ABSTRACT

Title of Thesis:	EXPLORING A TRANSDIAGNOSTIC GENERAL PSYCHOPATHOLOGY FACTOR: RELATIONSHIPS WITH NEGATIVE EMOTIONALITY, POSITIVE EMOTIONALITY, AND CONSTRAINT
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This study explores the role of core personality traits, positive emotionality (PEM), negative emotionality (NEM), and constraint (CON), in relation to broad dimensions of psychopathology, including general psychopathology, internalizing, and externalizing. Using the Hierarchical Taxonomy of Psychopathology (HiTOP) framework, the study tests the hypothesis that psychopathology is associated with increased NEM and decreased PEM and CON. The study further examines whether CON moderates the relationship between PEM, NEM, and psychopathological dimensions, proposing that lower levels of CON are linked to higher levels of all three dimensions.

To assess these relationships, the study utilizes the Multidimensional Personality Questionnaire (MPQ), a self-report measure that includes three higher-order dimensions

associated with underlying neurobiological processes: PEM, NEM, and CON. The hypothesis is that the general psychopathology factor will be associated with a general pattern of increased NEM and decreased levels of PEM and CON, with CON moderating the effects of PEM and NEM on internalizing, externalizing, and the general psychopathology factor.

The study pooled four archival datasets. Internalizing was operationalized through self-report measures of depression and anxiety, while externalizing was assessed via the Externalizing Spectrum Inventory. An estimate of the HiTOP general psychopathology factor was operationalized by the shared variance of internalizing and externalizing. Zero-order correlations examined the relationships between MPQ dimensions (PEM, NEM, CON) and HiTOP spectra (internalizing, externalizing, general psychopathology factor). Path analyses assessed the general psychopathology factor's role in the relationships between the MPQ factors and psychopathology dimensions. Moderation analyses tested whether CON moderated the effect of PEM and NEM on these dimensions.

The results supported the hypotheses, showing that the general psychopathology factor was linked to increased NEM and decreased PEM and CON. Internalizing evidenced a similar pattern for PEM and NEM, but with a significant drop in the role of CON, suggesting affect may have more impact than control for internalizing. Externalizing, on the other hand, evidenced no significant relationship to PEM, and decreases in the role of NEM and increases in the role of CON suggest COG has the strongest role in EXT (relative to INT and GP), with a prominent role of negative affect. Moderation analyses demonstrated PEM and NEM on the general psychopathology factor were moderated by CON, where higher levels of CON were associated with a significant reduction in the pattern of increased NEM and decreased PEM, predicting

lower levels of externalizing and the general psychopathology factor. Notably, the interaction between NEM and CON was not significant in predicting internalizing, consistent with the significantly reduced role of CON for INT, relative to EXT and GP. These findings suggest that higher levels of constraint may contribute to more adaptive emotional functioning, which is associated with reduced externalizing and general psychopathology.

By estimating the relationships between these transdiagnostic mechanisms, the present study contributes towards an understanding of how affective and control processes influence psychopathology. This framework offers new directions for research and potential targets for transdiagnostic treatments.

EXPLORING A TRANSDIAGNOSTIC GENERAL PSYCHOPATHOLOGY FACTOR: RELATIONSHIPS WITH NEGATIVE EMOTIONALITY, POSITIVE EMOTIONALITY, AND CONSTRAINT

by

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Chapter 1: Introduction

Quantitative Dimensional Models

Formal diagnostic systems, such as the Diagnostic and Statistical Manual of Mental Disorders (DSM) and the International Classification of Diseases (ICD), have long been the primary means of understanding psychopathology (Compton & Guze, 1995). However, there have been several limitations to these categorical models, including problems of comorbidity, heterogeneity within a diagnosis, and arbitrary distinctions between dimensions of psychopathology and its severity (Barlow et al., 2004; Kessler et al., 2003, 2005; Krueger et al., 2014; Solomon et al., 2000). To address this, there is a push to view mental health through a transdiagnostic lens, focusing on core processes and common vulnerabilities that contribute to multiple disorders (Dalgleish et al., 2020; Zarate-Guerrero et al., 2022). This paradigm shift laid the groundwork for the development of frameworks like the Hierarchical Taxonomy of Psychopathology (HiTOP).

Development of the Hierarchical Taxonomy of Psychology

HiTOP builds on foundational work in psychopathology, such as Dr. Thomas Achenbach's introduction of the terms 'internalizing' and 'externalizing' to describe groupings of behavioral, emotional, and social problems found in clinically referred children (Achenbach, 1966). Achenbach created a descriptive classification system, the Child Behavior Checklist (CBCL) for parents to screen abnormal behavior and emotions in children (Achenbach, 1991). Recognizing that these problems tend to co-occur in children, Achenbach employed quantitative methods like factor analysis to

group behavior problems that manifested in children's outward behavior or altered their internal psychological environment (Achenbach et al., 2016; Liu et al., 2024). Thus, behavior problems labeled schizoid, depressed, uncommunicative, obsessive-compulsive, and somatic complaints were loaded onto a second-order factor, internalizing, and behaviors including hyperactivity, aggression, and delinquency were loaded onto a factor, externalizing (Achenbach, 1978).

Recognizing these dimensional syndromes in child studies, researchers began conducting factor analysis to assess patterns of comorbidity within adults, with one looking at the DSM-III-r lifetime diagnoses of common disorders in the National Comorbidity Survey (NCS) sample. This study found that a three-factor variant of the traditional two-factor model had the best fit, with internalizing having two subfactors (anxious-misery and fear) and the other factor being externalizing (Krueger, 1999). This study further recognized that comorbidity is a result of underlying core psychopathological constructs that manifest as separate disorders, thus sparking continued interest in a more dimensional, quantitative classification of mental health.

Researchers continued to be dissatisfied with the existing diagnostic systems, with the inadequacies expanding beyond comorbidity to include heterogeneity of presentations with single disorders and poor inter-rater agreement, leading to poor understanding of an individual's mental health (Chmielewski et al., 2015; Galatzer-Levy & Bryant, 2013). In response to this dissatisfaction, a consortium of researchers and clinician nosologists continued employing quantitative methods to understand psychopathology, leading to the development of HiTOP, as a dimensional alternative to the traditional diagnostic system (Kotov et al., 2017).

HiTOP organizes psychopathology in a hierarchical structure, with its lowest level looking at signs, symptoms, and maladaptive traits grouped into specific dimensions such as performance anxiety and separation insecurity (Kotov et al., 2021). Its next level looks at related signs and symptoms that strongly co-occur, which forms separate, dimensional syndromes. The next level looks at broader spectra, externalizing and internalizing, and its highest level indexes their covariance into a superspectra, known as the generalized psychopathology factor or *p*-factor, reflecting overall maladaptation or impairment (Caspi & Moffitt, 2018; Kotov et al., 2018).

It is also important to acknowledge that the concept of the *p*-factor has garnered both interest and skepticism. Critics have raised concerns regarding the model's fit and its construct validity, questioning whether the p-factor truly represents a latent general psychological vulnerability construct, across a variety of symptom presentations, e.g. with genetic influences, or if it merely serves as an index of general impairment due to the problem behaviors indexed by psychopathology (McCabe et al., 2022; Watts et al., 2024). The findings from the present study do not rely on a model of a general psychopathology factor as a validated latent vulnerability factor, and thus can contribute to understanding framed solely as an index of general impairment. Notably, the idea of a general psychopathology factor also exists beyond HiTOP's framework(Smith et al., 2020), and which do not rely on inferring a latent vulnerability factor. Thus, while understanding of GP is emerging, the present study has relevance whichever frame may come to be more supported as this work progresses.

Although HiTOP was not initially designed for direct use in clinical practice, efforts have since been made to integrate it into practice (Ruggero et al., 2019). These efforts include systematic assessment tools, including a recently developed HiTOP-Self-Report, and treatments that utilize a transdiagnostic approach to treating mental health (Cicero et al., 2024). Recent research suggests that the *p*-factor holds potential clinical utility as clinicians can use it to determine the necessary duration and intensity of an individual's treatment plan, monitor progress, and identify vulnerabilities. Notably, two randomized control trials have indicated that the *p*-factor is influenced by treatment and accounted for most of the changes observed following interventions (Aitken et al., 2020; Constantinou et al., 2019). This positions *p*-factor as a measurable and actionable target in mental health treatment.

HiTOP's hierarchical structure further enhances its clinical potential by emphasizing psychological dysfunction across various levels. At its highest level, HiTOP can inform predictions about healthcare utilization, while lower levels, like symptom components, can guide the development of targeted treatments (Conway et al., 2023; Kotov, 2016; Michelini et al., 2021). HiTOP represents a pivotal advancement in understanding psychopathology, offering a framework that evolves alongside the field. Importantly, this adaptability reflects the growing recognition that dimensional models, which encompass foundational blocks of psychopathology, can enhance HiTOP's applicability by identifying actionable targets for intervention.

Personality and Psychopathology

The quantitative movement that led to the emergence of frameworks like HiTOP also helped advance the field of personality research. Early psychologists focused on trait-based approaches to look at personality as a quantifiable construct like factor analysis and cluster analysis identified dimensions of symptomology that helped form a basis for understanding personality (Cattell, 1943; Eysenck, 1944; Clark & Watson, 1991; Tellegen, 1985).

Such studies led to new models of personality, including the Five-Factor Model, known as the Big Five, with dimensions of extraversion, agreeableness, conscientiousness, neuroticism, and openness to experience (Briggs, 1992; Digman, 1990; McCrae & Costa, 1987; Miller, 1991). Another model influential model, the Big Three, proposed by Clark and Watson (1991) and Tellegen (1985) includes dimensions of negative emotionality (NEM), positive emotionality (PEM), and constraint (CON). Since their inception, these models have been studied extensively, being linked to various forms of psychopathology, such as anxiety, depression, and personality disorders (Kotov et al., 2010; Lamers et al., 2012; Miller, 1991).

Recognizing these links, researchers turned to affective studies to explore the dynamic and emotional components of human experience, providing a more nuanced understanding of personality traits and their relationship to mental health. In this pursuit, researchers continued utilizing factor analysis, consistently finding two dominant dimensions: positive affect and negative affect (E. Diener et al., 1985; Tellegen, 1985; Watson & Clark, 1991). Looking at personality and affect, Tellegen introduced the Multidimensional Personality Questionnaire (MPQ), a self-report assessment consisting of 11 primary trait scales and three higher-order factors: PEM,

NEM, and CON (Tellegen, 2003). These three higher-order factors are temperamental in nature and are conceptually linked to neurobiological systems, with PEM implicated in systems of appetitive approach and NEM implicated in systems of defensive withdrawal. CON has been conceptually linked to traits like impulsivity, self-regulation, and behavioral restraint, all of which are often considered facets of cognitive control (Patrick et al., 2002; Tellegen, 1985; Tellegen et al., 1999; Watson et al., 1999).

Further, these three dimensions have been implicated in psychopathology, with MPQ's NEM correlating positively, and for women, PEM correlating negatively with internalizing. Additionally MPQ's CON is found to negatively correlate with externalizing (Krueger et al., 2001). Individuals with lower levels of CON are characterized by impulsivity, disinhibition, and lower levels of harm avoidance (Baskin-Sommers et al., 2014). The inhibitory processes of CON's control system has found to moderate activity of motivational systems and subsequent behaviors, thus impacting levels of PEM and NEM (Read et al., 2010). While many existing studies have examined how traits, like personality, influence outcomes of psychopathology, few look at how the interactions between dimensions affect these relationships (Kotov et al., 2017). Given the importance of personality in determining treatment outcomes in psychotherapy, our study aims to explore how the dimensions of personality and temperament and their interactions relate to various dimensions of psychopathology (Lengel et al., 2016; Zinbarg et al., 2008).

Existing Frameworks and Neurophysiological Findings

The dimensions of the MPQ serve as markers of control and affective personality dimensions that are central to understanding psychopathology. Both older and newer models, such as the Cognitive-Affective System Theory of Personality (CAPS) and the Research Domain Criteria (RDoC), emphasize the roles of the propensity to positive and negative affectivity, cognitive control, and motivational processes in both normative functioning and psychopathology (Cuthbert & Insel, 2013; Mischel & Shoda, 1995). Similarly, transdiagnostic therapeutic intervention frameworks, such as the Unified Protocol, have been created targeting these same domains (Barlow et al., 2004; David et al., 2011).

Expanding on these frameworks, recent neuroimaging research has delved into the common networks associated with emotional dysregulation, a widely acknowledged transdiagnostic feature across psychopathologies (Berking & Wupperman, 2012). A review of such studies identified irregular patterns within specific subsets of these networks directly linked to neurobehavioral domains of positive valence, negative valence, and cognitive control (McTeague et al., 2020).

One of the most extensively studied of these domains is negative affect, which reflects a tendency toward negative states like anxiousness, distress, and irritability, which is a core feature of internalizing disorders, with negative emotionality being considered a core dispositional factor involved in both depression and anxiety disorders (Clark & Watson, 1991; Tellegen, 1985). Importantly, studies also link negative affect with externalizing disorders, suggesting a strong genetic influence on this association, with individual-specific environmental factors playing a smaller yet

significant role (Singh & Waldman, 2010; Waldman et al., 2011). Moreover, research indicates that negative affect encompasses genetic and environmental influences in relation to internalizing and externalizing in childhood, suggesting that negative affect may be key to their covariance, encompassed by *p*-factor (Krueger & Markon, 2006; Lilienfeld, 2003; Mikolajewski et al., 2013; Rhee et al., 2007; Tackett et al., 2011). Neuroimaging studies provide further insight, showing that dysfunction within the cingulate-amygdala circuit may underlie higher levels of negative affect. Such dysfunction is evident across a range of disorders, including schizophrenia, substance dependence, conduct disorders, mood disorders, and anxiety disorders (Cremers et al., 2010; Etkin et al., 2010; Marsh et al., 2008; Matthews et al., 2008; Rasetti et al., 2009; Upadhyay et al., 2010). Together, these findings suggest that negative affect, or emotionality, serves as a key transdiagnostic mechanism implicated across the higher dimensions in HiTOP.

While increased negative affectivity is a well-established vulnerability factor for internalizing and externalizing disorders, the role of positive valence in psychopathology is more nuanced. For instance, both enhanced and reduced positive valence activation have been implicated in pathologies (Kujawa et al., 2020). Unipolar depression has been associated with impaired levels of several components associated with positive valence and affect, such as positive emotion, reward processing, and approach motivation (Pizzagalli et al., 2008; Thibodeau et al., 2006; Treadway & Zald, 2011). Increased positive feelings can act as a protective barrier against stressors, showing enhanced resilience and potentially safeguarding against depression (Lindahl & Archer, 2013; Ong et al., 2006). However, elevated activation

of reward processing and approach motivation, both central concepts in the positive valence domain , is a characteristic of bipolar disorder (Alloy & Abramson, 2010; Nusslock et al., 2014). Moreover, neuroimaging studies have linked higher levels of externalizing to impairments in positive valence systems, suggesting that this transdiagnostic mechanism is relevant across various forms of psychopathology. Therefore, positive valence abnormalities may serve as a transdiagnostic mechanism across various forms of psychopathology.

Beyond affective dimensions, cognitive control or executive function represents another core transdiagnostic mechanism implicated in psychopathology. Impaired cognitive control has been identified as a key indicator of susceptibility to latent psychopathology (Buckholtz & Meyer-Lindenberg, 2012; McTeague et al., 2016). Additionally, cognitive control has a substantial genetic component, with individual differences in general cognitive control capability having an estimated heritability of 99%, underscoring its role as a biologically based vulnerability across psychopathologies (Friedman et al., 2008). Notably, the cognitive control neural circuitry is implicated in impulsivity as well as emotional regulation (Peckham & Johnson, 2018). In addition, deficits in executive cognition span across disorders, including schizophrenia, attention-deficit/hyperactive disorder, major depressive disorder, and substance dependence (Barkley, 1997; Garavan & Hester, 2007; Luck & Gold, 2008; Murrough et al., 2011). Supporting this, neuroimaging studies have shown that the dorsal lateral prefrontal-cingulate-parietal network, which is implicated in cognitive control, attention, and working memory, exhibits patterns of

abnormal connectivity in individuals with these deficits in executive cognition (Castellanos & Proal, 2012; Ma et al., 2010; Vasic et al., 2009).

While many models of psychopathology examine affective and cognitive control processes, a cohesive framework assessing the interactions between these constructs and their impact on diverse psychopathological outcomes is lacking. As our study does not utilize behavioral paradigms to assess for cognitive control, we will use the variable of constraint to look at facets within the cognitive control domain, namely impulsivity, self-regulation, and behavioral restraint (Read et al., 2010). The present study aims to investigate the relationships between positive and negative affect, control systems, and their interactions with distinct and overlapping domains of psychopathology.

Current Study

Our study investigates how the temperament dimensions of the MPQ (PEM, NEM, and CON) interact to influence psychopathological outcomes as measured by self-report estimated HiTOP constructs, internalizing, externalizing, and *p*-factor. Since our study includes an imperfect index of *p*-factor, we will call this variable the general psychopathology factor, or GP. We hypothesize that the domains of psychopathology related to HiTOP's internalizing, externalizing, and GP will be related to the MPQ factors in the same pattern: decreased PEM and CON and increased NEM. Further, we hypothesize that CON will moderate the relationship between PEM and NEM in relation to the HiTOP spectra, in which lower levels of CON would correspond to greater levels of psychopathology. By incorporating this moderation effect, our study extends existing models to explore how the interactions

of these affective and cognitive processes influence psychopathological outcomes. This study aims to test the broader concept that general psychopathology is linked to disruptions in affective and control systems, characterized by increased negative emotionality and reduced positive emotionality and constraint.

Chapter 2: Methods

Study Participants and Datasets

Data analysis conducted in the Clinical and Cognitive Neuroscience (CCN) Laboratory, led by Dr. Edward Bernat, aims to test our hypothesis across four datasets (N=153; N=120; N=156, N=249; Total N=678). Across the four datasets, the mean age of participants was 26.6 years (SD=13.1), with 57.5% identifying as female and 73.74% as White. Sample characteristics for the combined datasets are presented in Table 1.

HiTOP Measures and Data Standardization

Externalizing

All datasets examined externalizing (EXT) by utilizing the Externalizing Spectrum Inventory (ESI) comprised of 100 or 160 items carefully selected based on their highest loadings on the general factor derived from the original ESI, which initially included 415 items (ESI-100, ESI-160; (Patrick et al., 2013). Both versions of the ESI brief form consist of the items with the strongest loadings on the general factor from the original 415 items of the ESI form (Krueger et al., 2007; Patrick et al., 2013). They are designed to measure externalizing proneness through facets related to aggression, irresponsibility, deceitfulness, impulsivity, sensation-seeking, and substance use and abuse (Soe-Agnie et al., 2021). Before analysis, the ESI data were standardized using z-scores in RStudio, ensuring a mean of 0 and a standard deviation of 1. This transformation was applied to the ESI data in each dataset to ensure that the variable was on a comparable scale before merging (Adhikari et al., 2021).

Internalizing

The initial two datasets examined internalizing (INT) by using the Inventory of Depression and Anxiety Symptoms (IDAS), a reliable 64-item self-report instrument grounded in factor analysis, designed to measure depression and anxiety (Watson et al., 2007). The IDAS includes two broad scales—a 10-item Dysphoria scale and a 20-item General Depression scale. Additionally, there are 10 specific symptoms scales, derived from factor analysis—Well-Being, Suicidality, Lassitude, Insomnia, Appetite Loss, Appetite Gain, Ill Temper, Panic, Social Anxiety, and Traumatic Intrusions—all of which have demonstrated internal consistency and good convergent and discriminant validity (Stasik-O'Brien et al., 2019). The 64 items were summed, with some items being reverse-scored as per the IDAS manual. The data was then scaled in R Studio using z-scores within each dataset.

The two additional datasets employed principal axis factoring (PAF) in SPSS to calculate scores for an internalizing factor. This factor was defined by the shared variance between the Zung Depression Scale and the State-Trait Anxiety Inventory-Trait (STAI-T), aligning with methodologies from previous studies that assess internalizing behavior by examining the covariance between its constructs, namely anxiety and depression (Bernat et al., 2020; McGlinchey & Zimmerman, 2007; Watson et al., 2008). The Zung Self-Rating Depression Scale measures depression behaviors and consists of 20 items on a four-point Likert Scale ('a little of the time'; 'some of the time'; 'a good part of the time'; 'most of the time') with items being summed (Zung, 1965). The STAIT-T measures behaviors that represent anxiety and consists of 20 items on a four-point Likert Scale ('not at all'; 'a little'; 'somewhat'; 'very much so') that are summed for scoring (Spielberger et al., 1970). After

calculating shared variance, the internalizing variables in all datasets were standardized using z-scores in R Studio.

General Psychopathology Factor

The general psychopathology (GP) variable was calculated using principal axis factoring (PAF) in SPSS, leveraging the shared variance between the dataset's internalizing and externalizing variables (Gomez et al., 2019). This method parallels the factor analyses conducted by Caspi et al. (2014) in their work on the p-factor, which also aimed to integrate internalizing and externalizing dimensions into a unified construct of general psychopathology. Following the calculation of the GP scores, they were standardized using z-scores before the integration of the four datasets.

The MPQ Brief Form Scoring

All datasets employed the MPQ Brief Form (MPQ-BF), consisting of 155 self-report items. All items are rated on a two-point scale (True =1; False=0), with 34 items being reverse coded. The MPQ-BF yields 11 primary trait scales with 12 items each (Well-being, Social Potency, Achievement, Social Closeness, Stress Reaction, Alienation, Aggression, Harm Avoidance, Traditionalism, Control, Absorption) and three higher-order dimensions (Positive Emotionality, Negative Emotionality, Constraint) which embody temperament and affect constructs supported by empirical psychobiological evidence (Patrick et al., 2002). A 14-item ‘Unlikely Virtues’ scale acts as a stand-alone index of social desirability. It is utilized to assess an individual’s tendency to deny socially undesirable traits, thus gauging the validity of one’s responses. The MPQ utilizes two scales to index inconsistency in responses. The

Variable Response Inconsistency scale assesses discrepancies in answers for item pairs with similar content and scored in the same direction. The True Response Inconsistency scale assesses discrepancies in answers for item pairs with similar content but scored in the opposite direction. The questionnaire was scored with all dimensions being calculated based on established scoring syntax (Patrick et al., 2002). All scores reflect a t score, with ranges of 22-78, with a mean of 50 and a standard deviation of 1. All While the MPQ states the three higher-order factors are orthogonal, we confirmed this with our data using a correlation matrix on R Studio.

All variables (PEM, NEM, CON, INT, EXT, GP) were standardized using z-scores after merging the four datasets to ensure consistency in the measurement units across all variables and facilitate meaningful comparisons (Guilloux et al., 2011). More details on the scoring information of these self-report measures (ESI, STAI-T, ZUNG, IDAS, MPQ) can be found in their respective manuals or papers (Patrick et al., 2013; Spielberger, 1970; Zung, 1965; Watson et al., 2007; Patrick et al., 2002).

Statistical Analyses

We conducted zero-order correlations using Pearson's correlations to assess the relationships between individual components of HiTOP (INT, EXT, GP) and MPQ factors (PEM, NEM, CON). Multiple linear regression was used to examine the extent to which PEM, NEM, and CON predict scores on INT, EXT, and GP. This approach allows us to assess the unique contribution of each predictor (PEM, NEM, and CON) while controlling for the others, providing insight into how these dimensions individually and collectively impact the outcome variables (INT, EXT, and GP). To compare correlation coefficients, Fisher's Z transformation was applied,

followed by a Z-test for independent correlations (Fisher, 1921). The analyses were conducted in RStudio. To account for multiple comparisons, a Bonferroni correction was applied to adjust the significance threshold, reducing the risk of Type I error inflation (Holm, 1979). Adjusted p-values were used to determine statistical significance.

To understand the contribution of GP in these relationships, we conducted path analyses using the MPQ's PEM, NEM, and CON as predictors, with GP as the mediator, and internalizing (INT) and externalizing (EXT) as outcomes, employing Hayes' Process Macro in R Studio. Six distinct path models were tested: (1) PEM predicting INT, mediated by GP and covaried by NEM and CON; (2) PEM predicting EXT, mediated by GP and covaried by NEM and CON; (3) NEM predicting INT, mediated by GP and covaried by PEM and CON; (4) NEM predicting EXT, mediated by GP and covaried by PEM and CON; (5) CON predicting INT, mediated by GP and covaried by PEM and NEM; (6) CON predicting EXT, mediated by GP and covaried by PEM and NEM. Indirect effects were estimated using bootstrapping with 5000 resamples. All results are reported as standardized coefficients. We also examined whether CON moderates the relationships between PEM and NEM with GP, INT, and EXT using Hayes' PROCESS to estimate moderation effects (Hayes, 2013).

Chapter 3: Results

Zero-Order Correlations

Zero-order correlations assessed the relationships between PEM, NEM, and CON with GP, EXT, and INT (Table 1). Fisher's Z transformations were conducted to compare the correlations between different pairs of variables, with Bonferroni corrections applied to adjust for multiple comparisons (Table 2). Findings supported our a priori hypothesis that GP is associated with a pattern of increased NEM and decreased PEM and CON. While these overall patterns held for EXT and INT, one discrepancy was observed: While PEM and EXT have a nominal negative relationship, they are not significantly correlated.

Table 2a presents the comparisons of correlations between MPQ traits and different psychopathology domains (GP, INT, EXT), highlighting how these traits relate to each domain distinctly. Comparisons between INT and EXT demonstrated significant differences in all three MPQ traits. PEM and NEM comparisons demonstrated that these affect measures have a stronger relationship with INT than EXT, while CON has a stronger relationship with EXT. Thus, internalizing may be more driven by heightened emotional imbalance, while externalizing may be driven more by deficits in control.

Table 2b presents the comparisons of correlations between MPQ traits within psychopathology domains (GP, INT, EXT)

Regressions

Multiple linear regressions were conducted to examine the unique contributions of PEM, NEM, and CON in predicting INT, EXT, and GP scores. Predictors were standardized before the analysis; therefore, the regression models will be presented in standardized units. The model predicting GP was statistically significant, and PEM, NEM, and CON were all significant predictors of GP (Table 3). NEM acted as the strongest predictor, indicating that for general psychopathology, negative emotionality may need to be a primary target during treatment. In addition, targeting aspects of CON, such as impulsivity and self-regulation, through methods like cognitive restructuring may increase treatment success.

The model predicting INT was statistically significant, and PEM, NEM, and CON all significantly predicted INT (Table 4). Specifically, NEM had a positive standardized effect on INT, while both PEM and CON had significant negative standardized effects. NEM acted as the strongest predictor, indicating that higher negative emotionality is a key driver for internalizing symptoms. While PEM and CON are also important variables, treatments for internalizing disorders and symptoms may find greater benefit in targeting processes that contribute to negative emotionality.

The model predicting EXT was statistically significant, and NEM and CON were significant predictors of EXT. In contrast, PEM was not significantly associated with EXT (Table 4). These findings suggest that NEM and CON are important factors

influencing externalizing behavior, while PEM does not appear to have a significant direct relationship with EXT in this model. Thus, negative emotionality, impulsivity, and self-regulation may be more effective treatment targets in treating externalizing disorders.

Path Analyses

Path analyses examined the extent to which PEM, NEM, and CON influenced INT and EXT through the general psychopathology factor (GP). All indirect effects were estimated using bootstrapping with 5000 resamples. All results are reported as standardized coefficients. The model examining the effects of the MPQ's PEM, NEM, and CON on INT through GP was significant, $R^2 = .68$, $F(4, 673) = 363.38$, $p < .001$. The total effect of PEM on INT was significant ($\beta = -.15$, $p < .001$), as were both the direct effect ($\beta = -.08$, $p < .001$) and the indirect effect through GP ($\beta = -.08$, $p < .05$), indicating that GP partially mediates this relationship (Figure 1).

The total effect of NEM on INT was significant ($\beta = .50$, $p < .001$), but the direct effect was not ($\beta = .04$, $p = .20$), suggesting that GP fully mediates the relationship (Figure 2). The significant indirect effect ($\beta = .46$, $p < .05$) underscores the central role of GP in linking NEM to INT. Thus, NEM is a broad risk factor for psychopathology, broadly, that may manifest as internalizing symptoms in some individuals.

For CON, the total effect on INT was significant ($\beta = -.09$, $p < .01$), but the direct effect was positive ($\beta = .13$, $p < .001$), while the indirect effect through GP was significant and negative ($\beta = -.22$, $p < .001$) (Figure 3). This pattern suggests that GP serves as a mediator with a suppression effect in the relationship between CON and

INT. While increasing levels of constraint through treatments targeting emotional regulation and impulsivity may reduce GP and, consequently, INT, overly rigid control may exacerbate internalizing symptoms in some individuals (Eisenberg et al., 2001; Tandon et al., 2009).

The model examining the effects of the MPQ's PEM, NEM, and CON on EXT through GP was significant, $R^2 = .69$, $F(4, 673) = 374.16$, $p < .001$. The total effect of PEM on EXT was not significant ($\beta = .003$, $p = .92$). However, both the direct effect ($\beta = .07$, $p < .01$) and the indirect effect through GP ($\beta = -.08$, $p < .05$) were significant, suggesting that GP mediates this relationship with a suppression effect (Figure 4). The total effect reflects the nonsignificant relationship found in the zero-order correlations. However, the direct effect indicates that once controlling for GP, higher levels of PEM are associated with greater EXT. Importantly, increased levels of reward-seeking, a facet of PEM, are often seen in substance use disorder, aggression, and antisocial behaviors (Franken et al., 2006; Hasking et al., 2011). Future studies should work to parse out the facets of PEM that drive these opposite effects.

The total effect of NEM on EXT was significant ($\beta = .35$, $p < .001$), but the direct effect was not ($\beta = -.03$, $p > .05$), indicating that GP fully mediates the relationship between NEM and EXT. The significant indirect effect ($\beta = .46$, $p < .05$) highlights GP's crucial role in this relationship and suggests that NEM's influence on EXT is highly dependent on GP (Figure 5). While increased levels of NEM reflect a broad vulnerability to both INT and EXT, its effects on EXT can be explained

through its broad impact on GP, rather than EXT-specific traits like impulsivity or aggression.

Similarly, the total effect of CON on EXT was significant ($\beta = -.35$, $p < .001$), as were both the direct effect ($\beta = -.13$, $p < .001$) and the indirect effect through GP ($\beta = -.22$, $p < .001$), indicating that GP significantly contributes to this relationship (Figure 6). Thus, treatments targeting constraint can reduce externalizing symptoms by reducing GP as well as through independent mechanisms.

Moderation Analyses

The first analysis tested whether CON moderates the relationship between PEM and GP. The overall model was significant as well as the interaction between PEM and CON (Figure 7). As shown in the conditional effects, at lower levels of CON (-1 SD), the negative relationship between PEM and GP was stronger, while at the mean level of CON and higher levels of CON (+1 SD), the negative relationship remained significant but weakened. These findings suggest that higher levels of CON attenuate the negative impact of PEM on GP, with the relationship being more pronounced at lower levels of CON. Thus, increased levels of CON reduce the impact of low PEM on GP.

The second analysis tested whether CON moderates the relationship between NEM and GP as well as the interaction between NEM and CON (Figure 8). At lower levels of CON (-1 SD), the positive relationship between NEM and GP was stronger, while at the mean level and higher levels of CON (+1 SD), the positive relationship remained significant but weakened. These findings suggest that higher levels of CON attenuate the positive impact of NEM on GP, with the relationship being more

pronounced at lower levels of CON. Similarly to its effect on the relationship between PEM and GP, higher levels of CON mitigate the impact of high NEM on CON, serving as a protective factor against general psychopathology.

The third moderation analysis tested whether CON moderates the relationship between PEM and INT (Figure 9). The overall model was significant as was the interaction between PEM and CON. At lower levels of CON (-1 SD), the negative relationship between PEM and INT was stronger, while at the mean level and higher levels of CON (+1 SD) the negative relationship between PEM and INT was still significant but weaker. Thus, higher levels of CON act as a buffer of low PEM's effects on INT.

The fourth analysis tested whether CON moderates the relationship between NEM and INT (Figure 10). While the overall model was significant, the interaction between NEM and CON was not, suggesting that CON does not moderate the relationship between NEM and INT.

The fifth analysis tested whether CON moderates the relationship between PEM and EXT (Figure 11). The overall model was significant, as was the interaction between PEM and CON. At lower levels of CON (-1 SD), the negative relationship between PEM and EXT was stronger, while at the mean level and higher levels of CON (+1 SD), the negative relationship remained significant but weakened. These findings suggest that higher levels of CON attenuate the negative impact of PEM on EXT, with the strength of their negative relationship being more pronounced at lower levels of CON.

The sixth analysis tested whether CON moderates the relationship between NEM and EXT (Figure 12). The overall model was significant as well as the interaction between NEM and CON. As shown in the conditional effects, at lower levels of CON (-1 SD), the positive relationship between NEM and EXT was stronger, while at the mean level and higher levels of CON (+1 SD), the positive relationship remained significant but weakened. These findings suggest higher levels of CON act as a buffer for high levels of NEM's effect on externalizing behaviors.

Overall, these findings highlight that increased levels of CON act as a protective factor in mitigating psychopathological risk associated with reduced levels of PEM and increased levels of NEM.

Chapter 4: Discussion

This study aimed to assess how temperament dimensions assessed by the MPQ can interact to influence psychopathological outcomes measured through the constructs of externalizing, internalizing, and a general psychopathology factor. Specifically, the results confirm the anticipated relationship, indicating that broadly, psychopathology was associated with heightened negative emotionality, reduced positive emotionality, and control disruptions. Further, by investigating these biobehavioral systems and their links with estimates of HiTOP's spectra of psychopathology, this study contributes to the establishment of transdiagnostic mechanisms to establish the foundation for a cohesive, comprehensive model of psychopathology.

However, there were several deviations from the expected patterns, specifically seen in the path analyses. For instance, this study's path analysis presented two notable deviations for the internalizing model: CON exhibited a significant positive direct effect on INT, and NEM did not have a significant direct on INT as GP fully mediates their relationship. This may be due (in part or full) to the specifics and limitations of the present data already discussed. At the same time, it is worth considering that this complexity may stem from the multifaceted nature of internalizing disorders, which encompasses different levels of hyperarousal, anhedonia, and cognitive control (Angold, 2003; Brislin et al., 2021; Clark & Watson, 1991; Gunnar & Vazquez, 2006). Specifically, CON's positive direct effect on INT may reflect similar patterns observed in other areas. For example, increased neurocognitive functioning might lead to increased symptoms of fear and distress due

to increased levels of prospection and a propensity toward rumination (Brislin et al., 2021; Penney et al., 2015). Additionally, anxious individuals may rely on increased reactive control related to anxious apprehension (Paulus, 2015). Thus, CON's significantly weaker correlation in INT than both GP and EXT may be the result of internalizing disorder's heterogeneity and should be investigated further, divided into internalizing distress and fear subcategories.

Another finding that deviated from our hypothesized relationships was PEM's significant positive direct effect on externalizing. However, this deviation is consistent with literature linking the externalizing factor with increased scores on Behavioral Activation System Drive and Fun seeking scales, related to positive affect and reward responsiveness (Brislin et al., 2022)

At the same time, PEM also showed a significant negative indirect effect on externalizing through GP, suggesting that while PEM is directly positively linked to externalizing behaviors, this may be better understood as the effect increased general psychopathology rather than specifically PEM. This may reflect PEM's role in both reward sensitivity and adaptive motivational processes, which can have differential effects depending on the level of general psychopathology present (Brislin et al., 2022; Kaczkurkin, 2022). This result may indicate that interventions targeting externalizing behaviors may need to account for both positive emotional traits and underlying general psychopathology.

Aligning with previous literature, zero-order correlations and the multiple regressions indicated NEM as the strongest driver of INT, EXT, and GP

Zero-order correlations indicated that lower levels of positive emotionality may act as a risk factor for psychopathology, consistent with existing literature (Heininga & Kuppens, 2021). Mediation analysis demonstrates that GP partially mediated PEM's effects on INT and EXT, indicating that positive emotionality could be a critical focus for interventions. Indeed, such treatments are already in existence, including the application of mindfulness in a mindfulness-based stress reduction (MBSR) framework, which aims to enhance trait positive affect and overall well-being through the processes of decentering, attentional broadening, and cognitive reappraisal (Garland et al., 2017). Positive psychological interventions are shown to enhance positive emotional states and have been effective in decreasing levels of depression and minimizing engagement in substance-use behaviors (Krentzman, 2013; Quoidbach et al., 2015; Seligman et al., 2005).

This study's findings on negative emotionality demonstrated a significant positive relationship with psychopathology, supporting our hypothesis and prior findings that negative affect is a crucial driver of psychopathology (Brown et al., 1998; McTeague et al., 2020; Salehinejad et al., 2017; Stanton & Watson, 2014; Wichers et al., 2007). Interestingly, the effect of negative emotionality on externalizing and internalizing psychopathology is fully mediated by the GP. This finding underscores the shared association of GP and negative emotionality with increased levels of impairment and suggests a significant overlap in the mechanisms linking both constructs to functional difficulties (Kaczkurkin, 2022; Tackett et al., 2011). Numerous current interventions, such as mindfulness training and cognitive behavioral treatments, focus on negative emotions and seek to change unhelpful

thought and behavior patterns that perpetuate these feelings, such as rumination and avoidance (Chambers et al., 2008; Lohr et al., 2007).

The findings of the study regarding constraint also corroborate our hypothesis and align with previous research, indicating that impaired control systems are negatively correlated with INT, EXT, and GP (McTeague et al., 2016; Salehinejad et al., 2017). Importantly, moderation analyses exhibited that reduced levels of constraint appear to elevate the risk for these dimensions of psychopathology, even when positive and negative emotionality remain constant. Existing interventions, including mindfulness-based practices and cognitive behavioral therapy, have shown promise in enhancing cognitive control and reducing maladaptive cognitions, thus promoting well-being and mitigating psychopathology (Chang et al., 2018; Yang et al., 2018).

We recognize that numerous interventions address all three of these transdiagnostic mechanisms to treat various forms of psychopathology (McLaughlin et al., 2019; Villalobos et al., 2021; Yang et al., 2018). This recognition underscores the rationale for our focus on these three mechanisms in our study, as understanding their interplay can inform the development of more targeted and effective therapeutic approaches. For instance, interventions such as the Unified Protocol for Transdiagnostic Treatment of Emotional Disorders leverage cognitive-behavioral techniques to target neuroticism and associated emotional dysregulation while enhancing cognitive flexibility (Barlow et al., 2017; Farchione et al., 2012).

Focusing on the MPQ constructs of PEM, NEM, and CON may be particularly valuable due to their conceptual overlaps with RDoC's positive valence,

negative valence, and cognitive control systems, respectively. Indeed, PEM strongly aligns with positive valence constructs like reward responsiveness and hedonic receptors, as well as sharing neural links to dopaminergic activity (Khazanov et al., 2020; Olino, 2016). NEM is correlated with negative valence's processes of fear, distress, and threat detection, and both share a link to the brain's defensive motivational system (Cuthbert & Insel, 2013; Patrick & Kramer, 2017).

RDoC views its cognitive domain as complex, outlining its components as goal selection, response inhibition, and performance monitoring (Glahn et al., 2016). MPQ's CON dimension explores a person's inclination for self-restraint versus impulsivity, focusing on characteristics like caution, rational thinking, and the ability to foresee events and plan accordingly. The concept of CON has been linked to Gray's behavioral inhibition system, which is recognized to have neuropsychological foundations (Patrick et al., 2002; Gray, 1987; Tellegen, 1985). In this context, MPQ's constraint reflects the ability to inhibit maladaptive behaviors and activate goal-directed responses, paralleling aspects of RDoC's cognitive construct, perhaps most centrally cognitive control.

While the MPQ does not fully capture the breadth of these RDoC constructs, it may help uncover relationships between HiTOP and RDoC, contributing to ongoing efforts to integrate these two transdiagnostic frameworks (Michelini et al., 2021). However, this study does not utilize validated measures of RDoC constructs, highlighting a need for future research to examine the links between the MPQ and RDoC domains. Such work could pave the way for developing more practical self-

report measures of RDoC constructs, facilitating their application in research and clinical contexts.

Limitations

This study established the relationships of biobehavioral personality traits, PEM, NEM, and CON, in predicting and perhaps maintaining domains of psychopathology. However, it is crucial to point out several key limitations. Our study aims to understand the mechanisms underlying *p*-factor, which often reflects the shared variance across internalizing, externalizing, and thought disorders. Due to the absence of data on thought disorders in our study, we opted to label this construct as "general psychopathology". In addition, many other studies have looked at this construct as the shared variance of just internalizing and externalizing (Caspi et al., 2014). However, a future study including a larger sample of participants with thought disorders can increase the generalizability of our study's findings.

Using self-report measures for both personality traits and psychopathological domains is a feasible approach to collecting data, but it also has its limitations. This may create illusory correlations due to the common method variance, which arises when researchers collect independent and dependent variables via the same measurement source (self-report) (Cooper et al., 2020). Thus, it is crucial for future research to employ various techniques to assess these constructs, e.g., particularly biological methods relative to indexing psychopathology.

Future Directions

Future research should prioritize the investigation of the neural mechanisms that underlie individuals with elevated INT, EXT, and GP, with particular attention to

brain regions associated with constraint and cognitive control, including the dorsolateral and ventrolateral prefrontal cortices, anterior cingulate cortex, and anterior insula (C. Diener et al., 2012). Longitudinal studies could monitor the activation of regions implicated in both positive and negative emotionality, as well as a constraint over time, thus examining their relationship with fluctuations in internalizing and externalizing symptoms following cognitive behavioral therapy. Understanding the activation and interactions of these neural networks marks a significant step forward in our comprehension of various psychopathologies. This approach shifts from merely examining the activity of specific brain regions in disorders to emphasizing the impact of internetwork communication, enhancing our insights into the networks and neural patterns that play a role in the formation and persistence of psychopathological profiles (Barch, 2017). By understanding network dysfunctions, researchers can identify risk factors and gain insights into why certain symptoms appear more frequently in specific disorders than in others (Buckholtz et al., 2010; Vasic et al., 2009; Yang et al., 2018).

Advances in multimodal data, including self-report, neuroimaging, and genetic methods, offer promising insights into the structural, functional, and behavioral underpinnings of psychopathology (Meiering et al., 2023; Royer et al., 2024). By integrating neuroimaging, genetic, and behavioral data, we can more accurately map MPQ constructs onto HiTOP's dimensions, uncovering specific biobehavioral mechanisms across distinct psychopathological spectra (Sprooten et al., 2017, 2022; Zarate-Guerrero et al., 2022) This integrated approach, particularly in examining affective and control processes, can inform the development of more

targeted and effective therapeutic interventions (McTeague et al., 2016; Meiering et al., 2023).

Design Considerations

This study employed a cross-sectional design that integrated data from four different studies. A key reason for merging these datasets was to enhance the overall sample size, which improves statistical power in identifying significant relationships between the two frameworks (Andrade, 2020). Furthermore, this approach enabled us to encompass a broader age range, ensuring that our findings are not limited to any specific age group, which further bolsters the validity of the results (Goodwin et al., 2023). By encompassing a broad age range, the study ensures that the findings reflect emotional and control functioning across different life stages, addressing potential age-related variability in psychopathology (Erskine et al., 2007; Lutz et al., 2018) Pooling data from the different studies also allowed for more comprehensive analyses and improved the external validity of our results, especially as one dataset over-sampled externalizing participants and another over-sampled internalizing participants (Adhikari et al., 2021).

Conclusion

Explorations of these transdiagnostic affective and control experiences may serve as a basis for understanding the vulnerabilities that contribute to the high rate of comorbidities found within traditional diagnostic systems. Overall, this study examined the relationships between the MPQ's higher-order factors and HiTOP's internalizing, externalizing, and general psychopathology dimensions to explore how these temperamental traits contribute to transdiagnostic mechanisms influencing

psychopathology. The results supported the hypotheses, revealing that the general psychopathology factor was linked to increased NEM and decreased PEM and CON. Internalizing showed a similar pattern for PEM and NEM, but with a significant reduction in the role of CON, suggesting that affect plays a more prominent role than cognition in internalizing. In contrast, externalizing showed no significant relationship with PEM, with decreases in the role of NEM and increases in the role of CON, indicating that control (CON) is most influential in externalizing relative to internalizing and GP, with a notable role for negative affect.

Importantly, this study highlights constraint's moderating effects on positive and negative emotionality and their interplay with psychopathology, suggesting control as a pivotal therapeutic target. These findings suggest that higher levels of constraint can foster more adaptive affective functioning. Further studies should continue investigating not only the mechanisms involved in psychopathology but also how the interactions of these mechanisms affect behavioral and functional outcomes.

Appendices

Table 1. Correlation Table of Variables

Variable	PEM (r)	NEM (r)	CON (r)
GP	-.19 ***	.60 ***	-.29 ***
EXT	-.06	.45 ***	-.37 ***
INT	-.25 ***	.53 ***	-.10 **

Significance codes: ***p < .001; **p < .01; *p<.05.

Table 2a. Comparison of Between Domain Correlations Using Fisher's Z and Bonferroni Correction

Comparison	Z	p (Bonferroni-adjusted)
PEM Comparisons		
PEM-INT vs. PEM-EXT	-3.53	.0004**
PEM-INT vs. PEM-GP	-1.13	.257
PEM-EXT vs. PEM-GP	2.40	.016*
NEM Comparisons		
NEM-INT vs. NEM-EXT	2.09	.037*
NEM-INT vs. NEM-GP	-1.80	.073
NEM-EXT vs. NEM-GP	-3.88	.0001**
CON Comparisons		
CON-INT vs. CON-EXT	5.23	< .0001***
CON-INT vs. CON-GP	3.62	.0003**
CON-EXT vs. CON-GP	-1.60	.109

Table 2b. Comparison of Within-Domain Correlations

Comparison	Z	p (Bonferroni-adjusted)
GP Comparisons		
GP-PEM vs. GP-NEM	-16.47	< .0001***
GP-PEM vs. GP-CON	1.77	.077
GP-NEM vs. GP-CON	18.23	< .0001***
INT Comparisons		
INT-PEM vs. INT-NEM	-15.63	< .0001**
INT-PEM vs. INT-CON	-2.85	.004**
INT-NEM vs. INT-CON	12.78	< .0001***
EXT Comparisons		
EXT-PEM vs. EXT-NEM	-15.29	< .0001***
EXT-PEM vs. EXT-CON	1.05	.29
EXT-NEM vs. EXT-CON	16.34	< .0001***

Note. Fisher's Z tests were used to compare correlation coefficients. *p*-values were adjusted using Bonferroni correction. $p < .05$ (*), $p < .01$ (**), $p < .001$ (***).

Table 3. Standardized Regression Coefficients for the Prediction of GP from PEM, NEM, and CON

Predictor	β	Standard Error	t-value	p-value
(Intercept)	0	.03	0	1
PEM	-.09	.03	-3.15	< .01
NEM	.57	.03	19.05	< .001
CON	-.27	.03	-9.40	< .001

Model Information

Multiple R-squared = .44, Adjusted R-squared = .43, F(3, 674) = 173.8, p < .001.

Note. The coefficients presented above are standardized regression coefficients (β).

Table 4. Standardized Regression Coefficients for the Prediction of Internalizing (INT) from PEM, NEM, and CON

Predictor	β	Standard Error	t-value	p-value
(Intercept)	0	.03	0	1
PEM	-.15	.03	-4.63	< .001
NEM	.49	.03	15.08	< .001
CON	-.09	.03	-2.88	< .01

Model Information

Multiple R-squared = .31, Adjusted R-squared = .31, F(3, 674) = 101.4, p < .001.

Note. The coefficients presented above are standardized regression coefficients (β).

Table 5. Standardized Regression Coefficients for the Prediction of Externalizing (EXT) from PEM, NEM, and CON

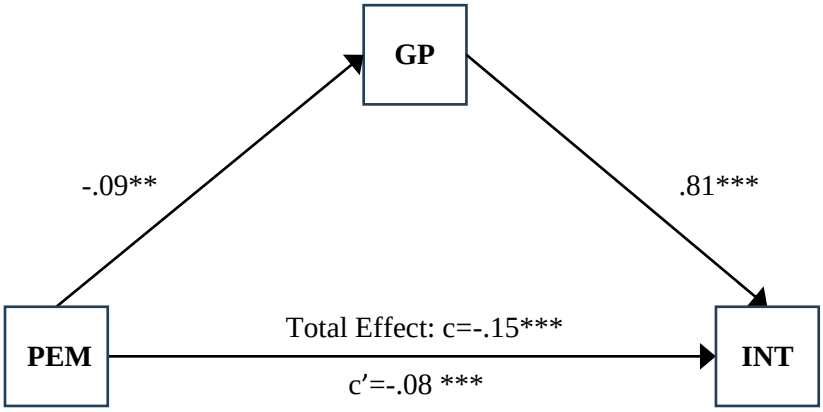
Predictor	β	Standard Error	t-value	p-value
(Intercept)	0	.03	0	1
PEM	-.001	.03	-.03	.98
NEM	.43	.03	13.16	< .001
CON	-.35	.03	-10.95	< .001

Model Information

Multiple R-squared = .32, Adjusted R-squared = .32, F(3, 674) = 105.9, p < .001.

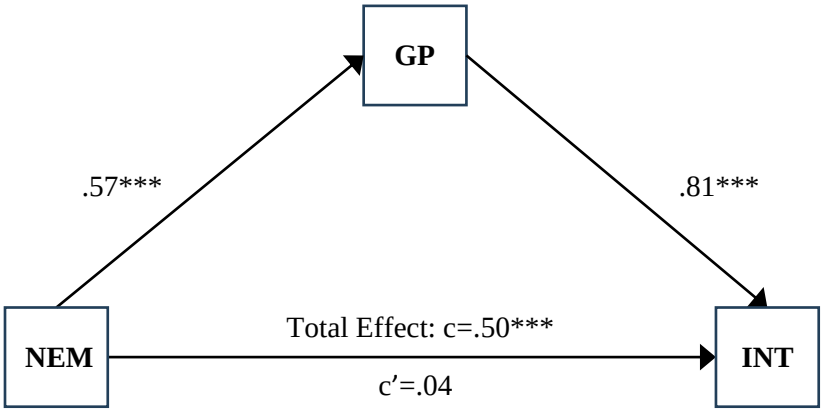
Note. The coefficients presented above are standardized regression coefficients (β).

Figure 1. PEM on INT Mediated by GP



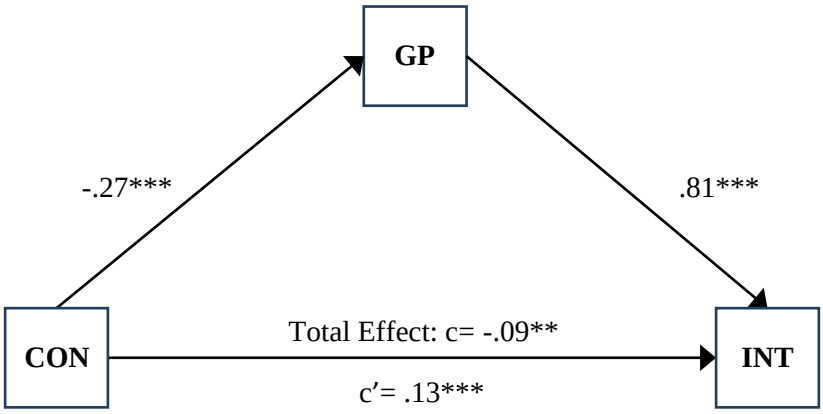
Proportion mediated= .50
ab=-.08 [95% CI: -.13, -.02]
Covariates: NEM and CON

Figure 2. NEM on INT Mediated by GP



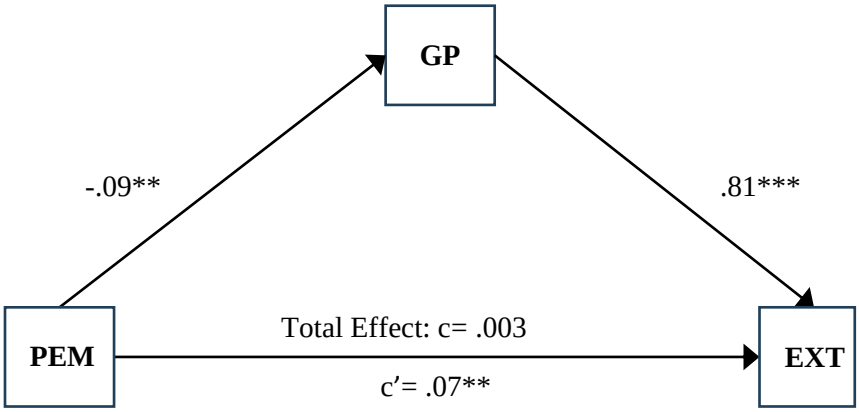
Proportion mediated= .93
ab= .46 [95% CI: .41, .51]
Covariates: PEM and CON

Figure 3. CON on INT Mediated by GP



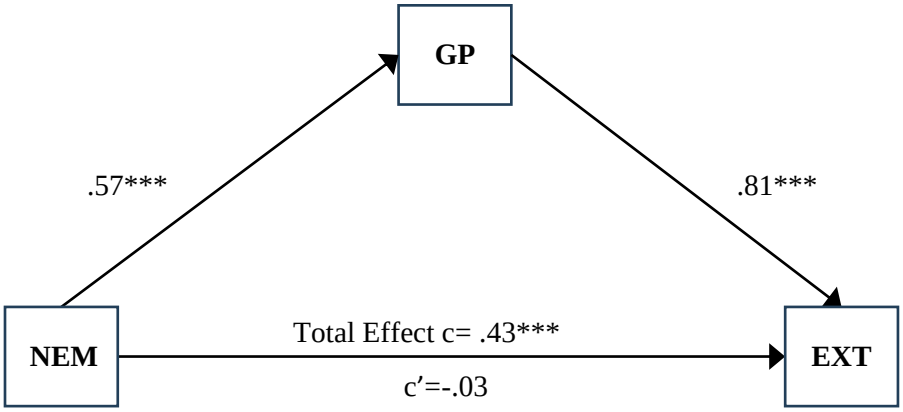
Proportion mediated= 2.41
ab= -.22 [95% CI: -.27, -.17]
Covariates: PEM and NEM

Figure 4. PEM on EXT Mediated by GP



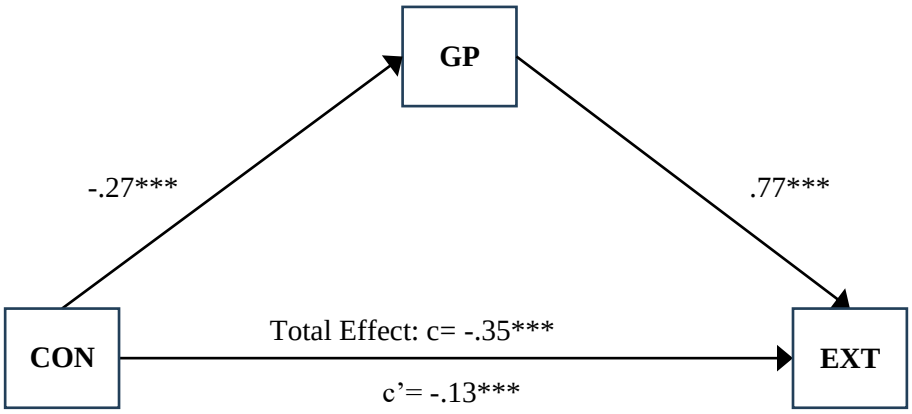
Proportion mediated=N/A
ab= -.08 [95% CI: -.12, -.02]
Covariates: NEM and CON

Figure 5. NEM on EXT Mediated by GP



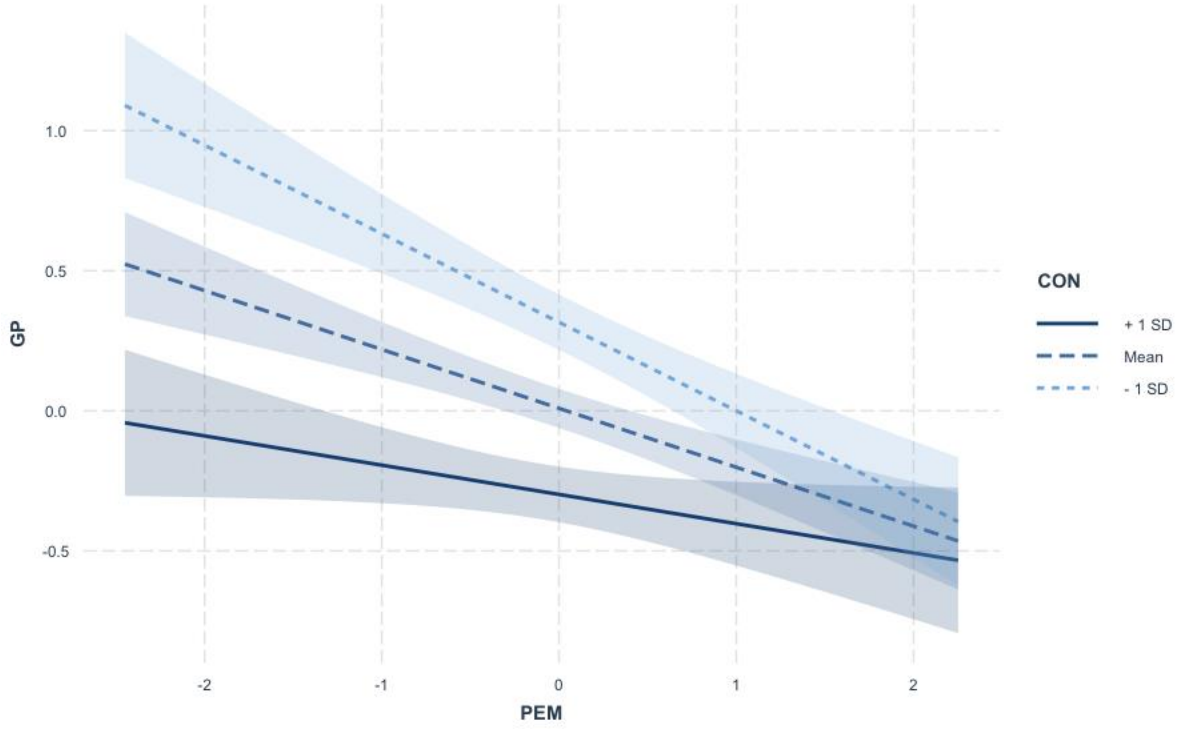
Proportion mediated= 1.07
ab= .46 [95% CI: .39, .53]
Covariates: PEM and CON

Figure 6. CON on EXT Mediated by GP



Proportion mediated= .63
ab= -.22 [95% CI: -.27, -.18]
Covariates: PEM and NEM

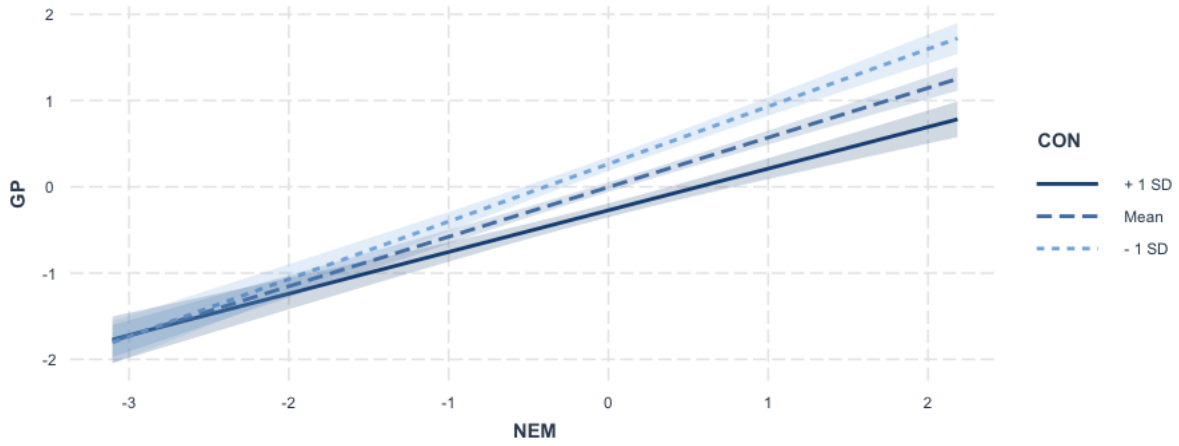
Figure 7. PEM on GP Moderated by CON



Overall Model Significance. $F(3, 674) = 37.82$, $p < .001$, $R^2 = .144$.

The interaction between PEM and CON was significant (b = 0.1058, SE = 0.0354, t = 2.99, p = .0029). As shown in the conditional effects, at lower levels of CON (-1 SD), the negative relationship between PEM and GP was stronger (b = -0.3161, SE = 0.0484, t = -6.53, p < .001). At the mean level of CON, the relationship remained significant (b = -0.2103, SE = 0.0359, t = -5.86, p < .001), and at higher levels of CON (+1 SD), the negative relationship weakened but remained significant (b = -0.1044, SE = 0.0522, t = -2.00, p = .0459). These findings suggest that higher levels of CON attenuate the negative impact of PEM on GP, with the relationship being more pronounced at lower levels of CON.

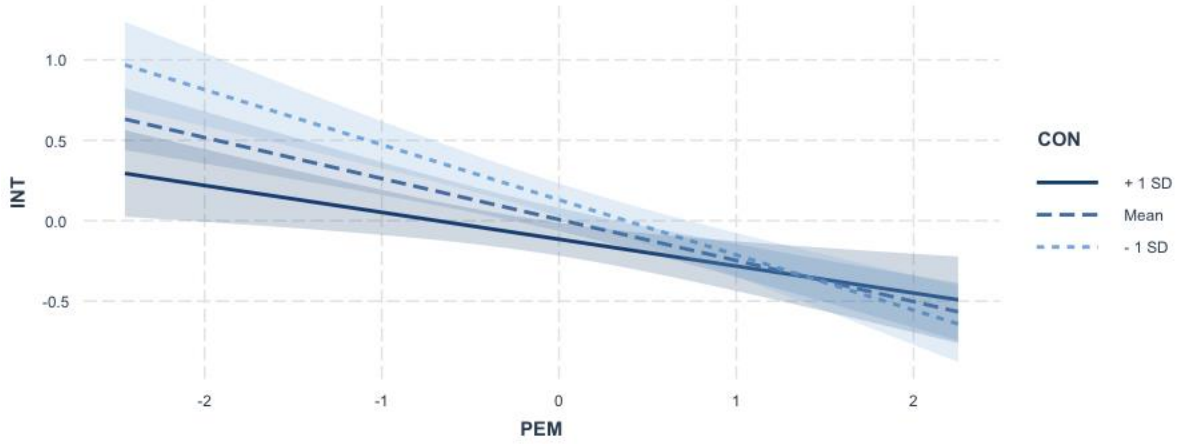
Figure 8. NEM on GP Moderated by CON



Overall Model Significance. $F(3, 674) = 174.22$, $p < .001$, $R^2 = .437$.

The interaction between NEM and CON was significant (b = -0.0919, SE = 0.0283, t = -3.25, p = .0012). As shown in the conditional effects, at lower levels of CON (-1 SD), the positive relationship between NEM and GP was stronger (b = 0.6666, SE = 0.0381, t = 17.49, p < .001). At the mean level of CON, the relationship remained significant (b = 0.5747, SE = 0.0291, t = 19.72, p < .001), and at higher levels of CON (+1 SD), the positive relationship weakened but remained significant (b = 0.4829, SE = 0.0429, t = 11.25, p < .001). These findings suggest that higher levels of CON attenuate the positive impact of NEM on GP, with the relationship being more pronounced at lower levels of CON.

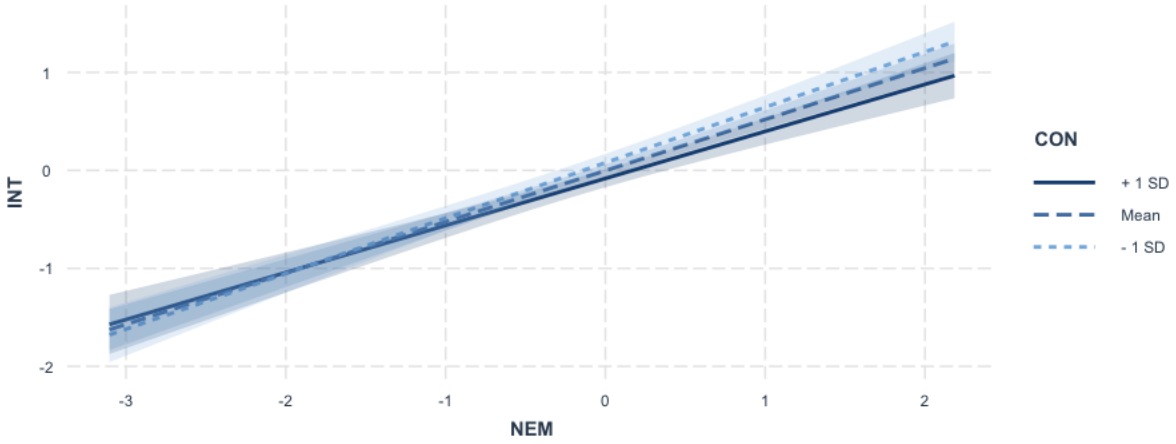
Figure 9. PEM on INT Moderated by CON



Overall Model Significance. $F(3, 674) = 21.25$, $p < .001$, $R^2 = .086$.

The interaction between PEM and CON was significant (b = 0.0877, SE = 0.0365, t = 2.40, p = .017). As shown in the diagram, at lower levels of CON (-1 SD), the negative relationship between PEM and INT was amplified (b = -0.3425, SE = 0.0500, p < .001). At the mean level of CON, the relationship remained significant (b = -0.2548, SE = 0.0371, p < .001). However, at higher levels of CON (+1 SD), the negative relationship between PEM and INT was still significant but weaker (b = -0.1671, SE = 0.0540, p = .002), suggesting that higher levels of CON attenuate the strength of the association.

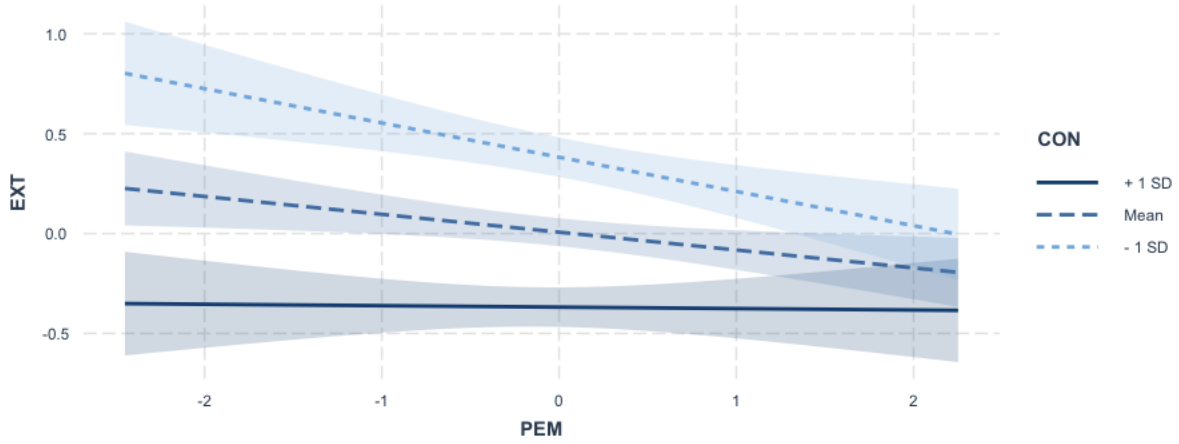
Figure 10. NEM on INT Moderated by CON



Overall Model Significance. $F(3, 674) = 92.24$, $p < .001$, $R^2 = .291$.

The interaction between NEM and CON was not significant ($b = -0.0429$, $SE = 0.0317$, $t = -1.35$, $p = .176$), suggesting that CON does not moderate the relationship between NEM and INT.

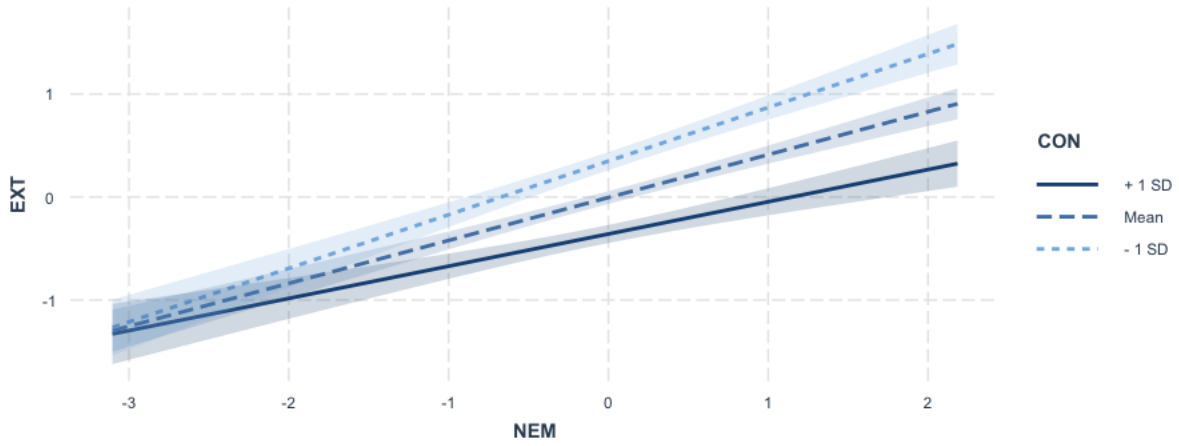
Figure 11. PEM on EXT Moderated by CON



Overall Model Significance. $F(3, 674) = 4.46$, $p < .001$, $R^2 = .153$.

The interaction between PEM and CON was significant (b = 0.0877, SE = 0.0365, t = 2.40, p = .017). As shown in the conditional effects, at lower levels of CON (-1 SD), the negative relationship between PEM and INT was stronger (b = -0.3425, SE = 0.0500, p < .001). At the mean level of CON, the relationship remained significant (b = -0.2548, SE = 0.0371, p < .001), and at higher levels of CON (+1 SD), the negative relationship weakened but remained significant (b = -0.1671, SE = 0.0540, p = .002). These findings suggest that higher levels of CON attenuate the negative impact of PEM on INT, with the strength of this negative relationship being more pronounced at lower levels of CON.

Figure 12. NEM on EXT Moderated by CON



Overall Model Significance. $F(3, 674) = 111.50$, $p < .001$, $R^2 = .332$.

The interaction between NEM and CON was significant (b = -0.1038, SE = 0.0308, t = -3.37, p = .0008). As shown in the conditional effects, at lower levels of CON (-1 SD), the positive relationship between NEM and EXT was stronger (b = 0.5203, SE = 0.0415, p < .001). At the mean level of CON, the relationship remained significant (b = 0.4165, SE = 0.0317, p < .001), and at higher levels of CON (+1 SD), the positive relationship weakened but remained significant (b = 0.3126, SE = 0.0468, p < .001). These findings suggest that higher levels of CON attenuate the positive impact of NEM on EXT, with the relationship being more pronounced at lower levels of CON.

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