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Mediating Effects of Attentional Control in the Relationship Between Neuroticism and Repetitive Negative Thinking

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Depression and anxiety symptoms frequently co-occur. Research suggests that a common shared symptom — repetitive negative thinking (RNT) — is a vulnerability factor that develops and prolongs symptoms of affective disorders. A dispositional factor that increases RNT is neuroticism. The mental noise hypothesis of neuroticism suggests that its volatile and reactive nature causes attentional control deficits. As theories of RNT, specifically regarding rumination and worry, indicate such deficits as underlying causes, it is hypothesized that the deficits may mediate the relationship between neuroticism and RNT. This study investigated whether attentional focusing and shifting mediates the relationship between neuroticism and RNT (worry and rumination). Results showed mediational effects of focusing on rumination, while the results on worry were not significant. Neuroticism has been discussed as a temperamental risk factor that increases vulnerability to psychopathology. Future research should employ longitudinal designs and behavioral measures to overcome this study's limitations.

Keywords: neuroticism, attentional control, repetitive negative thinking, worry, rumination

Introduction

According to reports on the high comorbidity of depressive and anxiety disorders, depression and anxiety are frequently co-occuring conditions. A longitudinal study has showed that around 75% of patients with depressive disorder also suffered from comorbid anxiety disorder, and 81% of patients with anxiety disorders also experienced depressive disorder (Lamers et al., 2011). Furthermore, Essau (2003) has reported that approximately 72% of adolescents with depression had comorbid anxiety disorder. These reports suggest that the high prevalence of comorbid depressive and anxiety disorders is a serious issue that requires further investigation, as it is likely to become chronic (Penninx et al., 2011).

To investigate why depressive and anxiety symptoms co-occur, it is essential to examine shared symptoms such as repetitive negative thinking (RNT). RNT is defined as a cognitive symptom characterized by: 1) repetitiveness, 2) being relatively difficult to control, and 3) containing negative content (Ehring & Watkins, 2008). In depressive and anxiety disorders, two common types of RNT are worry and rumination. Worry is defined as "a chain of thoughts and images, negatively affect laden and relatively uncontrollable" (Borkovec & Newman, 1998). Rumination is defined as "thinking perseveratively about one's feelings" (Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008). Transdiagnostic accounts of RNT suggest that RNT is a vulnerability factor to various affective disorders (McEvoy, Watson, Watkins, & Nathan, 2013). For example, levels of rumination and worry prospectively predict increased depression and anxiety symptoms (Segerstrom, Tsao, Alden, & Craske, 2000; Kocovski, Endler, Rector, & Flett, 2005). Further-

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more, levels of rumination and worry are not significantly different across patients with affective disorders (McEvoy et al., 2013). Thus, rumination and worry are vulnerability factors to the development and maintenance of affective disorders. This emphasizes the importance of investigating the dispositional factors that increase the likelihood of an individual developing RNT, such as neuroticism (Segerstrom et al., 2000).

Neuroticism is defined as a personality trait that predisposes an individual to experience negative emotions. Consequently, a highly neurotic individual may display increased reactivity to stressful events and exhibit associated traits such as decreased self-esteem, guilt, anger, or embarrassment (Costa & McCrae, 1980; Costa Jr & McCrae, 1987). Previous studies have showed that increased levels of neuroticism are associated with increased levels of rumination and worry (De Bruin, Rassin, & Muris, 2007; Muris, Roelofs, Rassin, Franken, & Mayer, 2005). This suggests that, since neurotic individuals are prone to experiencing negative affect, they may employ dysfunctional emotion regulation strategies, such as RNT. Since neuroticism and RNT are associated with increased vulnerability to psychopathology, it can be inferred that neuroticism leads to psychopathology via RNT. In fact, previous research has indicated that RNT mediates the effect of neuroticism on depressive and anxiety symptoms (Muris et al., 2005).

Neurotic individuals may be more likely to choose dysfunctional regulation strategies in response to stressful situations because the reactive and volatile nature of neuroticism acts as "mental noise" to negatively affect attentional control abilities (Robinson & Tamir, 2005; Bredemeier, Berenbaum, Most, & Simons, 2011). For example, neuroticism is related to increased levels of reaction time variability and committing cognitive failures (Robinson & Tamir, 2005; Flehmig, Steinborn, Langner, & Westhoff, 2007; Neupert, Mroczek, & Spiro, 2008). Since RNT is characterized as perseverative and intrusive, it follows that attentional control deficiency would increase a person's vulnerability to experiencing RNT.

Hirsch and Mathews (2012) suggest that pathological worry arises due to several reasons, including decreased attentional control. That is, worry may arise from failure to exert control over intrusive negative thought contents entered as stimuli-driven, bottom-up process. This has been supported empirically through experimental procedures such as the flanker test (Fox, Dutton, Yates, Georgiou, & Mouchliantis, 2015). Similarly, a theory on rumination suggests that ruminators lack the ability to inhibit negative thought contents (Cohen, Daches, Mor, & Henik, 2014). These theories on rumination and worry demonstrate that attentional control deficiency underlies RNT. Combined with the mental noise hypothesis of neuroticism, it can be suggested that attentional control deficiency may mediate the relationship between neuroticism and RNT. The current study thus aims to test a mediational model where attentional control is a mediator between the predictor variable (neuroticism) and the outcome variables (worry and rumination). This would elucidate the association between neuroticism and RNT.

Recently, studies employing Attentional Control Scale (Derryberry & Reed, 2002; ACS), a self-report scale to measure attentional control abilities have been increasing (e.g. Mills et al., 2016; Armstrong, Zald, & Olatunji, 2011). ACS and its subscales, focusing (remaining focused on a current task) and shifting (shifting attention rapidly between multiple tasks) have been shown to be successfully linked to corresponding behavioral measures, such as Attention Network Task and switch-trials in an anti-saccade task (Reinholdt-Dunne, Mogg, & Bradley, 2013; Judah, Grant, Mills, & Lechner, 2014).

Self-report studies that employed ACS showed that focusing and are differentially related to rumination and worry. Previous research shows that, while focusing relates to RNT, shifting does not (Mills et al., 2016; Armstrong et al., 2011). As attentional focusing is significantly related to behavioral inhibition (i.e., preventing distractions), it can be suggested theoretically that the intrusive nature of rumination and worry would adversely affect an individual with low focusing ability (Mills et al., 2016; Armstrong et al., 2011; Reinholdt-Dunne et al., 2013). Therefore, the current study also aims to determine whether there are different indirect effects of focusing and shifting. Previous research investigating demonstrated that focusing significantly mediated the longitudinal prediction of worry on General Anxiety Disorder symptoms, and rumination on depression symptoms. However, results regarding shifting were non-significant (Mills et al., 2016). Therefore, it is hypothesized that focusing would mediate the effect of neuroticism on rumination and worry.

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Method

Procedure

Participants were recruited online to complete online surveys via Google Form. All participants were rewarded with a small incentive for participating, and few participants were randomly selected to receive e-vouchers. All participants were given instructions and an overview of the study and were informed of their right to withdraw. To begin the survey, participants were required to grant informed consent to participate. The entire procedure was approved by the Institutional Review Board (Approval No. 1041078-202011-HRSB-327-01) and complied with the Declaration of Helsinki.

Participants

A total of 161 Korean participants (112 females) were recruited. Given that the appropriate sample size for 80% power and medium effect size was 116 (Fritz & MacKinnon, 2007), the sample size of 161 was thus deemed appropriate for mediation analysis. All participants were required to be 18 years or above to participate. Participants' age ranged from 20 to 69 years (M = 31.83, SD = 8.40).

Measures

The International Personality Item Pool, Neuroticism Subscale (IPIP–NEO–120; Johnson, 2014)

The IPIP-NEO-120 is a self-report scale used to measure the Big Five personality traits. Originally a 300-item inventory developed by Goldberg et al. (2006), the 120-item shortened IPIP-NEO-120 was developed and validated by Johnson (2014). The current study used the neuroticism subscale consisting of 24 items rated on a 4-point Likert scale ranging from 1 to 4. A Korean version translated and validated by Jahng (2018) was used. The neuroticism subscale showed good internal consistency in the original study by Johnson (2014) and by Jahng (2018), with values $\alpha = .90$ and $\alpha = .81$, respectively. The internal consistency demonstrated in the current study was good, $\alpha = .89$.

Attentional Control Scale (ACS; Derryberry & Reed, 2002; Yoon, Kim, & Choi, 2007)

The ACS is a self-report scale used to measure attentional control. It is a 20-item scale developed and validated by Derryberry and Reed (2002). Responses are rated on a 4-point Likert scale ranging from 1 to 4. A Korean version translated and validated by Yoon et al. (2007) was used. The ACS showed good internal consistency in both studies, with values $\alpha = .88$ and $\alpha = .84$, respectively. The internal consistency demonstrated in the current study was acceptable, $\alpha = .78$. Attentional focusing and shifting are two subscales of ACS, containing 12 items and 8 items, respectively.

Rumination Reflection Scale (RRS; Nolen–Hoeksema & Morrow, 1991; S. J. Kim, Kim, & Yun, 2010)

The RRS is a self-report scale originally developed by Nolen-Hoeksema and Morrow (1991) to measure ruminative responses. A Korean translated and validated version (Kim et al., 2010) was used in the current study. The RRS is a 22-item scale rated on a 4-point Likert scale ranging from 1 to 4. The internal consistency reported by Nolen-Hoeksema and Morrow (1991) and Kim et al. (2010) were both good, with values $\alpha = .89$ and $\alpha = .89$, respectively. The internal consistency in the current study was good, $\alpha = .93$.

Pennsylvania State Worry Questionnaire (PSWQ; Meyer, Miller, Metzger, & Borkovec, 1990; Kim & Min, 1998)

The PSWQ is a self-report scale developed by Meyer et al. (1990) used to measure levels of worry. A Korean version translated and validated by J. W. Kim and Min (1998) was used in the current study. The PSWQ is a 16-item scale rated on a 5-point Likert scale ranging from 1 to 5. The internal consistency reported by Meyer et al. (1990) and J. W. Kim and Min (1998) were both good, with values $\alpha = .93$ and $\alpha = .92$, respectively. The internal consistency demonstrated in the current study was also good, $\alpha = .87$.

Data Analysis

Data screening revealed no missing data or outliers. Data analyses were conducted using IBM SPSS version 25.0 and PROCESS Macro 3.4.1 developed by Hayes (2018). Pearson's correlations were calculated for neuroticism, attentional control, focusing, shifting, worry, and rumination. Mediational analyses were conducted to investigate: (1) focusing as a mediator between neuroticism and rumination; (2) shifting as a mediator between neuroticism and rumination; (3) focusing as a mediator between neuroticism and worry; and (4) shifting as a mediator between neuroticism and worry.

Results

Descriptive Statistics

The descriptive statistics are shown in Table 1. More than half of the participants were female (69.6%), and majority were attending or have attended universities (63%). The mean total ACS score was 41 (SD = 7.17), which is substantially lower than the score reported by the Korean ACS validation study (Yoon et al., 2007; M = 52.56, SD = 8.39). This is likely attributable to the overall mean age and age range of the participants in the current sample (M = 31.8, SD = 8.40) being older than that of Yoon et al. (2007) (M = 22.89, SD = 2.64). The RRS and PSWQ scores (M = 46.2, SD = 11.8; M = 44.1, SD = 11.2, respectively) reported in the current study are comparable to their Korean validation studies (Kim et al., 2010; J. W. Kim & Min, 1998).

Table 1. *Descriptive Statistics of the Sample*

Variable	Value
Sex %	
Male	30.4
Female	69.6
Age (yr)	
M	31.8
SD	8.40
Education	
High school or lower	13 (8%)
College	20 (12%)
University	101 (63%)
Postgraduate	27 (17%)
Marriage status	
Single or not married	125 (78%)
Married	33 (21%)
Separated or widowed	3 (2%)
Neuroticism	
M	16.7
SD	5.16
ACS (total)	
M	41.0
SD	7.17
ACS (focusing)	
M	24.0
SD	4.95
ACS (shifting)	
M	16.9
SD	3.47
RRS	
M	46.2
SD	11.8
PSWQ	
M	44.1
SD	11.2

ACS = Attentional Control Scale; RRS = Ruminative Response Scale; PSWQ = Pennsylvania State Worry Questionnaire.

Correlations

The correlation results are shown in Table 2. Neuroticism was significantly negatively correlated with attentional control, $r(159) = -.54$ ($p < .01$), attentional focusing, $r(159) = -.43$, ($p < .01$), and attentional shifting, $r(159) = -.51$ ($p < .01$). Neuroticism was significantly positively correlated with rumination, $r(159) = .31$ ($p < .01$), and worry, $r(159) = .25$ ($p < .01$). Attentional control was significantly negatively correlated with rumination, $r(159) = -.35$, ($p < .01$) and worry, $r(159) = -.18$ ($p = .02$). Both focusing and shifting were significantly correlated with rumination, with coefficients $r(159) = -.34$ ($p < .01$) and $r(159) = -.245$ ($p < .01$), but only shifting was significantly correlated with worry, $r(159) = -.16$, $p = .04$. Finally, rumination was significantly positively correlated with worry, $r(159) = .18$, $p = .02$.

Mediational Analyses

Before mediation analyses, all assumptions were checked (linearity, normality, homoscedasticity, and independence; Kane & Ashbaugh, 2017). *T*-tests and one-way ANOVAs were performed to examine any significant differences across demographic variables (age, sex, education, and marriage status). The analyses revealed a significant difference of worry according to sex, such that females worried more than males, $t(159) = -2.97$, $p < .01$. This is consistent with previous research (Robichaud, Dugas, & Conway, 2003). A

Table 2. *Pearson Correlations Between Neuroticism, ACS and Their Subscales, RRS, and PSWQ*

Variable	1	2	3	4	5
1 Neuroticism		-.43**	-.51**	.31**	.25**
2 ACS (focus)	-.43**		.43**	-.34**	-.15
3 ACS (shift)	-.51**	.43**		-.25**	-.16*
4 RRS	.31**	-.34**	-.25**		.18*
5 PSWQ	.25**	-.15	.16*	.18*	

ACS = Attentional Control Scale; RRS = Ruminative Response Scale; PSWQ = Pennsylvania State Worry Questionnaire.
*$p < .05$ (2-tailed). **$p < .01$ (2-tailed).

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one-way ANOVA revealed a significant effect of education status on neuroticism, $F(3, 157) = 2.94$ ($p = .04$) and rumination, $F(3, 157) = 4.21$ ($p < .01$). That is, neuroticism and rumination were lower among those with lower education status. Therefore, sex and education status were entered as covariates in the following mediational analyses.

PROCESS Model 4 (Hayes, 2018) was used as for separate analyses with outcome variables set as rumination and worry. Parallel mediational analyses with two mediators (focusing and shifting) were tested. The indirect effect was tested using 95% confidence interval and 5000 bootstrap samples for percentile bootstrapping. The main results are outlined in Figures 1 and 2. Table 3 shows the results of the mediational analyses.

Consistent with previous research, neuroticism positively predicted rumination, $c_1 = .69$ ($p < .01$). and worry, $c_2 = .16$ ($p < .001$).

With rumination as an outcome variable, focusing mediated the relationship between neuroticism and rumination (Figure 1). This result supported the hypothesis. The significant indirect effect of focusing was .25 (95% bootstrap CI = [.08, .48]). Figure 1 illustrates that the positive value indicates the negative relationship between neuroticism and attentional focus, $a_{11} = -.41$ ($p < .001$), and consequent negative relationship between attentional focus and rumination, $b_{11} = -.61$ ($p < .01$).

In model 2, worry was set as the outcome variable (Figure 2). Attentional focusing and shifting did not significantly mediate the effect of neuroticism on worry, as the bootstrapped confidence intervals did not straddle 0 (Table 3). However, neuroticism significantly predicted worry even after focusing and shifting were controlled for, $c'_2 = .14$, $p = .02$. This suggested that another variable may explain the relationship between neuroticism and worry.

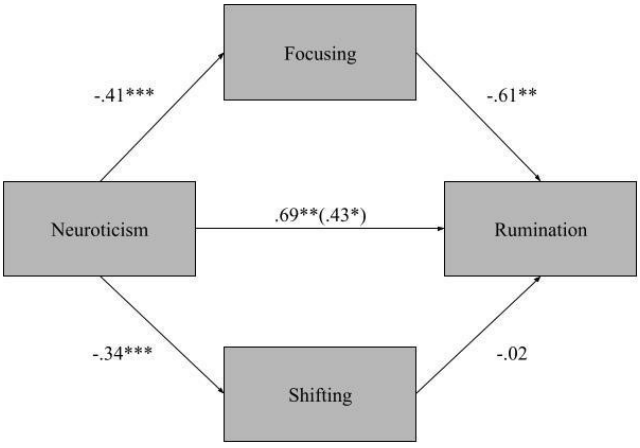

Figure 1. *Mediation model with rumination as the outcome variable.*

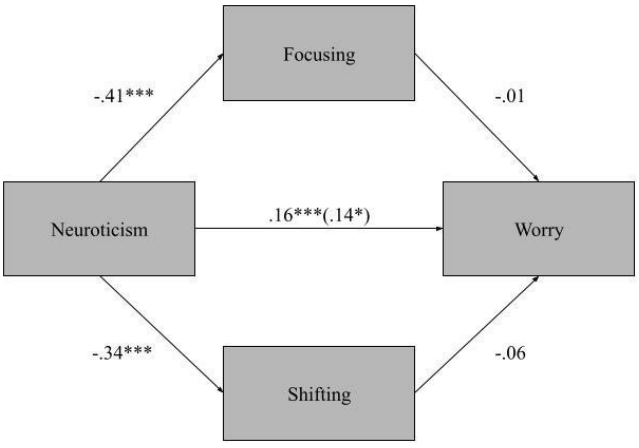

Figure 2. *Mediation model with worry as the outcome variable.*

Table 3. *Results of the Mediational Analyses*

DV	M	IV→M	M→DV	Direct Effect	Indirect Effect	Total Effect
Rumination	Focusing	-.41***	-.61**	.43*	.25	.69**
					95% CI = [.08, .48]	
	Shifting	-.34***	-.02		.01	
					95% CI = [-.22, .19]	
Worry	Focusing	-.41***	-.01	.14*	.01	.16***
					95% CI = [-.04, .05]	
	Shifting	-.34***	-.06		.02	
					95% CI = [-.03, .08]	

DV = Dependent Variable; M = Mediator; IV = Independent Variable; CI = Confidence Interval. All confidence intervals indicate bootstrapped lower and upper limit confidence intervals.
*$p < .05$. **$p < .01$. ***$p < .001$.

Discussion

The current study aimed to investigate whether attentional focusing and shifting mediated the effect of neuroticism on RNT, specifically rumination and worry. Considering previous research (Armstrong et al., 2011; Mills et al., 2016), we hypothesized that focusing would mediate the effects on rumination and worry. The results were supported for rumination, but not worry, as neither focusing nor shifting indirectly affected the relationship between neuroticism and worry.

The results of rumination as an outcome variable showed that neuroticism predicted increased rumination, and that attentional focusing mediated this relationship. Contrarily, while neuroticism significantly predicted a decrease in attentional shifting, shifting did not predict rumination. While the null result regarding shifting is in line with results from Mills et al. (2016), it contradicts the significant results from using behavioral measures of shifting in predicting rumination (De Lissnyder, Koster, & De Raedt, 2012). One explanation why the inconsistent results occurred may be attributed to the presence of emotional information in the latter study, where shifting from emotional information may have caused greater attentional influences. Therefore, future studies may investigate whether effects of shifting are limited to the involvement of emotional stimuli.

The indirect effect of focusing was of substantial size (.25), indicating that deficits in attentional focusing may play a significant role in the relationship between neuroticism and rumination. As attentional focusing is significantly correlated with behavioral inhibition (Judah et al., 2014), the present results support the evidence that lack of inhibition may be a vulnerability factor to RNT and, consequently, psychopathology (Mills et al., 2016). Furthermore, the significant indirect effect suggests that this lack of inhibition abilities may be partially explained by neuroticism, reinforcing the mental noise hypothesis (Robinson & Tamir, 2005).

Regarding worry, no significant indirect effects of attentional focusing and shifting emerged. This is consistent with the results from Armstrong et al. (2011) obtained from the non-clinical control group. However, focusing significantly predicted worry among patients with general anxiety disorder (GAD), and was also a significant mediator between worry and GAD symptoms (Armstrong et al., 2011; Mills et al., 2016). The difference in results may be attributed to the clinical status of participants. In studies indicating significant roles of attentional focusing, participants comprised those with a clinical anxiety disorder, or the variable being measured was psychopathology symptoms. This suggests that while attentional control may not impact worry in the general population, it may influence pathological levels of worry in vulnerable individuals. One theory on pathological worry hypothesize that vulnerable individuals possess pre-existing patterns of thinking and emotional processing biases of threat stimuli, which strengthen mere intrusions into episodes of pathological worry (Hirsch & Mathews, 2012). As the current study investigated worry in non-clinical participants, such habitual thinking patterns and processing biases may not be present to significant levels of pathological worry.

However, whether worry is normal or pathological is not necessarily dichotomous. Previous findings have shown that worry is a continuous spectrum; thus, factors that may contribute to variations in worry should be investigated (Ruscio, Borkovec, & Ruscio, 2001). This indicates that deficits in attentional focusing may increase levels of worry toward pathological levels. In fact, a recent nine-year longitudinal study revealed that impairments in inhibition predicted the onset of GAD nine years later (Zainal & Newman, 2018). Combined with the current results, neuroticism can be proposed as an underlying causal vulnerability factor for pathological worry. To further investigate this, a longitudinal study with neuroticism as a predictor variable may be useful.

Another reason why attentional focusing and shifting were not significant mediators of worry may be attributed to participants' judgement on what constitutes as worry. For example, a content analysis on worry episodes revealed that 48% of worry contents were categorized as a problem-solving process (Szabó & Lovibond, 2002). This suggests a possibility where those who attributed their worry as a productive problem-solving process may have undermined true levels of worry.

The results of the current study highlight the significance of neuroticism as a personality trait vulnerability factor for the potential development of psychopathology. Furthermore, there is evidence for the genetic basis of neuroticism (Okbay et al., 2016). If neuroticism is a core factor of psychopathology as well as their risk

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factors such as attentional control deficits, then neuroticism must be emphasized as a potential treatment target, rather than its consequent symptoms. For example, a randomized control trial implemented an intervention targeting anxiety risk factors in children, such as behavioral inhibition, a temperament factor that significantly relates to neuroticism (Vreeke & Muris, 2012). The results were encouraging, as the intervention decreased the severity of anxiety disorders (Rapee, Kennedy, Ingram, Edwards, & Sweeney, 2010). Additional research should determine effective ways to decrease levels of neuroticism.

In addition, the current study results show that rumination and worry are differentially affected by attentional focusing and shifting. While transdiagnostic accounts of RNT suggest that RNT acts as a common vulnerability factor to psychopathology, the current results suggest that their processes may differ in the context of attentional control. However, previous studies investigating differences between worry and rumination have investigated the issue mainly in terms of their cognitive content (e.g., Szabó & Lovibond, 2002). Therefore, future research should investigate how different types of RNT may arise due to different forms of attentional control deficits.

Finally, combined with previous studies investigating the relationship between neuroticism, psychopathology, RNT, and attentional control (Muris et al., 2005; Mills et al., 2016; Reinholdt-Dunne et al., 2013; Segerstrom et al., 2000), the results of the current study contribute to a holistic view on how the variables relate to each other. Muris et al. (2005) demonstrated that RNT mediates the effect of neuroticism on psychopathology. The current results show that attentional focusing acts as a mediator in the path from neuroticism to RNT. The results from Mills et al. (2016) indicate that attentional focusing influences the effect of various types of RNT on psychopathology. Combined with the current results, it can be suggested that attentional control may act as a common mediator influencing different paths from how vulnerability factor (neuroticism) may develop and manifest into psychopathology (e.g., depression, anxiety). Therefore, our understanding in their relationship may benefit from future studies investigating the role of attentional control deficits within the developmental trajectory from neuroticism to psychopathology.

The interpretation of the present results is limited due to its cross-sectional study design. Since we sought to investigate the mechanism by which neuroticism predicts psychopathology symptoms, a longitudinal design where the outcome variables are measured at subsequent time points may be more suitable. Another limitation is the use of self-report measures of attentional control. The ACS may reflect personal beliefs on the individual's attentional control ability (Quigley, Wright, Dobson, & Sears, 2017). To resolve this issue, future studies may employ behavioral measures of attentional control. Finally, the number of females exceeded that of male participants. This may have affected the results for worry, as research indicates that females tend to worry more than males (Robichaud et al., 2003).

In conclusion, the current study investigated whether attentional focusing and shifting indirectly affected the relationship between neuroticism and RNT, namely, rumination and worry. The results indicated that only attentional focusing indirectly affected neuroticism and rumination. Neither attentional focusing nor shifting indirectly affected neuroticism and worry. The results highlight the importance of neuroticism as a temperamental risk factor to the development of psychopathology.

Author contributions statement

EJC, graduate student and research assistant at Chung-Ang University, conceptualized the research, collected and analyzed the data, and wrote the original draft of the manuscript. MHH, professor at Chung-Ang University, served as the principal investigator of the research grant, supervised the research process, and reviewed and edited the writing. All authors provided critical feedback, participated in revision of the manuscript, and approved the final submission.

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