the life cycle is accounted for by assertiveness and energy level, but less so by sociability (Gensowski et al., 2021). Meanwhile, the negative associations between extraversion, and fluid and crystallized intelligence are uniquely driven by sociability and energy level, respectively (Rammstedt, Lechner, & Danner, 2018). Assertiveness drives the positive relationship between extraversion and ambiguity tolerance (Jach & Smillie, 2019), while health risk-taking is predicted more strongly by sociability compared to the other two facets (Joseph & Zhang, 2021). These findings suggest that studies should not only focus on overall Big Five constructs, but also examine if any specific facets drive certain relationships.

Given the positive association between extraversion and risk-taking (see Nettle, 2006), Joseph and Zhang (2021) finding sociability to be a stronger predictor of health risk-taking, Carvalho et al. (2020) suggesting extraverts refuse to abide by containment measures related to social interactions, and the social nature of extraversion manifesting in an increased perception of sociality opportunities even in times of a pandemic (Zajenkowski et al., 2020), we believe sociability, more so than assertiveness and energy level, to be particularly important in the risk of COVID-19 infection, perhaps through a mediated effect of relatively reckless behavior.

1.2. Exploratory dispositional variables that may also relate to COVID-19 infection

We were also interested in the potential relationship between political ideology and COVID-19 infection. Makhanova and Shepherd (2020) found trait pathogen avoidance predicted greater compliance with social distancing measures and with taking the threat of COVID-19 more seriously, and pathogen avoidance has been shown to consistently be positively related to *social conservatism* (see Terrizzi et al., 2013). As such, one could expect conservatives to be more cautious, and, thus, less

likely to contract COVID-19.

Interestingly, Makhanova and Shepherd (2020) also found greater political conservatism to be associated with higher germ avoidance but lower perceived infectability. Perhaps because the pandemic has become highly politicized (Pennycook et al., 2020), some research has found that American *conservatives* are actually less likely to be concerned about COVID-19 and to practice social distancing (Rothgerber et al., 2020). Additionally, Gollwitzer et al. (2020) found that political partisanship at county-wide levels in the U.S. strongly predicted adherence to physical distancing, which was subsequently related to COVID-19 infection rates in pro-Trump counties. While, according to Pennycook et al. (2020), the pandemic has not been as heavily politicized in the UK as it has been in the U.S., conservatism in both countries still correlated with greater COVID-19 misperceptions, and trust in liberal news outlets in both countries was associated with fewer misperceptions and higher COVID-19 risk perceptions, which one could argue would lead liberals to be more cautious of catching the virus. As such, any relationship between political ideology and COVID-19 infection could go in either direction.

2. Methods

2.1. Participants

Participants were recruited via a Psychology Today blog post and snowball sampling. We also emailed COVID-19 online support groups requesting they shared the survey on their newsletters and webpages. To be eligible, participants had to currently live in either the United States or the United Kingdom, be over 40 years of age, and provide consent after reading a Participant Information Sheet with details about the study. The age criterion was chosen because younger adults are more likely to be asymptomatic (Kronbichler et al., 2020), and allowing them to participate could increase error by virtue of potentially asymptomatic individuals categorizing themselves as never having had COVID-19.

Four hundred thirty participants began the survey, of which 172 were excluded for either not providing their age or being younger than 40. Seventeen were excluded for not providing any data for the extraversion and political orientation items. Twenty-four additional participants were also discarded due to their response to the COVID-19 status question, which we explain in closer detail in the Measures section. Our final sample consisted of 217 adults (160 women, 56 men, and 1 non-binary individual, $M_{age} = 52.66$, $SD_{age} = 9.00$), of which 184 were from the United States.

2.2. Measures

2.2.1. COVID-19 status

Participants were asked if they had ever been confirmed to have had COVID-19, either through a formal viral or antibody test. We gave a third option for participants who felt neither a *yes* or *no* statement accurately described them and asked them to elaborate on their response. A total of 164 participants reported never having had COVID-19 to their knowledge; 53 reported having had a positive diagnosis at some point either through a viral or antibody test; and 24 selected the third option. Of those, 10 mentioned being clinically diagnosed by doctors based on symptoms when viral testing was not readily available. While we initially considered those 10 individuals as part of the positive group, Struyf et al. (2020) shows that diagnoses based on symptoms are not accurate enough to either rule in or rule out the disease. As a result, all 24 participants who selected the third option were excluded.

2.2.2. Big Five Inventory-2 Short Form (BFI-2-S)

We used the Big Five Inventory-2 Short Form (BFI-2-S; Soto & John, 2017a), which divides extraversion into 3 facets: sociability, energy level, and assertiveness. Both the BFI-2 and the BFI-2-S have been shown to possess good validity (Soto & John, 2017a, 2017b), even amongst Dutch (Denissen et al., 2020; Vedel et al., 2020), German (Rammstedt,

Danner et al., 2018), Slovak (Halama et al., 2020; Kohút, Halama, et al., 2020; Kohút, Kohútová, et al., 2020), and Russian samples (Shchebtenko et al., 2020). While Soto and John (2017a, 2017b) caution against the use of the shortened BFI-2 versions on smaller samples, Rammstedt et al. (2020) found that these perform sufficiently well in terms of their psychometric properties and their representation of the Big Five nomological network. Further, we found good internal reliability for all three extraversion facets (α range = 0.71–0.75) and for the overall construct ($\alpha = 0.74$). Note that participants completed the full BFI-2-S, but we kept our analyses to only the 6 items pertaining extraversion.

2.2.3. Political ideology

For exploratory analyses on political ideology, we asked participants to rate how they would describe their political orientation with regards to social issues and to economic issues. Both items were on a 7-point Likert scale, with 1 being “very liberal” and 7 “very conservative.” Participants from the U.S. were also asked to rate which party they agreed with more often, with 1 being “much more with Democrats” and 7 being “much more with Republicans.”

3. Results

While we initially intended to run analyses separately for each nation, we were not able to recruit enough participants, particularly ones who had had COVID-19. As such, we ran several preliminary *t*-tests comparing both countries in terms of age, extraversion and its facets, and political attitudes. We found no significant country differences in these constructs. Thus, to increase power, both samples were combined for analyses going forward.

3.1. COVID-19 and extraversion

We ran four one-tailed independent groups *t*-tests with a Bonferroni adjusted alpha level of 0.012 (0.05/4) and ran post-hoc power analyses with G*Power (Faul et al., 2007; Frieden & Lee, 2020). We found no significant differences between the COVID-19 positive ($M = 4.56$, $SD = 0.89$) and negative ($M = 4.37$, $SD = 1.04$) groups in overall extraversion, $t(214) = 1.22$, $p = .110$, $d = 0.20$, 95% CI [-0.11, 0.51], Power = 0.35. Sociability scores for the positive group ($M = 4.79$, $SD = 1.40$) were marginally greater than were scores for the negative group ($M = 4.29$, $SD = 1.42$), $t(214) = 2.23$, $p = .013$, $d = 0.35$, 95% CI [0.06, 0.94], Power = 0.72. There were no significant differences in assertiveness ($M_{positive} = 4.46$, $SD = 1.24$; $M_{negative} = 4.52$, $SD = 1.33$), $t(214) = -0.27$, $p = .393$, $d = 0.04$, 95% CI [-0.46, 0.35], Power = 0.08, or in energy level ($M_{positive} = 4.45$, $SD = 1.52$; $M_{negative} = 4.29$, $SD = 1.37$), $t(214) = 0.727$, $p = .234$, $d = 0.11$, 95% CI [-0.28, 0.60], Power = 0.17.

We then conducted a post hoc hierarchical regression to better focus on the relationship between COVID-19 status and sociability while accounting for the other facets of extraversion and for country of origin, which allowed us to observe the relationship of our variables within a single analysis in order to address issues of Type-I error and collinearity. In step 1, we entered country of origin as a control variable. In step 2, assertiveness and energy level were entered into the step 1 equation. Finally, in step 3, we entered COVID-19 status. All variance inflation factors were less than 0.20 and all collinearity tolerance values were greater than 0.90, suggesting that the estimated β s in our model were well-established.

The results of step 1 indicated that country of origin did not contribute to the regression model, $F(1, 214) = 0.01$, $p = .92$. In step 2, the addition of assertiveness and energy level resulted in a significant change, $\Delta R^2 = 0.18$, $F(2, 212) = 23.25$, $p < .001$. Finally, adding COVID-19 status in step 3 resulted in an additional significant change, $\Delta R^2 = 0.02$, $F(1, 211) = 5.20$, $p = .02$. Together, all variables accounted for 20% of the variability in sociability. Table 1 provides a summary of the regression statistics.

Table 1

Hierarchical regression showing unstandardized (*B*) and standardized (β) regression weights for country, extraversion facets, and COVID-19 status, and change in R^2 at each step.

Variable	<i>B</i>	β	<i>t</i>	ΔR^2
Step 1				0.00
Country	-0.03	-0.01	-0.10	
Step 2				0.18***
Country	-0.08	-0.02	-0.30	
Assertiveness	0.27	0.25	3.98***	
Energy level	0.29	0.29	4.46	
Step 3				0.02*
Country	0.01	0.002	0.04	
Assertiveness	0.28	0.26	4.10***	
Energy level	0.28	0.28	4.35***	
COVID-19 status	0.47	0.14	2.28*	

* $p < .05$.

*** $p < .001$.

3.2. COVID-19 and political ideology

To explore any differences in political ideology between the COVID-19 positive and negative groups, we ran three two-tailed independent samples *t*-tests. Participants in the COVID-19 positive group described themselves as more socio-politically conservative-leaning ($M = 3.27$, $SD = 1.47$) than did participants in the COVID-19 negative group ($M = 2.61$, $SD = 1.58$), $t(200) = 2.51$, $p = .013$, $d = 0.43$, 95% CI [0.14, 1.18], Power = 0.72. Similarly, when it came to economic issues, participants in the COVID-19 positive group also described themselves as more conservative-leaning ($M = 3.84$, $SD = 1.60$) compared to participants in the negative group ($M = 3.20$, $SD = 1.73$), $t(200) = 2.23$, $p = .027$, $d = 0.38$, 95% CI [0.07, 1.21], Power = 0.62. Finally American participants in the COVID-19 positive group tended to agree more with the Republican Party ($M = 3.33$, $SD = 2.06$) than did participants in the negative group ($M = 2.55$, $SD = 1.87$), $t(171) = 2.12$, $p = .035$, $d = 0.40$, 95% CI [0.06, 1.51], Power = 0.53. Whereas *p*-value adjustments can be considered impractical and debatable for exploratory analyses (Sainani, 2009), it should be noted that a Bonferroni correction would set the new alpha criterion at 0.017 (0.05/3), in which case, only differences in socio-political ideology reach significance.

Given that the negative and positive COVID-19 groups differed in both sociability and political ideology, we were interested in seeing if all constructs were inter-related, particularly with regards to sociability and political ideology. We ran two-tailed point-biserial correlations and found significant relationships between COVID-19 status and socio-political ideology ($r_{pb} = 0.18$, $n = 202$, $p = .01$), COVID-19 status and economic ideology ($r_{pb} = 0.17$, $n = 202$, $p = .03$), COVID-19 status and party affiliation ($r_{pb} = 0.16$, $n = 173$, $p = .04$), and COVID-19 status and sociability ($r_{pb} = 0.15$, $n = 216$, $p = .03$). However, Pearson correlations between sociability and socio-political ideology ($r = 0.06$, $n = 201$, $p = .42$), sociability and economic ideology ($r = 0.06$, $n = 201$, $p = .36$), and sociability and party affiliation ($r = 0.08$, $n = 172$, $p = .32$) were all non-significant. Thus, while there seems to be a relationship between contracting COVID-19, and both greater sociability and slightly more conservative political ideologies, the latter two do not seem to be inter-related.

4. Discussion

The current research sought to add to the efforts to understand the COVID-19 pandemic by exploring the behavioral science surrounding the spread of SARS-CoV-2. People who contracted COVID-19 reported marginally greater sociability scores than did people who never contracted COVID-19, whereas differences in overall extraversion, assertiveness, and energy level did not differ significantly between groups. In terms of political orientation, exploratory analyses suggest that participants who had been infected with SARS-CoV-2 leaned relatively more

conservative, especially regarding social issues, and, in the case of American participants, potentially agreed more with the Republican Party than did participants who had never been infected.

4.1. Limitations and future research

While our sample size may not have been ideal, we believe our study to be a first step into looking at personality differences between people who have become infected with COVID-19 versus those who have not, especially since past research has mostly focused on personality traits and COVID-19 related measures (e.g., perceived susceptibility and obedience of contingency measures) but not actual infections. Larger samples with more evenly distributed techniques would benefit future work. Additionally, collecting data from a broader array of nations would be useful, particularly since the American and British left-right parties may differ from the left-right parties of other nations. While Pennycook et al. (2020) explain how the U.S. right politicized the pandemic, in Mexico, for example, it was President Lopez Obrador's left government making claims about the country having tamed COVID-19 or that facemasks have practically null utility (Loret de Mola, 2021).

Future research might be wise to test specific models that can provide a broader frame for the relationship between extraversion and COVID-19, perhaps by incorporating other similarly related variables such as risk aversion and disgust sensitivity. For instance, the balancing-selection model (see Nettle, 2006) argues that traits with heritable components that show high degrees of variability might have been selected because both high and low ends of such traits might have benefits and costs from an evolutionary perspective. High extraversion may provide increased social status, but also greater fitness-related costs in the form of more risk-taking behavior. Perhaps across many generations of human life, pandemics that thrive on people interacting with others wipe out sociable extraverts disproportionately.

The directionality of the extraversion-COVID-19 relationship also merits further research. Are extraverts more likely to get infected; can the virus impact hosts' social behavior; or both? The nervous-system hijacking model (see Reiber et al., 2010; Seitz et al., 2020) suggests viruses may temporarily increase sociable activities in hosts to benefit their spread and replication. Given organisms like toxoplasma gondii can alter our behavior (da Silva & Langoni, 2009), and that SARS-CoV-2 shows up in neural tissue (Mao et al., 2020) and in spinal fluid (Wu et al., 2020) in severe cases—suggesting the virus is making contact with the nervous system in some way—the possibility of viruses affecting human host behavior should not go unresearched.

4.2. Conclusion

Because the SARS-CoV-2 spreads via human-to-human contact, the pandemic is largely an issue of human social behavior. We documented two important personality-based variables that potentially significantly relate to the spread of the virus: the sociability facet of extraversion and self-identified conservative tendencies. We hope that these findings can help inform policy and processes moving forward as we work together as a global community to stop this pandemic in its tracks and get back to life as we knew it.

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CRediT authorship contribution statement

Vania Rolón: Investigation, Formal analysis, Writing – original draft, Writing – review & editing. **Glenn Geher:** Conceptualization, Writing – original draft, Supervision, Project administration. **Jennifer Link:** Methodology, Writing – original draft, Writing – review & editing.

Alexander Mackiel: Investigation, Writing – original draft, Writing – review & editing.

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Declarations of interest

None.

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