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Beyond neuroticism: mediators of personality traits and internalizing psychopathology



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Abstract

Background Neuroticism is considered the general antecedent of many specific psychopathological conditions. Even though previous studies addressed the issue of a mediated relationship by which it exerts its influence, they failed to encapsulate the changes that occur over time. Approaching the pathway between neuroticism and psychopathology from a longitudinal perspective might clarify its underlying mechanisms.

Methods The present study aimed to address this by examining the associations between neuroticism, socialcognitive vulnerabilities (anxiety sensitivity, intolerance of uncertainty, experiential avoidance, looming cognitive style), and internalizing psychopathology (depression, anxiety, panic) in an N= 373 student sample. Cross-lagged Panel Model (CLPM) and Random-Intercept Cross-Lagged Panel Model (RI-CLPM) were used to test the mediation analyses in a longitudinal three-wave design.

Results At the between-person level, the effect of neuroticism and social-cognitive vulnerabilities, such as experiential avoidance and intolerance of uncertainty, on depression and anxiety was found to be significant. An indirect effect of neuroticism was observed specifically for anxiety sensitivity and panic. No significant effects emerged at the within-person level.

Conclusions Neuroticism and social-cognitive factors together contribute to depression and anxiety symptoms, while neuroticism's indirect influence better explains the onset of panic at a stable, between-person level. Theoretical considerations of the results and prospective research implications are discussed.

Keywords Neuroticism, Social-cognitive vulnerabilities, Depression, Anxiety, Panic

Background

Throughout history, mental health challenges have been reflected by exploring individual differences at various levels. In personality psychology, neuroticism has been shown to be the most predictive personality factor for mental health challenges [1]. However, the true nature of this relationship – pathoplastic, spectrum, causal [2]

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- and the potential mediators as intervening mechanisms (i.e., cognitive vulnerabilities) have not been extensively addressed. In clinical psychology, narrower constructs than neuroticism have been developed, such as anxiety sensitivity [3] or intolerance to uncertainty [4]. Previous authors [5, 6, 7, 8] considered these individual differences as social-cognitive factors for the onset or maintenance of specific mental health challenges, whereas the neuroticism trait was seen as a more distal and general factor.

There are currently several theoretical models for the association between personality and psychopathology. The tripartite model of anxiety and depression [9], suggests that anxiety and depression can be explained by



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three dimensions of the mood: negative affect, positive affect, and hyperarousal (highly correlated with neuroticism and extraversion). Similarly, the hierarchical model of anxiety disorders [10] proposes a common (shared) factor for all anxiety disorders - anxious apprehension (loosely related to the negative affect dimension described by the previous model). In addition, it states the existence of specific (unique) factors for each of the anxiety disorders (e.g., while social anxiety and panic disorder share a common underlying factor in anxious apprehension, anxious arousal is specific only to panic disorder) [11]. A third integrative hierarchical model [12] proposes to integrate the previously mentioned models by emphasizing three types of factors that contribute to anxiety and depression: a general factor (common among all disorders - neuroticism), a specific factor (shared between some disorders, but not all – anxiety sensitivity) and a unique factor (specific for a single disorder - negative evaluation sensitivity).

In this current longitudinal study, we aimed to examine whether the relationship between neuroticism and internalizing symptoms (depression, anxiety, and panic) is mediated by four social-cognitive vulnerabilities that are frequently linked to these emotional responses: anxiety sensitivity, intolerance of uncertainty, experiential avoidance, and looming cognitive style. By examining this dynamic, we can enhance our understanding of the factors contributing to the expression of mental health symptoms, either as specific or, to a greater extent, as comorbid. Similarly, by examining concepts from various backgrounds (such as personality psychology and clinical psychology) simultaneously, we can investigate how social-cognitive vulnerabilities uniquely contribute to predicting the severity of common mental health challenges, going beyond what can be predicted by neuroticism. This is particularly important as neuroticism has failed to distinguish between specific forms of internalizing disorders while correlating intensively and indiscriminately with all internalizing disorders. Thus, we consider neuroticism as a global or general factor of psychopathology that antecedes various forms of disorders. Based on these considerations, the relationship between neuroticism and psychopathology needs to be addressed by its underlying mechanisms [13]. The relationship between neuroticism and psychopathology needs to be addressed by its underlying mechanisms [13].

Anxiety sensitivity is a cognitive vulnerability linked to internalizing psychopathology and is characterized by a fear of anxiety and its associated sensations [14]. It reflects how individuals respond to anxiety [14] and is closely associated with panic disorder [15]. Anxiety sensitivity is a significant mediator between neuroticism and anxiety-related disorders [16]. Moreover, it has been shown that anxiety sensitivity demonstrates incremental validity in predicting dispositional disorders over neuroticism [17], and it predicts the maintenance of anxiety disorders uniquely, surpassing other factors such as neuroticism [18]. This strong association was again emphasized through the moderating effect of neuroticism on the relationship between anxiety symptoms and anxiety sensitivity [19].

Intolerance of uncertainty is typically described as a tendency to deem the possible occurrence of a negative event as unacceptable [20]. It describes how individuals anxiously react in uncertain situations [4], which is central to generalized anxiety disorder [21] and may also explain conditions like obsessive-compulsive disorder and specific phobias [22]. High levels of intolerance of uncertainty were also identified in depressed individuals, with the inhibitory component being associated with depression even after controlling for anxiety [23-24]. For this reason, intolerance of uncertainty is considered an important transdiagnostic factor for internalizing symptoms. Regarding the relationship with neuroticism, it was previously underscored that neuroticism is a strong predictor of intolerance to uncertainty [25]. Similarly to anxiety sensitivity, intolerance of uncertainty was found to be a significant mediator of the relationship between neuroticism and anxiety-related disorders [16]. Neuroticism was also mediated by intolerance of uncertainty in predicting generalized anxiety disorder, obsessive-compulsive disorder, and other anxiety-related disorders; since intolerance of uncertainty is strongly related to generalized anxiety disorder, it mediated most strongly the relationship between neuroticism and worry [21].

Experiential avoidance is the reluctance to engage with cognitive, emotional, or physiological experiences due to their unpleasant nature [26]. Experiential avoidance was also useful in predicting the ongoing manifestation of anxiety symptoms and worry [27, 18]. The unique contribution of experiential avoidance to internalizing psychopathology (both depression and anxiety) was also demonstrated [28]. Regarding its relationship with personality, it has been shown that experiential avoidance mediates between self-critical perfectionism and depressive and anxious manifestations, while controlling for neuroticism [29]. Because perfectionism and experiential avoidance are associated with the anxiety facet of neuroticism [7], and self-critical perfectionism and neuroticism are closely related traits [29], we expect that experiential avoidance will mediate between neuroticism and the internalizing symptoms.

The looming cognitive style is a bias that causes individuals to perceive increasing danger over time and space [30]. It represents an exaggerated tendency to quickly process potentially dangerous stimuli [31] and is associated with anxiety symptoms [32]. Although there is a positive correlation between neuroticism and looming,

their relationship with psychopathology is inconsistent: though both are associated with anxiety, looming has not been established as a mediator between neuroticism and internalizing psychopathology such as depression, anxiety, or panic [5]. Additionally, their theoretical conceptualization appears to involve different mechanisms, as neuroticism leads to perceiving neutral stimuli as distant, while the looming biases perception toward stimuli as rapidly approaching [33, 21]. Clarifying this relationship in a model that accounts for other socialcognitive vulnerabilities could increase our understanding of the individual differences that lead to internalizing psychopathology.

This study had two goals: (i) to investigate whether the relationship between neuroticism and three internalizing symptoms – depression, generalized anxiety, and panic – is mediated by specific cognitive vulnerabilities, and (ii) to explore the temporal dynamics among these variables to understand their influence on each other over time.

The first goal addresses whether social-cognitive vulnerabilities serve as proximal factors for mental health challenges, clarifying their role in the relationship between neuroticism and these disorders. The second goal sheds light on causal relationships by examining how these variables interact longitudinally.

Even though several studies [5, 6, 7, 8] have previously examined similar relationships in a cross-sectional fashion, this is, to the best of our knowledge, the first attempt to examine this complex dynamic in a longitudinal design.

Method

Participants and procedure

We pre-registered the study at AsPredicted (https://aspr edicted.org/LTQ_DH4). We deviated from the pre-regis tered form in three ways. First, we included a traditional Cross-Lagged Panel Model (CLPM) analysis alongside the Random-Intercept Cross-Lagged Panel Model (RI-CLPM). Reasons for this deviation are provided in the analytical strategy section.

Regarding the second deviation, we employed the fullinformation maximum likelihood method instead of the preregistered multiple imputation method to estimate the parameters of our statistical models. We opted to use this method mainly because no imputations were required for this dataset. Additionally, since we operated under the missing at random assumption and the fullinformation maximum likelihood method is more parsimonious than multiple imputation, we chose the former for our analyses.

The third one included a slight deviation from the initial estimation of the sample (at least 400 in the pre-registration form, 387 in the initial data collection stage, and 373 after the exclusion criteria were applied) because of accessibility reasons.

We collected data through online forms that included a consent form outlining the study's nature, confidentiality measures, and participants' right to withdraw. The longitudinal study had three waves, each five weeks apart, and involved students recruited via online announcements on the university platform. Participants received course credits for their involvement.

The initial sample for the first wave consisted of 387 participants. Of this total, 14 participants (3.61%) participated only in one wave, while 22 participants (5.68%) participated in two waves. The remaining participants (N=351) had valid data from all three measurement moments.

The main exclusion criterion was the absence of response variability (e.g., employing the same response for all items – $\sigma^2 = 0$). We analyzed the variance in participants' responses for personality and cognitive measurements. Although a few showed low variability, it was random across items (i.e., low variability, but not in consecutive items). Thus, we retained all data, but we excluded participants who participated in only one wave (N=14). This resulted in a final sample of 373 participants.

The resulting sample had a $m_{age} = 23.61$, *S.D.* = 7.58, and of which 334 (89.5%) were females; 249 of the participants (66.8%) were from the urban area; 312 of them (83.6%) were undergraduate students, while the remaining were graduate students. All the participants were Romanian students from two large public universities in the western part of the country.

To estimate our sample size, we initially used GPower [34]. Our simulated model included five predictors, and we considered this an approximation for our CLPM models (since they only relied on observed variables, thus returning similar results to regression-based models). Based on the small to medium effect size observed in previous studies examining social-cognitive vulnerabilities and internalizing symptoms [7], we determined that a sample size of at least N=134 would be necessary to achieve 80% power for detecting a small to moderate effect size of $f^2 = 0.10$, using a standard alpha level of $\alpha = 0.05$.

However, for the RI-CLPM models, in light of our collected data and initial findings, we conducted a post-hoc sensitivity power analysis utilizing Monte Carlo simulations via the powRICLPM package [35]. The objective was to evaluate the smallest effect size that we could reliably detect with a power of 80% in the context of the RI-CLPM models. For this analysis, we drew upon data from one of the Models 2b that we had previously examined (refer to Table 1 for details). The results of our simulations indicated that our current sample size (N= 387) was

Table 1 Model description

| Model | Description |
|----------|---|
| Model 1a | Predictor and outcome only with unconstrained parameters |
| Model 1b | Predictor and outcome only with constrained parameters |
| Model 2a | Predictor, mediator, and outcome with unconstrained parameters |
| Model 2b | Predictor, mediator, and outcome with constrained parameters |
| Model 3 | Predictor, mediator, and outcome with constrained parameters and the path between predictor and outcome constrained to be null |
| Model 1 | Predictor, mediator, and outcome with unconstrained parameters |
| Model 2 | Predictor, mediator, and outcome with constrained parameters |
| | Model Model 1a Model 1b Model 2a Model 2b Model 3 Model 1 Model 2 |

insufficient to achieve adequate statistical power necessary to detect a standardized cross-lagged effect size of 0.1, using a significance level of $\alpha = 0.05$.

Measures

Neuroticism

To measure neuroticism, we used the 120-item International Personality Item Pool-NEO (IPIP-NEO-120) [36]. The neuroticism subscale contains 24 phrases that describe 6 underlying facets of the concept, such as anxiety, anger, depression, self-consciousness, immoderation, and vulnerability. Each item is measured on a 5-point Likert scale from 1 (almost never) to 5 (almost always). The instrument proved to be reliable in our study, with $\alpha = 0.93$ in all three waves.

Social-cognitive vulnerabilities

Anxiety sensitivity was assessed using the Anxiety Sensitivity Index (ASI-16) [37], which measures the belief that experiencing anxiety has negative consequences. It consists of 16 items rated on a 5-point Likert scale from 0 (very little) to 4 (very much). The ASI-16 demonstrated strong internal consistency, with coefficients between $\alpha = 0.91$ and $\alpha = 0.93$.

Regarding intolerance of uncertainty measurement, the instrument chosen was the Intolerance of Uncertainty Scale (IUS-12) [20]. IUS-12 measures two facets of the concept: prospective anxiety and inhibitory anxiety. The items are rated on a 5-point Likert scale from 1 (not at all characteristic of me) to 5 (entirely characteristic of me). For the purpose of this study, the total IUS-12 score was considered, as recommended in the original validation study [20]. Our data confirmed the instrument's good internal consistency (α = 0.92 to 0.93).

We measured experiential avoidance using the Brief Experiential Avoidance Questionnaire (BEAQ) [38]. It was constructed to measure avoidant behaviors using a 6-point Likert scale ranging from 1 (strongly disagree) to 6 (strongly agree). The instrument yielded satisfactory internal consistency ($\alpha = 0.89$ to 0.90).

The Looming Maladaptive Questionnaire (LMSQ-R) measures the looming cognitive style through six vignettes depicting scenarios of rapidly increasing anxiety. It contains two subscales: physical and social looming. The total score is the average of the 2nd to 4th questions across all six vignettes, which are rated on a 5-point Likert scale [31]. Our study found the instrument to be highly reliable, with internal consistency ranging from $\alpha = 0.93$ to $\alpha = 0.95$.

Internalizing symptoms

The Patient Health Questionnaire 9 (PHQ-9) [39] was used to measure the depression symptoms. The PHQ-9 comprises 9 items to which the subject responds using a Likert scale ranging from 0 (not at all) to 3 (almost every day). Our study revealed a strong internal consistency of the instrument with an α = 0.89 to 0.91.

Anxiety symptoms were measured with the Generalized Anxiety Disorder Scale 7 (GAD-7) [40]. The instrument was developed to capture anxiety symptomatology within the last two weeks. The items are rated on a 4-point Likert scale, spanning from 0 (not at all) to 3 (almost every day). The internal consistency for the present study was satisfactory, $\alpha = 0.91$ to 0.93.

Concerning panic symptoms, we used the Panic Disorder Severity Scale (PDSS) [41], an instrument composed of 7 items that measure the magnitude of symptoms specific to panic disorder. The items are rated on a 5-point Likert scale. Our data confirmed the instrument's good psychometric proprieties, with Cronbach's $\alpha = 0.92$ to 0.94.

Analytic strategy

We conducted our statistical analyses in R, using the lavaan package [42] and RI-CLPM method [43]. This method breaks down longitudinal relationships between two constructs (using at least three waves) into stable between-person associations (time-invariant components of different individuals) and temporal within-person dynamics (deviations of the within-person effects from these between-person components). This approach allows for the estimation of within-person cross-lagged effects while accounting for the influence of stable trait factors, such as neuroticism.

There has been an ongoing discussion about the ambiguity created by RI-CLPM and CLPM in differentiating between within-subject and between-subject variance. Traditional CLPM is typically viewed as focusing on between-subject variability [44] and is also nested within RI-CLPM [45]. Because CLPM estimates average effects for the entire sample, we used it to further explore results from the more favored RI-CLPM approach, which effectively separates within-person and between-person effects. Despite its critiques, some scholars argue that traditional CLPM is still useful for descriptive and predictive analysis of between-person effects [44, 46].

Using the RI-CLPM, we examined between-subject and within-subject levels. We investigated whether individuals with greater levels of neuroticism report greater levels of social-cognitive factors and symptoms than those with low neuroticism. Additionally, we assessed if short-term deviations from an individual's usual level of social-cognitive vulnerabilities predict subsequent fluctuations in internalizing symptoms. Understanding these dynamics is crucial, as the vulnerabilities and symptoms may fluctuate over time, which the RI-CLPM effectively captures by analyzing individual deviations.

Regarding the mediation analysis, we tested a series of nested models. In the first model, we fitted a simple 2-variable RI-CLPM to test the presence of a lagged relationship between the predictor (neuroticism) and the outcome (internalizing symptoms). We considered two versions of this model: in Model 1a, parameters were freely estimated, whereas in Model 1b, contemporaneous, autoregressive, and cross-lagged effects were constrained to be stable over time (see Fig. 1). The second model was a three-variable RI-CLPM in which we added a candidate mediator (social-cognitive factors). In one version, parameters could vary freely over time (Model 2a), and in the other, contemporaneous, autoregressive, and cross-lagged effects were constrained to be stable over time (Model 2b). This model allowed us to decompose the effect of neuroticism on the outcome into the direct and the mediated path (see Fig. 2). We also tested a mediation model (Model 3), identical to Model 2b, except that the direct path from neuroticism to the outcome was set to zero. Given one predictor, four candidate mediators, and three outcomes, we tested 12 models.



Fig. 1 Model 1a with unconstrained parameters for RI-CLPM. Note: Model 1b is similarly represented, but the contemporaneous, auto-regressive, and cross-lagged parameters are constrained to be equal over time. For presentation considerations, the visual representation of the contemporaneous parameters regarding model 1a and the time-constrained parameters regarding model 1b were omitted



Fig. 2 Model 2a with unconstrained parameters for RI-CLPM. Note. Models 2b and 3 are similarly represented, but the contemporaneous, auto-regressive, and cross-lagged parameters are constrained to be equal over time. In addition, model 3 has a null relationship between the predictor and outcome. For presentation considerations, the visual representation of the contemporaneous parameters regarding model 2a, the time-constrained parameters regarding model 1b, and the null relationship between the predictor and outcome from model 3 were omitted

For the CLPM, we used a simplified strategy, choosing the most parsimonious model based on degrees of freedom between a simpler constrained model (Model 2) and a more complex time-variant model (Model 1). Table 1 provides a summary of the models.

Several fit indices were of interest in evaluating the goodness of fit of the models: the comparative fit index (CFI), the root mean square error of approximation (RMSEA), and the standardized root mean squared residual (SRMR). Additionally, we report the Tucker–Lewis index (TLI) in the supplemental materials. The interpretation of these indices follows the guidelines established by Hu and Bentler [47] and Browne and Cudeck [48]. According to these guidelines, CFI and TLI values should be close to 0.95 or higher to indicate a good fit, while RMSEA and SRMR values below 0.08 also suggest a good fit.

Results

Preliminary analysis

We performed a multivariate analysis of variance comparing participants who engaged in only two waves (N=22) with those who participated in all three waves (N=351). The results showed no significant differences, F(8, 371) = 0.40, p = .91, suggesting that the missing data pattern is likely random. Consequently, all 373 participants were included in the final analysis using the full information maximum likelihood method. Reliability indices and descriptive statistics are detailed in Supplemental Materials Sect. 1.

Before the main analyses, we calculated the intra-class correlations (ICC) to assess the variance attributed to differences between individuals versus within individuals. For neuroticism, 85% of the variance was due to between-person differences, while 15% was from within-person fluctuations. Regarding social cognitive factors, the variance attributed to between-person differences was 73% for looming, 76% for anxiety sensitivity, 79% for intolerance of uncertainty, and 77% for experiential

avoidance. For internalizing symptoms, the between-person variance was 72% for depression, 71% for anxiety, and 62% for panic. These results, while indicating a significant percentage of variance explained by between-person fluctuations, support the decision to examine both within-person and between-person variations.

Main analysis

Correlation between neuroticism, social-cognitive factors, and internalizing symptoms

Regarding the association between the social-cognitive factors with themselves and with the trait factor (neuroticism), the data presented in Table 2 shows the correlation indices, with the lowest situated at 0.40 between panic symptoms and experiential avoidance at time 1, and the highest at 0.76 between anxiety symptoms and neuroticism. All social-cognitive factors correlated with neuroticism: the correlation indices fell between 0.60 for neuroticism with experiential avoidance and 0.71 for neuroticism with intolerance of uncertainty. We reported only the T1 correlations to establish baseline associations between neuroticism, social-cognitive vulnerabilities, and internalizing symptoms. Demonstrating significant correlations at T1 provides initial support for the mediation model, as it confirms that the variables are meaningfully related before testing their longitudinal relationships.

Fit indices and model triage

Regarding the fit indices of the CLPM models, the complex models (model 1 in CLPM) presented no significant differences compared to the simple models (model 2 in CLPM). Because the time constraints did not affect the models, we chose the simple (constrained) to proceed with further analyses: $\chi^2(21) < 192.78$, *ps* > 0.001, CFIs > 0.97, RMSEAs < 0.14, SRMR < 0.05.

Similarly, for RI-CLPM, we chose the most parsimonious models based on the degrees of freedom, eliminating Models 1a and 2a. For all the dependent variables, Model 1b fit the data very well, all $\chi^2(6) < 8.27$, ps > 0.219, CFIs > 0.99, RMSEAs < 0.03, SRMR < 0.02, and so did Model 2b, all $\chi^2(15) < 17.13$, ps > 0.310, CFIs > 0.99, RMSEAs < 0.02.

The final models selected for analyses and data reporting were the most parsimonious models with constrained parameters (Model 2 for CLPM and Model 2b for RI-CLPM). The fit indices for all models (CLPM and RI-CLPM) can be consulted in Supplemental Materials Sect. 2.

Cross-lagged panel modeling

Before conducting the mediation analysis, we explored the lagged relationships in CLPM on the following pathways: neuroticism and internalizing symptoms, neuroticism and social-cognitive factors, and social-cognitive factors and internalizing symptoms.

Neuroticism was found to be a significant predictor of depression and anxiety, but not of panic. It also predicted social-cognitive factors at later stages, allowing for an examination of the pathways between neuroticism and outcomes.

Depression was predicted by anxiety sensitivity and experiential avoidance (T2-3, $\beta = 0.05$, p < .01 and $\beta = 0.04$, p < .01). Anxiety was similarly predicted by anxiety sensitivity, experiential avoidance (T2-3, $\beta = 0.06$, p < .001 and $\beta = 0.04$, p < .001), and intolerance of uncertainty (T2-3, $\beta = 0.06$, p < .001). Panic was also predicted by these three social-cognitive factors (T2-3, $\beta < 0.06$, p < 0.001).

Given these significant lagged results, we were able to test the mediation analyses. It was revealed that the combined influence of neuroticism and some of the socialcognitive factors predicts depression and anxiety. A total effect of neuroticism on depression and anxiety emerged in the case of experiential avoidance and intolerance of uncertainty. Specifically, apart from the direct effect of neuroticism, experiential avoidance also mediates the relationship between neuroticism and depression, while intolerance of uncertainty mediates the link between neuroticism and anxiety. In the case of panic, the hypothesized indirect effect model was supported, as anxiety sensitivity, experiential avoidance, and intolerance of uncertainty mediated panic's relationship with neuroticism. On the contrary, looming cognitive style failed to mediate this relationship. The results are presented in Table 3.

| Table 2 | Correlations | between | all | variables | at | T1 |
|---------|--------------|---------|-----|-----------|----|----|
|---------|--------------|---------|-----|-----------|----|----|

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|-------------------------------|----------|----------|----------|----------|----------|----------|----------|---|
| 1. Neuroticism | _ | | | | | | | |
| 2. Looming | 0.643*** | _ | | | | | | |
| 3. Anxiety sensitivity | 0.655*** | 0.678*** | _ | | | | | |
| 4. Experiential avoidance | 0.607*** | 0.460*** | 0.579*** | _ | | | | |
| 5. Intolerance of uncertainty | 0.722*** | 0.588*** | 0.662*** | 0.638*** | _ | | | |
| 6. Depression | 0.711*** | 0.522*** | 0.602*** | 0.602*** | 0.601*** | _ | | |
| 7. Anxiety | 0.770*** | 0.558*** | 0.657*** | 0.584*** | 0.668*** | 0.826*** | — | |
| 8. Panic | 0.517*** | 0.406*** | 0.546*** | 0.407*** | 0.426*** | 0.631*** | 0.639*** | _ |

Note. * p <.05, ** p <.01, *** p <.001

Table 3 Standardized coefficients (standard errors) for the mediation analyses in the CLPM

| Predictor | Mediator | Outcome | Total effect | Indirect effect | Direct effect |
|-------------|----------------------------|------------|----------------------------|---------------------------|----------------------------|
| Neuroticism | Looming | Depression | β=0.08(0.01)*** | $\beta = 0.00(0.00)$ | β=0.07(0.01)*** |
| | Anxiety Sensitivity | | β=0.07(0.01)*** | $\beta = 0.00(0.00)$ | $\beta = 0.06(0.01)^{***}$ |
| | Intolerance of Uncertainty | | $\beta = 0.07(0.01)^{***}$ | $\beta = 0.00(0.00)$ | $\beta = 0.07(0.01)^{***}$ |
| | Experiential Avoidance | | $\beta = 0.07(0.01)^{***}$ | $\beta = 0.00(0.00)^*$ | $\beta = 0.07(0.01)^{***}$ |
| | Looming | Anxiety | $\beta = 0.09(0.01)^{***}$ | $\beta = 0.00(0.00)$ | β=0.08(0.01)*** |
| | Anxiety Sensitivity | | $\beta = 0.08(0.01)^{***}$ | $\beta = 0.00(0.00)$ | β=0.07(0.01)*** |
| | Intolerance of Uncertainty | | $\beta = 0.08(0.01)^{***}$ | $\beta = 0.00(0.00)^{**}$ | β=0.07(0.01)*** |
| | Experiential Avoidance | | $\beta = 0.08(0.01)^{***}$ | $\beta = 0.00(0.00)$ | $\beta = 0.08(0.01)^{***}$ |
| | Looming | Panic | $\beta = 0.04(0.01)^{***}$ | $\beta = -0.00(0.00)$ | $\beta = 0.04(0.01)^{***}$ |
| | Anxiety Sensitivity | | $\beta = 0.02(0.01)^*$ | $\beta = 0.00(0.00)^*$ | $\beta = 0.02(0.01)$ |
| | Intolerance of Uncertainty | | $\beta = 0.02(0.01)$ | $\beta = 0.00(0.00)^*$ | $\beta = 0.01(0.01)$ |
| | Experiential Avoidance | | $\beta = 0.01(0.01)$ | $\beta = 0.00(0.00)^*$ | $\beta = 0.01(0.01)$ |

Note. * *p* <.05, ** *p* <.01, *** *p* <.001

Table 4 Between-person standardized estimates (covariances) and standard errors for the random intercepts

| Model (Predictor – Mediator – Outcome) | Predictor-Mediator | Predictor-Outcome | Mediator-Outcome |
|---|--------------------|-------------------|-----------------------------|
| Neuroticism – Looming – Depression | β=0.73 (1.21)*** | β=0.79 (7.82)*** | β=0.65 (0.38)*** |
| Neuroticism – Anxiety sensitivity – Depression | β=0.80 (14.02)*** | β=0.79 (7.19)*** | β=0.77 (5.19)*** |
| Neuroticism – Intolerance of uncertainty – Depression | β=0.82 (11.65)*** | β=0.79 (7.23)*** | β=0.66 (4.06)*** |
| Neuroticism – Experiential avoidance – Depression | β=0.72 (14.18)*** | β=0.80 (7.16)*** | β=0.68 (5.25)*** |
| Neuroticism – Looming – Anxiety | β=0.75 (1.08)*** | β=0.84 (6.84)*** | β=0.69 (0.33)*** |
| Neuroticism – Anxiety sensitivity – Anxiety | β=0.80 (13.86)*** | β=0.85 (6.40)*** | β=0.81 (4.55)*** |
| Neuroticism – Intolerance of uncertainty – Anxiety | β=0.82 (11.42)*** | β=0.85 (6.23)*** | $\beta = 0.78 (3.53)^{***}$ |
| Neuroticism – Experiential avoidance – Anxiety | β=0.73 (14.18)*** | β=0.85 (6.36)*** | β=0.69 (4.63)*** |
| Neuroticism – Looming – Panic | β=0.73 (1.38)*** | β=0.52 (7.54)*** | β=0.30 (0.42) |
| Neuroticism – Anxiety sensitivity – Panic | β=0.79 (14.70)*** | β=0.55 (6.23)*** | β=0.63 (4.89)*** |
| Neuroticism – Intolerance of uncertainty – Panic | β=0.82 (12.03)*** | β=0.56 (6.21)*** | β=0.48 (3.57)*** |
| Neuroticism – Experiential avoidance – Panic | β=0.72 (14.92)*** | β=0.56 (6.05)*** | β=0.50 (4.86)*** |

Note. * p <.05, ** p <.01, *** p <.001

Random-intercept cross-lagged panel modeling: covariance of the random-intercepts

The covariance between the random intercepts indicated the between-person effects in RI-CLPM. Table 4 describes their standardized estimates and standard errors.

The random intercepts of neuroticism were positively linked to internalizing symptoms, indicating that individuals with greater neuroticism levels tend to experience greater depression, anxiety, and panic. Additionally, greater neuroticism was associated with increased socialcognitive factors. The association between social-cognitive factors and internalizing symptoms was also significant and positive, except for panic.

These results were consistent with those obtained from the traditional CLPM approach. This indicates that both methods yield similar insights regarding the relationships and variations between subjects.

Random-intercept cross-lagged panel modeling: covariances, auto-regressive, and cross-lagged paths

The contemporaneous relationships revealed that individuals who scored above their average levels of

neuroticism experienced increased depression, anxiety, and greater levels of looming, anxiety sensitivity (except for Time 1), intolerance of uncertainty, and experiential avoidance (excluding Time 1). Those with elevated neuroticism also had a positive correlation with panic. Additional details on construct residual covariances can be found in Supplemental Materials Sect. 3.

Before conducting within-person mediation analyses, we first assessed the lagged main effects of neuroticism on depression, anxiety, and panic (Model 1b). We found no significant effects for depression and anxiety, so we did not test mediation models for these outcomes. For panic, an increase in neuroticism predicted a subsequent increase (β = 0.19, *p* =.04). However, the analysis of four Models 2b revealed that this effect was not mediated by any cognitive factors (all *ps* > 0.18). While neuroticism predicted panic initially, this relationship became nonsignificant when mediators were included. In summary, at the within-person level, the significant lagged effect was only for neuroticism predicting panic, and mediation analysis showed no significant relationships with the cognitive factors as mediators.

Discussion

In this study, we aimed to assess the role of socialcognitive factors in the relationship between vulnerability-related traits (neuroticism) and internalizing psychopathology (depression, anxiety, and panic). We did this using two analytical approaches: traditional CLPM and RI-CLPM. We compared the results based on the cross-lagged effects and the mediation analyses we conducted in both models.

Using traditional CLPM, we found some support for the mediational hypothesis in the relationship between neuroticism and internalizing symptoms. On the one hand, anxiety sensitivity, intolerance of uncertainty, and experiential avoidance mediated the relationship between neuroticism and panic, indicating a significant indirect effect. On the other hand, a significant total effect was found between neuroticism as predictor, intolerance of uncertainty, experiential avoidance as mediators, and both depression and anxiety as outcomes. Employing an RI-CLPM to examine the between-subjects effects yielded convergent results.

Our findings on anxiety sensitivity support previous research that indicates it captures cognitive aspects of panic, biasing thought processes, and increasing anxiety-related symptoms [49, 6]. Intolerance of uncertainty is associated with high-activation negative emotions, as it reflects pathological worry, a central feature in generalized anxiety disorder [16, 50]. Experiential avoidance significantly contributes to emotional disorders through maladaptive coping strategies [51]. Regarding looming, although it is related to anxiety [32], its importance diminishes when neuroticism is controlled. It appears that, while looming is a general factor in anxiety, its unique impact is limited when other broad factors are considered [5]. Future research should focus on the relationship between neuroticism and looming cognitive style, especially regarding threat evaluation, as traditional anxiety measures may obscure these effects.

The results highlight the importance of neuroticism as a risk factor for psychopathology, consistent with previous research [1, 52]. Our findings address whether neuroticism and social-cognitive factors jointly predict internalizing symptoms or if neuroticism has an indirect effect. While neuroticism can influence psychopathology through social-cognitive factors, it can also hold a direct effect, as explained by the primary and secondary emotional processes [53]. Our findings suggest that neuroticism indirectly affects panic through social-cognitive factors. Additionally, both neuroticism and social-cognitive vulnerabilities have a direct impact on depression and anxiety, with each contributing to the variation observed in these conditions. This distinction may arise from the nature of these emotions: panic is closely tied to fear, which is an object-related emotion, while depression and anxiety are more generalized. Understanding this difference aids in exploring the precursors of anxiety and panic and clarifies why neuroticism does not directly influence the onset of panic.

The results varied when examining the relationship between neuroticism and internalizing symptoms using the RI-CLPM at the within-person level. No significant relationships were found, except for panic symptoms, which did not support a mediation analysis.

The lack of predictive relationships between neuroticism, social-cognitive factors, and the three outcomes can be attributed to several factors. Recent discussions suggest limited evidence for the heterotypic continuity of psychopathology, where factors linked to specific symptoms fail to predict those correlated with different symptoms later [54]. This may explain why certain social-cognitive factors, such as anxiety sensitivity and intolerance of uncertainty, do not significantly impact internalizing symptoms like depression in a within-person analysis.

Additionally, methodological issues likely play a role. The challenges of performing a mediation analysis using RI-CLPM with only three time points can affect results. It appears that RI-CLPM has limitations when insufficient time points exist, which is important for interpreting our findings [55]. Most importantly, neuroticism and the social-cognitive factors we studied are stable, trait-like characteristics that tend to remain consistent over time. As a result, they are less vulnerable to fluctuations within individuals, which may explain the observed lack of variability within individuals. However, this stability also presents opportunities for future research. This aspect could be explored in future longitudinal studies in three ways. Firstly, researchers could investigate the temporally fluctuating processes that are neuroticism-driven that may explain internalizing symptoms at the within-person level. One such process is emotion dysregulation, which is highly context-dependent and influenced by situational factors. At a cross-sectional level, emotion dysregulation mediates the relationship between neuroticism and depression [56]. Examining within-person fluctuations in emotion dysregulation over short time intervals could provide insights into the connection between neuroticism and internalizing symptoms at this level. Secondly, researchers could consider larger time intervals, such as those spanning from adolescence to young adulthood, during which the stable constructs that we addressed in our study (the social-cognitive vulnerabilities) are more likely to fluctuate due to developmental changes. Thirdly, according to the whole trait theory [57], the Big-Five conceptualization of personality traits accounts for the distribution of the states that can be seen within an individual. This approach favors variability at a within-person level, as states are expected to fluctuate, even though they form a distribution with average tendencies. Therefore, experience sampling methods that capture the states contributing to neuroticism could be informative at the within-person level in future studies, helping to identify variability that may predict internalizing symptoms.

Comparing between-subjects and within-subjects effects reveals a complex relationship between variables. Small fluctuations in the average level of a risk factor do not significantly affect the severity of internalizing disorders when controlling the between-subjects effects. However, the average (dispositional) level of risk factors remains important, as it predicts subsequent internalizing psychopathology. These findings suggest that it is less important to focus on fluctuations in broad factors or specific factors. Instead, we should assess whether the average level, determined from repeated measurements, is high, average, or low since stable traits usually show minimal variation across measurements.

Finally, regarding the specificity of the social-cognitive factors to the internalizing disorders, our results also suggest that anxiety sensitivity holds specificity to panic disorder. Additionally, intolerance of uncertainty appears to be linked to anxiety-related disorders with high-activation negative emotions. Although experiential avoidance is not specific to a single disorder, its connection to internalizing symptoms suggests it acts as a reliable transdiagnostic factor.

To the best of our knowledge, this study is the first to use a longitudinal design to explore the interaction between personality traits and social-cognitive factors in predicting internalizing psychopathology. By viewing neuroticism from a distal factor perspective, we gain insights into how it influences internalizing symptoms through proximal social-cognitive factors. This underscores the need to consider neuroticism in assessing the continuum between normative manifestations and psychopathology. Furthermore, distinguishing between within-person and between-person effects of social-cognitive factors is crucial for understanding the development of psychopathology over time.

The present study had several limitations. Although it utilized a longitudinal design, the sample consisted only of undergraduate students, which limited variability in demographic characteristics and restricted generalizability. Because female participants comprised most of the sample, the results may not be generalized well to males. Utilizing only three time points in the longitudinal design, without controlling for the baseline outcome in the final mediation analysis, created challenges in analyzing within-subject effects and made it difficult to draw strong conclusions regarding mediational hypotheses.

Although traditional CLPM has been criticized for failing to clearly distinguish causal effects from mere correlations [58, 45], similar insights from RI-CLPM at the between-person level are to be considered when interpreting the results.

Future research should employ more measurement waves and a more diverse sample to enhance generalizability and explore state-like factors that could further clarify the mediation of psychopathology at the withinperson level.

Conclusions

The current study provides insights into the role of social-cognitive vulnerabilities as mediative mechanisms for the relationship between emotional-vulnerability personality traits (neuroticism) and internalizing psychopathology (depression, anxiety, and panic).

The findings indicate that, at a between-person level, neuroticism plays a significant role in understanding broader emotional states such as depression and anxiety, when considered alongside social-cognitive factors. Additionally, the research provides evidence that neuroticism has an indirect influence on specific symptoms related to particular objects, such as the intense feelings associated with panic attacks. This highlights the complex interplay between personality traits and cognitive processes in shaping emotional experiences.

Abbreviations

| CLPM | Cross-Lagged Panel Model |
|--------------|---|
| RI-CLPM | Random-Intercept Cross-Lagged Panel Model |
| IPIP-NEO-120 | International Personality Item Pool-NEO-120 |
| ASI-16 | Anxiety Sensitivity Index-16 |
| IUS-12 | Intolerance of Uncertainty Scale-12 |
| BEAQ | Brief Experiential Avoidance Questionnaire |
| LMSQ-R | Looming Maladaptive Style Questionnaire |
| PHQ-9 | Patient Health Questionnaire-9 |
| GAD-7 | Generalized Anxiety Disorder-7 |
| PDSS | Panic Disorder Severity Scale |
| CFI | Comparative Fit Index |
| RMSEA | Root Mean Square Error of Approximation |
| SRMR | Standardized Root Mean Squared Residual |
| TLI | Tucker-Lewis Index |
| ICC | Intra-Class Correlation |

Supplementary Information

The online version contains supplementary material available at https://doi.or q/10.1186/s40359-025-02716-x

Supplementary Material 1

Author contributions

D.F. conception, design of the work, the data acquisition, analysis, interpretation of data, drafting and revising the manuscript; CM.D. data acquisition, analysis, interpretation of data, revising the manuscript; MI.D. data acquisition, analysis, interpretation of data, revising the manuscript; FA.S. conception, design of the work, analysis, interpretation of data, revising the manuscript. All authors reviewed the final manuscript and gave their consent.

Funding

Not applicable.

Data availability

Data is provided within the manuscript or supplementary information files and on the Open Science Framework (OSF) repository: DOI https://doi.org/10. 17605/OSF.IO/R4P9S (https://osf.io/r4p9s/).

Declarations

Ethics approval and consent to participate

The study received ethical approval from the university's ethical committee (West University of Timişoara, no. 17661/15.03.2023). All steps of the study were in accordance with the ethical standards. An informed consent form was presented at the beginning of the study and all participants agreed to participate in exchange for course credit. No personal data that could be used to identify the participants (e.g., name, social security number) was collected.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Received: 24 January 2025 / Accepted: 8 April 2025 Published online: 18 April 2025

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