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ORIGINAL ARTICLE

Direct and Interactive Effects of Personality and Experiencing Changes in Relationships on Symptoms of Internalizing Psychopathology During the COVID-19 Pandemic

Christina S. Galiano[1] · Alexandra M. Andrea[1] · Timothy A. Brown[1] · Anthony J. Rosellini[1]

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Abstract

Purpose The present study examined the prospective direct and interactive effects of personality (neuroticism, extraversion) and experiencing changes in friendships during the pandemic on symptoms of stress, anxiety, and depression.

Methods A sample of patients ($N=77$) at an outpatient treatment clinic who had received a diagnostic assessment in the 6 months prior to the COVID-19 lockdown was re-contacted during the pandemic (May–June 2020) and completed a survey assessing stressors and symptoms of internalizing psychopathology.

Results Neuroticism had main effects on anxiety, whereas experiencing changes in friendships had main effects on stress and depression. Extraversion did not have main effects on stress, depression, or anxiety. The relationship between experiencing changes in friendships and stress and anxiety was moderated by extraversion, such that the strength of the relationship between changes in friendships and stress and anxiety waned as the level of extraversion increased. Neuroticism was not a moderator of the association between changes in friendships and emotional disorder symptoms.

Conclusion These results suggest that higher levels of extraversion may protect against symptoms of stress reactivity and anxiety that are associated with COVID-related changes in friendships, while neuroticism may have limited prospective associations with symptoms during the pandemic.

Keywords COVID-19 pandemic · Personality · Depression · Anxiety · Stress

Introduction

The spread of the ongoing coronavirus disease (COVID-19) was declared a pandemic by the World Health Organization in March of 2020 and resulted in lockdowns across the United States. The pandemic has been an unparalleled stressor that has impacted the mental health of the general public and led to fear and panic. This was particularly true in the early stages of the pandemic when there was a lack of consensus about the methods of transmission of the COVID-19 virus, how to prevent the spread of the disease, and widespread uncertainty about how long the pandemic would last (Gao et al., 2020; Xiong et al., 2020). As a result of the COVID-19 pandemic, there have been unprecedented levels of social isolation, increases in unemployment, economic recession, and other broad disruptions in daily life (Kroencke et al., 2020; Thakur & Jain, 2020), all of which have harmful effects on mental health (Razai et al., 2020, Shrivastava et al., 2019; Thakur & Jain, 2020).

Internalizing Psychopathology During the Pandemic

The literature on the prevalence and correlates of internalizing psychopathology during the pandemic is rapidly growing (Daly & Robinson, 2021; Robinson et al., 2022; Shokrkon & Nicoladis, 2021; Wei, 2020). For instance, in a representative sample of US adults, Daly and Robinson

✉ Christina S. Galiano
cgaliano@bu.edu

Alexandra M. Andrea
aandrea@bu.edu

Timothy A. Brown
tabrown@bu.edu

Anthony J. Rosellini
ajrosell@bu.edu

[1] Center for Anxiety and Related Disorders, Department of Psychological and Brain Sciences, Boston University, 900 Commonwealth Ave., 2nd Floor, Boston, MA 02215, USA

(2021) found that levels of anxiety greatly increased during the initial stages of the COVID-19 pandemic and reduced after stay-at-home orders concluded, though levels of anxiety remained higher than pre-COVID-19 pandemic (baseline) levels. A recent meta-analysis showed similar results of increases in anxiety and depression that were largest early in the pandemic (e.g., March to April of 2020) and declined over time (Robinson et al., 2022).

Although pandemic-related stress has detrimental effects on mental health, not all individuals are equally affected. In one of the few studies to have a pre-pandemic assessment of mental health, Ettman et al. (2020) found that those who had lower income, less financial savings, and experienced more stressors during the pandemic were at highest risk of worsening symptoms of depression (i.e., relative to pre-pandemic levels). It is also documented that individuals with pre-existing diagnosed mental illnesses may be more vulnerable to increases in psychological distress during the pandemic (Vigo et al., 2020). Several recent studies examined the impact of the pandemic on individuals with emotional disorders (Asmundson et al., 2020; Plunkett et al., 2021), with results showing modest increases in anxiety and mood symptoms compared to before the pandemic (Plunkett et al., 2021). In contrast, however, a meta-analysis by Robinson et al. (2022) found that increases in symptoms of psychological disorders in individuals with pre-existing mental health conditions decreased to pre-pandemic levels by mid-2020. Overall, there is evidence that individual differences contribute to the vulnerability of internalizing psychopathology during the pandemic.

Changes in Socialization and Internalizing Psychopathology

The degree to which an individual has experienced changes in socialization is one factor that may impact how susceptible someone with a pre-existing mental health diagnosis is to experiencing greater severity of symptoms. Most individuals who followed social distancing recommendations experienced interruptions in their typical social connectedness, including changes in the frequency and quality of their interactions with friends and loved ones (Saltzman et al., 2020). There is evidence that social isolation and loneliness have deleterious effects on mental and physical health (Leigh-Hunt et al., 2017; Saltzman et al., 2020). For example, a study during the early portion of the COVID-19 lockdown found that loneliness was occurring at significantly higher rates than pre-pandemic levels and was associated with greater symptoms of depression and suicidal ideation (Killgore et al., 2020).

Although research has been completed on specific stressors and social changes due to COVID-19, a number of studies have assumed that changes in social relationships have occurred in the samples used. For example, participants have reported on mental health symptoms due to "COVID-19 related circumstantial changes" (Wei, 2020). Other studies have more directly assessed changes in social relationships using self-report measures of emotional and instrumental social support, friendships, and loneliness (Philpot et al., 2021), and perceptions of the pandemic's effect on social relationships (Naser et al., 2021). Overall, studies imply that the COVID-19 pandemic has negatively affected social relationships (Naser et al., 2021) and led to increases in loneliness (Bu et al., 2020; Dahlberg, 2021; Killgore et al., 2020; Lee et al., 2020; Philpot et al., 2021) and decreases in experiencing friendships (Philpot et al., 2021). It is crucial to examine how changes in socialization have impacted individuals with pre-existing psychological diagnoses, as there is evidence that this population is more negatively affected by loneliness during the COVID-19 pandemic (Hoffart et al., 2020).

Personality and Internalizing Psychopathology

There is extensive evidence that two personality traits, extraversion and neuroticism, are strongly linked to mental health and psychopathology (Klinger- König et al., 2018; Kotov et al., 2010; Lahey, 2009). Neuroticism, which is defined as the broad trait-like tendency to experience negative affect, is associated with virtually all forms of psychopathology, but has particularly strong associations with internalizing disorders (Brandes &Tackett, 2019; Sauer-Zavala & Barlow, 2021). Neuroticism is also linked to reduced mental and physical health and lower subjective well-being (Kotov et al., 2010; Kroencke et al., 2020) and predicts quality and longevity of life (Lahey, 2009). Individuals high in neuroticism have stronger negative reactions to stressful live events than those who are low in neuroticism (Hisler et al., 2020; Kroencke et al., 2020; Suls & Martin, 2005). In contrast, extraversion, which is defined as a trait-like tendency towards positive emotions, sociability, and high activity levels (Liu et al., 2021), is inversely related to depression and social dysfunction (Watson et al., 2019). Thus, extraversion may be a protective factor, particularly for depression, anhedonia, and social and interpersonal difficulties (Watson et al., 2019) and is associated with assertiveness and more adaptive problem-oriented coping (Mirnics et al., 2013).

It has been suggested that during challenging and novel situations that are marked with uncertainty (e.g., changes in socialization/relationships), individual differences in personality influence behavior and experiences more than during ordinary life circumstances (Caspi & Moffitt, 1993; Kroencke et al., 2020). Accordingly, several recent studies have explored the association between personality traits, such as neuroticism, and negative affective responses during the COVID-19 pandemic. Research indicates that individuals

with higher levels of neuroticism experience greater negative affect and lower subjective well-being during the pandemic, and a greater preoccupation with the pandemic (Kroencke et al., 2020; Modersitzki et al., 2021). Similarly, another study found that neuroticism was strongly associated with a psychological response to the pandemic characterized by high worry and emotionality about the pandemic (Stadler et al., 2020). Moreover, increased levels of neuroticism have been associated with greater perceived threat of the pandemic, which was predictive of greater stress levels (Liu et al., 2021). Liu and colleagues also found that highly extraverted individuals had higher levels of perceived stress during the pandemic and suggest that changes in socialization may be particularly relevant for the mental health of individuals with high extraversion. This is in line with work suggesting that the relationship between extraversion and well-being is mediated by being socially connected and engaging in social activities, which has been more difficult for individuals to do during the pandemic (Buecker et al., 2020; Gubler et al., 2021; Lee et al., 2008; Liu et al., 2021).

The existing literature on the role of personality in psychological responses to the COVID-19 pandemic suggests that highly neurotic individuals are at elevated risk of experiencing psychological distress during the pandemic (Kroencke et al., 2020; Liu et al., 2021; Modersitzki et al., 2021; Stadler et al., 2020). However, some recent work suggests that highly extraverted individuals may also be vulnerable to experiencing increased distress due to the lack of social connection during the pandemic (Liu et al., 2021; Proto & Zhang, 2021). Overall, studies have yet to test how personality interacts with changes in socialization (e.g., due to social distancing) to contribute to symptoms of internalizing disorders (e.g., depression, anxiety). Given prior work on the associations between neuroticism, extraversion, and internalizing disorders, it is possible that the impact of changes in socialization on mental health symptoms would be more pronounced among individuals with high neuroticism (i.e., more reactive to stress) and high introversion (i.e., more difficulty socializing in new or alternate ways during social distancing).

Further, the current knowledge on the role of personality in experiencing distress during the COVID-19 pandemic remains limited in two important ways. First, many existing studies of personality variables in the COVID-19 pandemic have relied on convenience samples (e.g., college students, subjects recruited through social media) as opposed to patient samples who are at particularly high risk for emotional distress during the pandemic (Kroencke et al., 2020; Liu et al., 2021; Modersitzki et al., 2021; Nikčević et al., 2021; Stadler et al., 2020). Second, many studies are limited by the use of cross-sectional designs that do not include pre-COVID-19 measures of personality or symptoms. In other words, it is unclear how personality is associated with *changes* in internalizing psychopathology during the pandemic (e.g., relative to pre-pandemic symptoms). Additionally, there are potential limitations in assessing personality within a single survey/interview during the pandemic, as both situational factors and acute mood states can impact the assessment of personality traits (e.g., mood-state distortion, Brown, 2007; Clark et al., 2003).

Current Study

The aim of the present study was to determine the prospective direct and interactive effects of experiencing changes in relationships and personality (neuroticism and extraversion) on symptoms of anxiety, stress, and depression during the pandemic in a clinical sample. We hypothesized that (a) neuroticism, extraversion, and experiencing changes in friendships due to the COVID-19 pandemic would predict symptoms of anxiety, stress and depression during COVID-19, and (b) the deleterious effects of changes in friendship on symptoms of stress, anxiety, and depression would be stronger as a function of increasing levels of neuroticism and introversion.

Material and Methods

Participants

Participants ($N = 77$) were recruited from a larger study at the Center for Anxiety and Related Disorders (CARD) at Boston University (BU) aimed at better understanding the nature and course of emotional disorders among outpatients. Participants in the larger study who had completed an intake or follow-up diagnostic assessment in the 6 months prior to the start of the COVID-19 lockdown in Massachusetts (from September 10, 2019 to March 10, 2020) were re-contacted in June of 2020 to complete a survey assessing stressors and symptoms of anxiety and depression during the pandemic. Twelve participants were treated at CARD between the beginning of the COVID pandemic and the follow-up survey. Forty-two participants received treatment at CARD between their most recent assessment (i.e., an intake or follow-up assessment since September of 2019) and the time of the survey. Inclusion criteria for the larger study included being over 18 years of age, having a current diagnosis of an anxiety, and/or mood disorder. Exclusion criteria included the presence of significant cognitive impairment (e.g., dementia), suicidal ideation requiring crisis intervention, or current psychotic symptoms.

Procedures

The protocol for the present study was approved by the Institutional Review Board of BU, and all participants provided written informed consent. For the larger study, participants completed a diagnostic assessment in-person (for baseline/pretreatment assessments) or over the telephone (for follow-up assessments at 12 or 24 months) with a graduate student or doctoral-level clinician. These assessments included the Anxiety and Related Disorders Interview Schedule for *DSM-5* (ADIS-5; Brown & Barlow, 2014) and several self-report questionnaires (those used in the current study are detailed below). The ADIS-5 is a semi-structured interview designed to ascertain reliable diagnoses of *DSM-5* anxiety, mood, somatoform, obsessive–compulsive, trauma, and substance use disorders, and to screen for the presence of other conditions (e.g., eating and psychotic disorders).

The survey administered during the pandemic assessed pandemic-related stressors, symptoms of depression and anxiety, and other reactions surrounding the COVID-19 pandemic. Data collection began in May 2020. Potential participants were contacted via email (up to two times) and telephone (up to one time) over a two-week eligibility period and received a description of the present study. Interested individuals were sent (via email) a secure link to complete the questionnaire on their personal device using the Qualtrics software system for questionnaire administration. The survey took 10 to 15 min to complete. Of the 189 eligible participants who were contacted to complete the survey, there were 77 respondents. Those who completed the survey were entered into a raffle of 10 Amazon gift cards (worth $25 each).

Measures

Changes in Friendships Due to COVID

Social life disruption was assessed by asking participants the extent to which an individual had experienced changes in friendships due to COVID-19. Specifically, respondents were asked, "how much has COVID-19 caused changes in the following areas of your life (e.g., changes to weekly activities or nature of relationships due to social distancing or non-essential business closure?)" including "friendships" as one of several areas. Participants rated their response on a 5-point Likert-like scale with 1 indicating "no change/difference" and 5 indicating "significant change/difference."

Personality

Neuroticism and extraversion were assessed as part of the larger study prior to the COVID-19 pandemic using 12-item subscales of the NEO Five-Factor Inventory, a measure of the five-factor model of personality (NFFI; Costa & McCrae, 1992). Items consist of statements that participants rate on a 5-point Likert-like scale, with a score of 1 indicating that they "strongly disagree" and a score of 5 indicating that they "strongly agree" with the statement. The resulting domain scores (e.g., neuroticism [NFFI-N], extraversion [NFFI-E]) possess adequate reliability (Costa & McRae, 1992; Brown & Rosellini, 2011) and temporal stability (rs = 0.86 to 0.90; Robins et al., 2001), and have support for their latent structures in clinical samples (Brown & Rosellini, 2011).

Depression Anxiety Stress Scales-21

The depression anxiety stress scales (DASS-21; Lovibond & Lovibond, 1995) was used to assess symptoms of depression (e.g., sadness, loss of interest and pleasure in usual activities), general tension/non-specific distress (e.g., agitation, irritability, and impatience), and anxiety (e.g., physiological arousal) both prior to the COVID-19 pandemic (i.e., during the participant's baseline or follow up assessment for the larger study) and during the COVID-19 lockdown (i.e., as part of the survey administered during COVID). All three DASS-21 subscales (Depression, Stress, Anxiety) are comprised of 7 items. A four-point Likert-like frequency/severity scale is used to report the extent to which participants experienced symptoms in the last week (i.e., 0 = "did not apply to me at all" to 3 = "applied to me very much of the time"; Lovibond & Lovibond, 1995). The DASS-21 has high internal consistency (alphas = 0.96, 0.89, 0.93 for Depression, Anxiety, and Stress, respectively), favorable temporal stability (*r*s = 0.71 to 0.81) and has support for its three-factor latent structure in clinical samples (Brown et al., 1997).

Results

Descriptive Statistics

The sample was 70.9% female, as shown in Table 1. The most common current *DSM-5* diagnoses (collapsing across principal and additional diagnoses) were generalized anxiety disorder (43%), followed by social anxiety (31%) and unipolar depressive disorders (24%; major depressive disorder = 13.9%, persistent depressive disorder = 10.1%) (Table 1). All variables were examined for skewness and kurtosis and values were acceptable (all values < 3.0). The presence of outliers was evaluated via Mahalanobis distance measures, and no outliers were found. Analyses were conducted in R (R Development Core Team, 2020), using the *interactions* package (Long, 2019). The means, standard deviations, ranges, and Pearson correlations for predictors, covariates, and outcome variables are reported in Table 2. Changes in friendships was significantly correlated with

Table 1 Demographic characteristics of sample

	n	%
Gender		
Female	56	70.9
Male	21	26.6
Race		
White/Caucasian	57	72.2
Black/African American	7	8.9
East Asian	8	10.1
South Asian	3	3.8
Middle Eastern/North African	1	1.3
More than one race	1	1.3
Other	2	2.5
Current *DSM-5* diagnosis		
Generalized anxiety disorder	34	43
Social anxiety disorder	25	31
Obsessive compulsive disorder	14	17.7
Major depressive disorder	11	13.9
Persistent depressive disorder	8	10.1
Panic disorder	6	7.6
Specific phobia	5	6.3
Post-traumatic stress disorder	4	5.1
Agoraphobia	3	3.8
Somatic symptom disorder	3	3.8
Illness anxiety disorder	2	2.5

post-COVID DASS Stress and Depression (rs = 0.34, 0.36, ps < 0.01), but not pre-COVID symptoms. The association between changes in friendships and post-COVID anxiety was positive but nonsignificant ($r = 0.09$, $p = 0.43$). Neuroticism was significantly correlated with both pre- and post- DASS scores (i.e., for all 3 subscales: rs = 0.47 to 0.66, ps < 0.01). Extraversion was also significantly correlated with pre- and post- DASS scores (rs = − 0.40 to − 0.23, ps < 0.05), with the exception of pre-DASS anxiety ($r = -0.18$, $p = 0.12$).

As shown in Table 3, a paired samples *t*-test revealed a significant difference in DASS Anxiety before ($M = 10.91$, SD = 9.69) and during the pandemic ($M = 8.94$, SD = 8.77), with a decrease in anxiety during the pandemic, $t(76) = 2.07$, $p = 0.04$). There were no significant differences in symptoms before and during the pandemic for DASS Stress and DASS Depression. As there were initial concerns reported of dramatic increases in symptoms of anxiety and depression during the pandemic (Czeisler et al., 2020; Twenge & Joiner, 2020), we explored whether the lack of symptom change observed between the initial assessment (pre-pandemic) and the COVID survey in our study was due to participants who were treated with cognitive behavioral therapy at CARD in that timeframe. A mixed ANOVA analysis was completed with pre- and post-COVID-19 DASS scores as the within-subjects factor and treatment as the between-subjects factor. This analysis revealed that pre- and post- COVID-19 DASS scores did not significantly differ based on whether participants received treatment at CARD for DASS Anxiety, Stress and Depression, suggesting that receiving treatment did not impact symptom change during COVID-19 in our sample.

Hierarchical Regression Analyses

Hierarchical multiple regression was used to estimate the direct and interactive effects of changes in friendship, neuroticism, and extraversion on symptoms of stress, anxiety, and depression during the COVID-19 pandemic. Hierarchical regression was used to foster the interpretation of main effects (prior to including interaction terms) and to ascertain the amount of variance accounted for by the interactions

Table 2 Pearson correlations, means, SDs, range of study variables

Variable	1	2	3	4	5	6	7	8	9
1. Changes in friendships	–								
2. Neuroticism	0.01	–							
3. Extraversion	− 0.02	− 0.57**	–						
4. Post-COVID DASS anxiety	0.09	0.51**	− 0.23*	–					
5. Post-COVID DASS stress	0.34**	0.48**	− 0.26*	0.66**	–				
6. Post COVID DASS depression	0.36**	0.47**	− 0.31**	0.51**	0.61**	–			
7. Pre-COVID DASS anxiety	− 0.16	0.51**	− 0.18	0.59**	0.40**	0.26*	–		
8. Pre-COVID DASS stress	0.06	0.66**	− 0.24*	0.45**	0.59**	0.42**	0.68**	–	
9. Pre-COVID DASS depression	− 0.01	0.59**	− 0.40**	0.37**	0.38**	0.65**	0.39**	0.50**	–
Mean	3.54	27.68	24.53	8.94	16.73	13.64	10.91	16.34	12.23
Standard deviation	1.12	10.28	7.79	8.85	10.29	9.92	9.69	11.17	10.62
Range	1–5	4–48	9–44	0–40	0–42	0–40	0–36	0–40	0–38

DASS-A, DASS-S depression, anxiety, stress scales-anxiety and stress subscales, respectively

*$p < 0.05$. **$p < 0.01$

Table 3 Results of paired samples t-test and descriptive statistics for DASS scores pre- and post- COVID-19

Outcome	Pre-COVID-19		Post-COVID-19		Mean difference	95% CI for mean difference	*t* (76)	*p*
	M	SD	M	SD				
DASS anxiety	10.91	9.69	8.94	8.77	1.97	0.071, 3.88	2.07	0.042*
DASS stress	16.34	11.17	16.73	10.14	− 0.390	− 2.58,1.80	− 0.354	0.724
DASS depression	12.23	10.62	13.64	9.59	− 1.41	− 3.36, 0.53	− 1.45	0.153

DASS-A, DASS-S depression, anxiety, stress scales-anxiety and stress subscales, respectively

*$p < 0.05$

above and beyond main effects and pre-COVID symptoms (i.e., incremental validity). Variables were mean-centered to reduce multicollinearity and aid in the interpretation of interaction effects. Interaction terms were created using the product of the centered predictor and moderator variables. Separate models were estimated for each of the three DASS outcomes (DASS Stress, Depression, and Anxiety) and interaction effect of interest (3 models for the interaction of neuroticism and changes in friendships; 3 models for the interaction of extraversion and changes in friendships). Pre-COVID-19 DASS scores were included as covariates in all models. In Step 1, the main effects of personality and changes in friendships were entered. In Step 2, two-way interactions were entered to examine the moderating effects of neuroticism and extraversion on the relationship between changes in friendships and post-COVID-19 symptoms of DASS Stress, Anxiety, or Depression.

Changes in Friendships and Extraversion

Results of the hierarchical multiple regression models examining the moderating effects of extraversion on the DASS outcomes are reported in Table 4. There were main effects of changes in friendships on DASS Stress ($b = 2.57$, $t = 3.25$, $p = 0.002$) and DASS Depression ($b = 2.91$, $t = 4.27$, $p < 0.001$). The main effect of changes in friendships on DASS Anxiety was in the positive direction but non-significant ($b = 1.21$, $t = 1.66$, $p = 0.10$). Extraversion had non-significant main effects on all three DASS subscales ($bs = -0.16$ to -0.07, $ts = -1.34$ to -0.61, $ps = 0.18$ to 0.54).

Table 4 Hierarchical multiple regression results for the effects of changes in friendships and extraversion on depression, anxiety, and stress during COVID-19

Step and predictor variable	*B*	SE *B*	*t* value	*p* value	R^2	f^2
DASS-stress						
Step 1						
DASS stress	0.50	0.08	6.06	< 0.001		
Extraversion	− 0.16	0.12	− 1.34	0.18		
Changes in friendships	2.57	0.79	3.25	< 0.001	0.45	
Step 2						
Extraversion x changes in friendships	− 0.21	0.10	− 2.16	0.03	0.48	0.03
DASS-anxiety						
Step 1						
DASS anxiety	0.54	0.09	6.30	< 0.001		
Extraversion	− 0.14	0.10	− 1.33	0.19		
Changes in friendships	1.21	0.73	1.66	0.10	0.39	
Step 2						
Extraversion x changes in friendships	− 0.27	0.09	− 3.08	< 0.01	0.46	0.08
DASS-depression						
Step 1						
DASS depression	0.57	0.08	7.26	< 0.001		
Extraversion	− 0.07	0.11	−0.61	0.54		
Changes in friendships	2.91	0.68	4.27	< .001	0.54	
Step 2						
Extraversion x changes in friendships	− 0.12	0.09	− 1.3	0.20	0.55	0.01

DASS Stress, Depression, and Anxiety scales denote measures collected prior to the COVID-19 pandemic

*$p < 0.05$. **$p < 0.01$

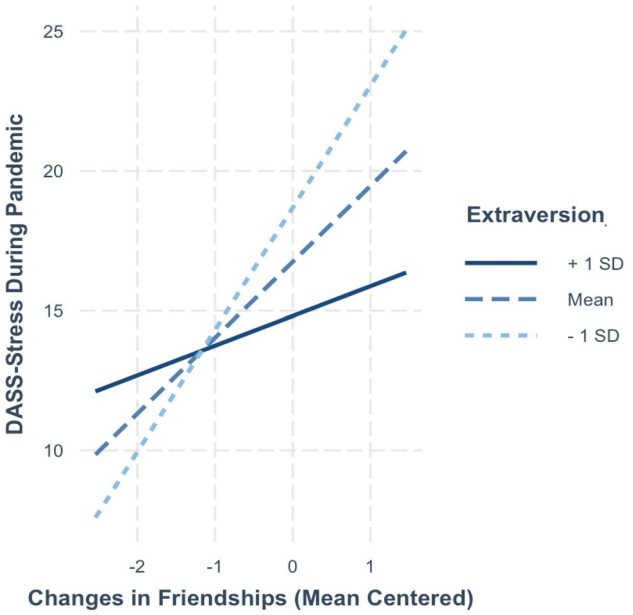

Fig. 1 Regression plot displaying interaction of changes in friendships and extraversion on post-COVID-19 DASS stress

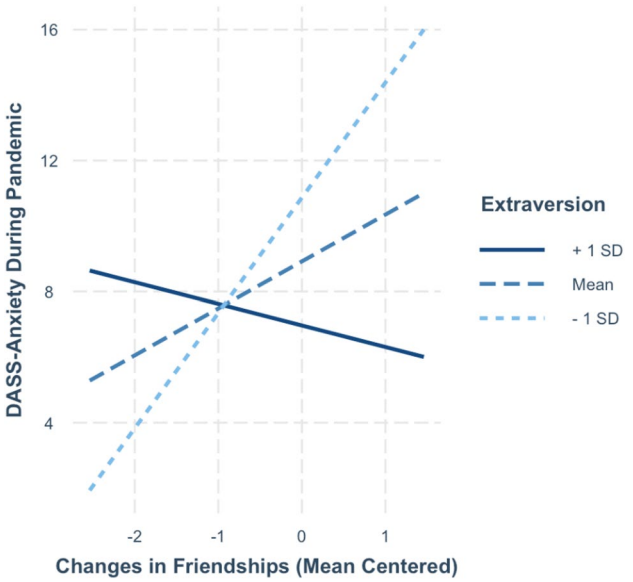

Fig. 2 Regression plot displaying interaction of changes in friendships and extraversion on post-COVID-19 DASS anxiety

In Step 2, the interaction between changes in friendship and extraversion was significant for both DASS-Stress ($b = -0.21$, $t = -2.16$, $p = 0.03$) and DASS Anxiety ($b = -0.27$, $t = -3.08$ $p = 0.003$). Conditional slopes were plotted using one standard deviation above and below the mean for the significant interaction effects. The conditional slopes are depicted in Fig. 1 for DASS Stress and Fig. 2 for DASS Anxiety. For both of these interaction terms, the strength of the direct effect of changes in friendships on DASS Stress and DASS Anxiety weakened as the level of extraversion increased. In other words, for people who were less extraverted, the strength of the effect of changes in friendships on DASS Stress and DASS Anxiety was stronger, while for those who were more extraverted, the effect of perceived changes in friendships on anxiety and stress was weaker. Overall, 48% of the variance in DASS Stress and 46% of the variance in DASS Anxiety were explained by the full regression models (Step 2). The interaction of extraversion and changes in friendships uniquely predicted 3.4% of the total variance in DASS Stress and 7.1% of the total variance in DASS Anxiety. Using Cohen (1988) guidelines, the effect sizes of the interaction terms were in the small range for DASS Stress ($f^2 = 0.03$) and the medium range for DASS Anxiety ($f^2 = 0.08$) (Table 4).

Changes in Friendships and Neuroticism

Results of the models examining the interactive effects of changes in friendships and neuroticism on the DASS outcomes are reported in Table 5. There were main effects of changes in friendships similar to those in the models examining extraversion. There was a main effect of changes in friendships on DASS Stress ($b = 2.62$, $t = 3.32$, $p < 0.001$) and DASS Depression ($b = 2.90$, $t = 4.30$, $p < 0.001$). The main effect of changes in friendships on DASS Anxiety was non-significant but in the positive direction ($b = 1.06$, $t = 1.50$, $p = 0.14$). Neuroticism had a significant main effect on DASS Anxiety ($b = 0.22$, $t = 2.47$ $p = 0.02$) but not DASS Stress or DASS Depression ($ps = 0.16$ to 0.20). Two-way interactions between neuroticism and changes in friendships were not significant in any of the models ($ps = 0.26$ to 0.80).

Discussion

Consistent with our hypotheses, we found that experiencing changes in friendships was positively associated with symptoms of stress and depression during the pandemic, and that neuroticism was positively associated with anxiety. Despite notions of the pandemic causing dramatic increases in mental health symptoms, our study showed that average DASS scores prior to and during the pandemic were not significantly different for DASS Stress and DASS Depression and there was a slight, though significant, decrease in DASS Anxiety. Our findings thus suggest that changes in friendships and neuroticism likely impacted the *persistence* of symptoms of stress and depression during the pandemic in our clinical sample, as opposed to an increase in symptoms. However, it is also important to note that experiencing changes in friendships during the pandemic may not be associated with the persistence of symptoms of stress and

Table 5 Hierarchical multiple regression results for the effects of changes in friendships and neuroticism on depression, anxiety, and stress during COVID-19

Step and predictor variable	*B*	SE *B*	*t* value	*p* value	R^2	f^2
DASS-stress						
Step 1						
DASS stress	0.42	0.11	4.00	< 0.001		
Neuroticism	0.16	0.11	1.43	0.16		
Changes in friendships	2.62	0.79	3.32	< 0.001	0.45	
Step 2						
Neuroticism x changes in friendships	− 0.02	0.076	− 0.25	0.80	0.45	
DASS-anxiety						
Step 1						
DASS anxiety	0.44	0.10	4.56	< 0.001		
Neuroticism	0.22	0.09	2.47	0.02		
Changes in friendships	1.06	0.71	1.50	0.14	0.42	
Step 2						
Neuroticism x changes in friendships	0.03	0.07	0.46	0.64	0.42	
DASS-depression						
Step 1						
DASS depression	0.52	0.09	5.9	< 0.001		
Neuroticism	0.12	0.09	1.30	0.20		
Changes in friendships	2.90	0.67	4.30	< 0.001	0.55	
Step 2						
Neuroticism x changes in friendships	− 0.07	0.06	− 1.14	0.26	0.56	

DASS Stress, Depression, and Anxiety scales denote measures collected prior to the COVID-19 pandemic
$^*p < 0.05$. $^{**}p < 0.01$

depression in a causal manner, and instead may reflect the persistence of these symptoms impacting one's perception of experiencing changes in friendships (e.g., if someone is experiencing heightened stress and depression, they may perceive less friendships and social support). In addition, the relationship may also be impacted by a confounding omitted variable (e.g., emotional state at the time of completing the survey impacting perception of changes in friendships).

The lack of significant increases in mental health symptoms during the pandemic in our sample may be due to the pre-existence of these symptoms (much like a ceiling effect), while the mental health of individuals without psychological disorders may have been more affected as they were not previously dealing with mental health symptoms and therefore had greater increases in symptoms. Along these lines, work by Kessler et al. (2022), showed that clinically significant symptoms of anxiety and depression in a non-patient adult sample in the United States increased only modestly in 2020 compared to findings from 2017 to 2019. In other words, it is possible that the pandemic did not lead to as significant overall increases in mental health symptoms for all individuals, particularly those already experiencing emotional distress.

Contrary to our hypotheses, neuroticism did not moderate the effects of the relationship between changes in friendships on the DASS outcomes. In contrast, and consistent with study hypotheses, extraversion moderated the relationship between experiencing changes in friendships and DASS Stress and Anxiety, such that the positive association between changes in friendships and DASS Stress and Anxiety weakened as extraversion increased. In other words, for people who were less extraverted, the strength of the effect of changes in friendships on DASS Stress and DASS Anxiety was stronger, while for those who were more extraverted, the effect of perceived changes in friendships on anxiety and stress was weaker.

Experiencing changes in friendships had main effects on symptoms of DASS Stress and Depression, which is consistent with work showing that elevations in social loneliness predicted symptoms of depression (Killgore et al., 2020) and was associated with psychological well-being during the pandemic (Tuason et al., 2021). Neuroticism had main effects only on DASS Anxiety during COVID-19 in our analysis, which is supported by work suggesting that neuroticism is associated with lower well-being (Gubler et al., 2021) and more affective reactivity during the COVID-19 pandemic (Kroencke et al., 2020). Though extraversion did not have significant main effects on the DASS outcomes, the direction of the effects indicate that lower extraversion is associated with higher stress, anxiety, and depression. The direction of this effect is consistent with previous literature proposing an inverse relationship between extraversion and

internalizing psychopathology (Naragon-Gainey & Simms, 2017).

The significant interaction effects in our study suggest that higher levels of extraversion may protect against persisting or increasing symptoms of stress and anxiety that are associated with COVID-related changes in friendships. These findings are in line with work by Wei (2020), which showed that low extraversion predicted higher levels of anxiety, loneliness, and depression due to life changes associated with the COVID-19 pandemic (e.g., social distancing and lockdown measures) in a sample of residents of the United States. Nevertheless, the direction of the interaction effect also could be viewed as somewhat unexpected. Given that extraverts have greater requirements for a social audience around them (DeYoung & Gray, 2009), it would have been reasonable to expect that extraverts would be more negatively affected by perceiving changes in their friendships. However, our findings are also supported by research demonstrating that extraverts are better able to cope with life-changing events (Shokrkon & Nicoladis, 2021), such as experiencing changes in friendships, and are more likely to use adaptive emotion regulation strategies (e.g., reappraisal, problem solving) when experiencing adversity (Barańczuk, 2019; Shokrkon & Nicoladis, 2021). Similarly, greater use of maladaptive cognitive emotion regulation strategies was associated with greater reported loneliness for introverted individuals compared to extraverts (Gubler et al., 2021). Although extraverts may be vulnerable to experiencing distress with changes in relationships due to greater social needs, in our clinical sample, more extraverted individuals may have been more likely to adapt to changes in socialization (e.g., in the amount of time spent in-person with friends and ways of communicating) and more motivated to seek out remote social interactions during the pandemic (e.g., use of texting, phone calls, and Zoom) than introverted individuals and as a result, experience less stress and anxiety due to changes in friendships.

Individuals who are highly extraverted also have higher quality social relationships and experiences (Harris et al., 2017). Thus, individuals in our sample who had higher scores on extraversion may have already had (and continued to seek out) more quality social experiences and social support during the pandemic than introverted individuals—even though socialization and social support may have looked different than social experiences prior to the pandemic (Shokrkon & Nicoladis, 2021). Further, given that extraversion is associated with having a greater number of social connections and greater perceived availability of social support (Shokrkon & Nicoladis, 2021; Swickert et al., 2002), experiencing changes in socialization during the pandemic may be less disruptive to highly extraverted individuals. Conversely, individuals who are more introverted may be more affected by changes in their usual patterns of socialization (e.g., by experiencing heightened stress and anxiety during the pandemic).

The results of our study also suggest that neuroticism may have limited prospective associations (both main and moderating effects) with stress and depression during a pandemic (neuroticism only had main effects on DASS-anxiety). Given the strong associations of neuroticism with mental health outcomes in general (Kotov et al., 2010), the lack of main effects found between neuroticism and DASS Stress and Depression were unexpected, though the positive direction of the main effects were in line with our hypotheses. It is possible that at the time the data were collected towards the beginning of the pandemic, the distress associated with an unprecedented stressor and lack of certainty about the future (e.g., a poorly understood virus, uncertainty around potential treatments and vaccination, uncertainty around economic recession and lockdown measures) manifested in symptoms of anxiety more than stress or depression for individuals high in neuroticism (which individuals high in neuroticism may be more used to coping with). It is possible that further along in the pandemic when changes to work (e.g., prolonged remote work) and social life were more enduring, there would have been a greater association between neuroticism and stress and depression.

Nevertheless, our findings are supported by recent work by Proto and Zhang (2021) who found non-significant associations between neuroticism and mental health decline during the pandemic. The authors suggest that because neuroticism is a predictor of a poor mental health trajectory in general, highly neurotic individuals may experience a "habituation effect" during the pandemic given that they may have experienced multiple other drastic negative life events (Proto & Zhang, 2021). However, overall, our findings are somewhat unexpected given the robust relationship between neuroticism and mental health outcomes (Sauer-Zavala & Barlow, 2021). Neuroticism has not been directly examined as a moderator between changes in socialization and psychological symptoms during COVID-19, however, recent work shows that neuroticism is significantly negatively associated with psychological and emotional well-being during the COVID-19 pandemic in a sample of Canadian citizens (Shokrkon & Nicoladis, 2021). Although neuroticism had significant zero-order associations with DASS outcomes and a main effect on DASS Anxiety in our study, one possible explanation for the discrepancy between these findings and our own could be that this prior work did not include measures of mental health prior to the pandemic. In contrast, our study held the effects of pre-COVID-19 DASS measures constant. This allowed us to examine the unique effects of neuroticism on psychological symptoms during the pandemic holding prior symptoms constant. Additionally, unlike cross-sectional study designs, our personality

measures were collected prior to the COVID-19 pandemic, which precludes our measures of personality from being influenced by COVID-19-related mood-state distortion (e.g., situational factors and mood states impacting the assessment of personality). Our study also used a patient sample, which could impact the differences observed between our results and other current research (e.g., a restricted/elevated range of neuroticism in a clinical sample compared to a fuller range of neuroticism in a community sample).

Moreover, there is work suggesting that highly neurotic individuals may focus more on pandemic-related information and consequences of the pandemic (e.g., their own health) and experience more affective reactivity due to this preoccupation (Khosravi, 2020; Shokrkon & Nicoladis, 2021). This implies that individuals high in neuroticism may experience negative emotionality circumscribed to the effects of the pandemic rather than the more general symptoms of anxiety, depression and stress assessed by our measures. In work by Abdelrahman (2020), neuroticism also predicted adopting social distancing in order to avoid becoming infected with COVID-19 compared to other personality traits. Individuals high in neuroticism could view social distancing as a necessary means to prevent becoming infected with COVID-19 due to their heightened fear of the pandemic in general (Shokrkon & Nicoladis, 2021). It is possible that participants in the current study who were high in neuroticism were more preoccupied with dire consequences of the pandemic and viewed social distancing—and the changes in socialization that go along with it—as a necessary means to avoid infection, which resulted in neuroticism not impacting the relationship between experiencing changes in friendships and the DASS outcome variables.

Limitations

There are several study limitations of note. Changes in friendships were assessed with a single item asking about the degree of change individuals have experienced in their friendships. Responses to this item were subjective and up to the interpretation of participants. Respondents may have experienced differences in the types of changes in their social life (e.g., some individuals may have been socializing less, while some individuals may have been socializing as much as usual, but virtually). Thus, it is difficult to draw conclusions about the exact types of changes in socialization that impacted psychological symptoms in this sample. Additionally, the sample size in our study was small relative to those of other studies conducted, many of which gathered data from convenience samples from > 1,000 participants (Kroencke et al., 2020; Liu et al., 2021; Moderitski et al., 2021; Stadler et al., 2020). There was also attrition in the study (112 cases lost out of 189 individuals contacted), and it is possible that there were meaningful differences in the outcomes between the individuals who completed the survey and those who declined that may affect the generalizability of our findings. Given the longitudinal nature of our study design, we expected a certain level of attrition in completion of the COVID-19 survey. However, we believe this inevitable limitation was outweighed to a considerable degree by the ability to control for pre-COVID-19 mental health, which would not have been possible with a cross sectional sample. Compared to other work on this topic, our study adds to the literature despite the attrition inherent in the longitudinal design, as we utilized a patient sample rather than a cross-sectional convenience sample. Given the small sample size and attrition in the sample, it is important to replicate the current findings in other clinical samples in future waves of the pandemic or future pandemics.

Conclusions and Future Directions

Despite these limitations, our findings contribute to understanding the relationship between experiencing changes in socialization during the COVID-19 pandemic, personality traits, and symptoms of stress, anxiety, and depression. Our study adds to current literature on the harmful effects of social isolation during COVID-19 (Bu et al., 2020; Dahlberg, 2021; Killgore et al., 2020; Lee et al., 2020; Naser et al., 2021; Philpot et al., 2021) and work on psychological distress during the pandemic in patient samples (Asmundson et al., 2020; Plunkett et al., 2021) by demonstrating that experiencing changes in socialization was significantly associated with persistence of stress and depression in a clinical sample. Further, we found that extraversion moderated the relationship between experiencing changes in friendships and DASS Stress and Anxiety, while neuroticism had limited prospective associations with stress, anxiety and depression. Our study also allowed for investigating changes in symptoms of stress, anxiety, and depression during the pandemic as we included measures of symptoms collected prior to the pandemic instead of measuring symptoms at only one timepoint.

These findings have important clinical implications, as we have provided evidence that for patients who are more introverted, experiencing changes in socialization during the pandemic may result in the persistence of symptoms of stress and anxiety, whereas extraverted individuals may not be as affected by such changes. During the pandemic, it may be useful for clinicians to consider using personality questionnaires in assessment and treatment settings to have an understanding of how patients' personalities may interact with pandemic-related stressors. As there is work suggesting that introverted individuals may be less likely to use adaptive emotion regulation strategies (e.g., cognitive reappraisal)

(Barańczuk, 2019; Shokrkon & Nicoladis, 2021) and that use of maladaptive cognitive emotion regulations strategies are associated with increased loneliness for introverts (Gubler et al., 2021), psychoeducation on adaptive emotion regulation strategies can be emphasized in treatment for highly introverted patients during the pandemic. Additionally, therapeutic interventions can focus on problem-solving how to maintain friendships and adapt to changes in socialization during the pandemic for introverted patients.

Future research should explore whether the associations found in this study can be replicated over more prolonged time periods during the pandemic and through changes in social distancing guidelines and evolving lockdown measures. Additionally, research is needed to determine the moderating impact of extraversion and neuroticism surrounding other significant life changes due to COVID-19 (e.g., individuals becoming unemployed or experiencing prolonged financial strain). The COVID-19 pandemic has caused many difficult changes in socialization for individuals with pre-existing mental health problems and our findings shed light on personality traits that may be more vulnerable to experiencing increases in internalizing symptoms due to these changes. Our findings have valuable clinical implications as these results can be used to create more personalized treatment interventions for patients. Further, as the pandemic appears to be an enduring stressor in daily life, our findings may be useful in informing the creation of widespread mental health resources that could be publicly accessible for individuals with mental health diagnoses who have experienced changes in socialization.

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Data Availability The datasets generating during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Conflict of interest Christina S. Galiano, Alexandra M. Andrea, Timothy A. Brown and Anthony J. Rosellini declare that they have no conflict of interest.

Ethical Approval The study was approved by the Human Investigation Committee (IRB) of Boston University.

Informed Consent Informed consent was obtained from all individual participants included in the study.

Research Involving Human and Animal Rights All procedures performed in studies involving human participants were in accordance with the ethical standards of the Institutional and/or National Research Committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

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