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The Heterogeneous Roles of the UPPS-P Impulsivity Pathways across Features of Psychopathology

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Abstract

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By Joanna M. Berg

Impulsigenic constructs, including impulsivity, sensation-seeking, and disinhibition, are frequently studied in relation to symptoms of psychopathology. However, these studies rarely examine the structure of impulsigenic constructs themselves, which is a longstanding topic of considerable confusion. Here, I examined the five subscales of the UPPS-P in the context of mood and anxiety disorders, eating disorders, psychotic features, and personality disorders in a sample of 405 undergraduate students. My goals were twofold: first, to contribute to the literature on the relationships between these subscales and a range of psychopathology; and second, to use cluster analyses and profile analyses for the purpose of examining the structure of and relationships among the constructs assessed by the UPPS-P. Findings indicated that Negative and Positive Urgency were highly correlated with a wide range of features of psychopathology, and also demonstrated very similar "behavior" with respect to profile and cluster analyses, suggesting that these two subscales are closely related or possibly overlapping. Additionally, Lack of Premeditation and Lack of Perseverance had more distinct profiles than predicted, with the former correlating most strongly with externalizing behaviors, and the latter correlating most strongly with mood disorders. Finally, Sensation Seeking appeared to predict more adaptive functioning overall, and in profile and cluster analyses, this subscale was an entirely distinct construct compared to the other UPPS-P subscales.

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The Heterogeneous Roles of the UPPS-P Impulsivity Pathways across Features of Psychopathology

Impulsivity is a broad and heterogeneous construct associated with poor planning skills, difficulty maintaining attention, and risk-taking behavior (e.g., Sharma, Markon, & Clark, 2014). It has been a construct of interest within clinical psychology for more than half a century: In 1954, impulsivity was described as the experience of a "sudden, unpremeditated welling-up of a drive toward some action, which usually has the quality of hastiness and a lack of deliberation" (Frosch & Wortis, 1954, p. 132). At that time, the category of "impulse control disorders" was broad, and included any disorder presumably involving high levels of impulsivity. However, within this category a distinction was made between characterological disorders and symptomological disorders, with the former comprising disorders in which impulsivity permeates the individual's behavior across a range of situations (e.g., psychopathic personality), and the latter comprising disorders in which impulsivity is restricted to a specific symptom or set of symptoms (e.g., pyromania, kleptomania; Frosch & Wortis, 1954).

Today, we distinguish between personality disorders (formerly Axis II conditions in the Diagnostic and Statistical Manual of Mental Disorders, 4th Edition, Text Revision; DSM-IV-TR; American Psychiatric Association [APA], 2000) and mood, anxiety, developmental, and eating disorders (formerly Axis I disorders in DSM-IV), rather than characterological or symptomological disorders, respectively. Yet research has identified impulsivity as an underlying component of a much vaster range of disorders than was previously thought. In many cases, impulsivity's contribution may not take the form of a single self-evident behavioral manifestation. Instead, this trait may predispose

individuals towards a wide range of maladaptive behaviors, emotional patterns, or cognitive distortions, including externalizing symptoms (e.g., aggression, alcohol and substance abuse; Lejuez et al., 2010; Miller, Flory, Lynam, & Leukefeld, 2003; Zapolski, Settles, Cyders, & Smith, 2010), internalizing symptoms (e.g., anxiety, depression; Cyders & Coskunpinar, 2011; d'Acremont & Van der Linden, 2007), eating disorders (Miller et al., 2003; Waxman, 2009; Zapolski et al., 2010), attention-deficit/hyperactivity disorder (ADHD; Miller, Derefinko, Lynam, Milich, & Fillmore, 2010; Miller et al., 2003; Zapolski et al., 2010), and some personality disorders (e.g., borderline personality disorder [BPD], antisocial personality disorder [ASPD], psychopathic personality;[1] Miller et al., 2003; Poythress & Hall, 2011; Zapolski et al., 2010).

Theory and Conceptualizations of Impulsivity

Early research on impulsivity was based on the assumptions that impulsivity is (1) largely orthogonal to neuroticism, and (2) multidimensional (Barratt, 1965; Stanford et al., 2009). These ideas guided the construction of the Barratt Impulsiveness Scale, now in its eleventh revision (BIS-11; Patton, Stanford, & Barratt, 1995), which is sometimes regarded as the quintessential self-report measure of impulsivity. Early research based on these assumptions helped to spawn the development of Gray's psychobiological model of personality, including his behavioral inhibition and behavioral activation (or approach) systems (BIS/BAS; Gray, 1981, 1987), which has informed an immense body of research (e.g., Carver & White, 1994; Fowles, 1980, 1987).

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[1] Psychopathic personality, or psychopathy, is not currently included in Section II of DSM-5, although it is included as a potential specifier for ASPD in Section III (APA, 2013).

Both of these ideas – the relative orthogonality of impulsivity and anxiety, and the multidimensional nature of impulsivity – have since been largely borne out empirically. With regard to the first, impulsivity has been shown to relate most strongly to low agreeableness and low conscientiousness from the Five Factor Model of personality (FFM; McCrae & Costa, 1987), but to be largely orthogonal to neuroticism (Watson, Clark, & Harkness, 1994). With regard to the second assumption, numerous studies suggest that different facets of impulsivity relate to different behaviors and disorders (e.g., Moeller, Barratt, Dougherty, Schmitz, & Swann, 2001). Nevertheless, the number of dimensions that comprise impulsivity is perpetually in dispute, ranging from as few as two to as many as fifteen (Kirby & Finch, 2010); some broad-band personality measures even include unidimensional impulsivity subscales (e.g., Buss & Plomin, 1975; Jackson, 1967). This varying number may stem in part from traits being differentially represented based on item selection or item construction for any given instrument. In turn, these item selection decisions may lead to differential representations of the factor space of impulsivity itself. Across models, some of the facets of impulsivity have included (reversed) inhibition and activation/approach systems (e.g., Gray, 1987), as well as risk- or thrill-seeking, nonplanfulness, and distractibility (Carver & White, 1994; Kirby & Finch, 2010).

Impulsivity, Disinhibition, and Sensation Seeking

There is a high degree of terminological confusion within the impulsivity literature, including both "jingle" and "jangle" fallacies (Block, 1995). The former refers to situations in which two or more different constructs are given the same label, whereas the latter refers to situations in which the same constructs are given two or more different

labels. Impulsivity, disinhibition, and sensation-seeking have come to comprise what we might term a "jingle-jangle triad": in some models these terms are used interchangeably, whereas in others they represent separable and sometimes even non-overlapping constructs (e.g., Colder & Chassin, 1997; Eysenck & Zuckerman, 1978; Gorenstein & Newman, 1980).

From here forward, I will distinguish among these terms as follows. Disinhibition is characterized by an often-harmful lack of regard for aversive consequences (Gorenstein & Newman, 1980); it frequently includes aggression or disregard for others' well-being, and tends to be manifested largely in externalizing behavior (e.g., Gorenstein & Newman, 1980; Patrick, Hicks, Krueger, & Lang, 2005). In some models, disinhibition correlates strongly with indicators of "meanness" or lack of empathy (Patrick, Fowles, & Krueger, 2009). Sensation-seeking bears a robust positive correlation with measures of extraversion (Eysenck & Zuckerman, 1978), and indeed, the Revised NEO Personality Inventory (NEO-PI-R, Costa & McCrae, 1992), a widely used measure of the FFM, includes a facet within the Extraversion factor termed "Excitement-Seeking." In contrast to disinhibition, sensation-seeking may be more relevant to arousal level (Zuckerman, 1971). Specifically, individuals with high sensation-seeking may have an over-powered "gas pedal," rather than the deficient "brakes" that one might see in individuals with high disinhibition. High sensation-seekers may experience an increased drive towards impulsive action, whereas highly disinhibited individuals may experience a deficit in behavioral regulation. Finally, impulsivity itself may be defined as a quick response style, characterized by a lack of forethought and a lack of perseverance (Avila,

2001).[2]

Adding to the terminological muddiness, in any given conceptualization, any one of these three constructs – as contrasted with the labels themselves – may be placed superordinate to the others. It is therefore challenging to determine which of these constructs is the "biggest umbrella" in the hierarchical structure of impulsive behavior. To sidestep this confusion, I will use the term "impulsigenic traits" (Sharma et al., 2014) to denote any constructs that ostensibly lead to impulsive behavior.

Measurement of Impulsive Behavior

The overlap of impulsigenic constructs presents significant challenges for measurement validity. At a broad level, there are two types of measurement approaches: those involving self- or other-report questionnaires and those involving behaviorally-based laboratory tasks.

There are dozens of self-report questionnaires assessing impulsigenic traits. A complete inventory of all such questionnaires is beyond the scope of this review; thus, I provide only a brief overview of several widely used measures here. Some of these measures are highly circumscribed and designed to assess only a specific feature of impulsive behavior, whereas others include impulsigenic traits as a subscale within a measure of broad personality.

Each of the trait measures derives from a major model of personality. For example, Eysenck's "Big Three" personality structure of *psychoticism*, *extraversion*, and *neuroticism* (Eysenck & Eysenck, 1975) subsumes impulsigenic traits within the

[2] For in-depth reviews of these overlaps, see Carver, 2005; Eysenck and Zuckerman, 1978; Nigg, 2000; Zuckerman, 1996.

psychoticism factor (although initially these traits fell largely within *extraversion*; see Eysenck & Eysenck, 1963). Tellegen's (1985) and Watson and Clark's (1993) three-factor models both include variants of *disinhibition vs. constraint*, which map at least partly onto the definition of *disinhibition* offered previously. Finally, although impulsivity does not map directly onto any factors in the Big Five structure (Goldberg, 1993), it generally comprises several lower-order facets from this model, including low *agreeableness* and low *conscientiousness*, as well as high *neuroticism* and high surgency from *extraversion* (e.g., Watson, Clark, & Harkness, 1994).

The widely used BIS-11 (Patton et al., 1995) is often considered one of the best-validated self-report measures of impulsigenic traits. It comprises three factors intended to capture different areas of the impulsigenic "factor space." Zuckerman's Sensation Seeking Scale (SSS; Zuckerman, Kolin, Price, & Zoob, 1964) assesses only its eponymous construct, but yields a number of fine-grained sensation-seeking subfactors. The BIS/BAS scales (Carver & White, 1994) are based on Gray's (1981, 1987) psychobiological model, described previously, and conceptualize two factors within the impulsigenic factor space: behavioral inhibition and behavioral activation/approach. Eysenck and colleagues developed the I-7 (Eysenck, Pearson, Easting, & Allsopp, 1985) after they realized that the Eysenck Big Three did not adequately capture impulsigenic traits. The I-7 includes scales assessing "impulsiveness, venturesomeness, and empathy" – interestingly, these may map partly onto the definitions for impulsivity, sensation-seeking, and (reversed) disinhibition, respectively.

Laboratory measures of impulsigenic traits have been categorized in a variety of ways. In an effort to streamline these categories, a recent meta-analysis (Cyders &

Coskunpinar, 2012) separated the constructs measured by lab tasks into five facets based on both findings and theory: (1) prepotent response inhibition (e.g., go/no-go tasks), (2) resistance to distractor interference (e.g., Stroop tests), (3) resistance to proactive interference (e.g., cued recall tasks), (4) delay response (e.g., gambling tasks), and (5) distortions in elapsed time (e.g., time-judgment tasks). Task selection therefore becomes critically important to the validity of a given study: If the paradigm chosen to assess impulsigenic traits is not relevant to the researchers' aims, the findings may be misinterpreted or even essentially meaningless.

Most of these categories of behavioral tasks demonstrate a similar correlational pattern with regard to self-report assessments of impulsigenic traits. For each category, there tend to be several studies with one or two significant correlations between lab tasks and subscales from self-report tasks, but these findings are rarely replicated. In contrast, many of these behavioral tasks demonstrate significant convergent validity with features of psychopathology (e.g., ADHD, Bezdjian, Baker, Lozano, & Raine, 2009; conduct disorder, Dougherty, Bjork, Marsh, & Moeller, 2000; alcohol use, Christiansen, Cole, Goudie, & Field, 2012; personality disorders, McCloskey et al., 2009). Based on their lack of clear associations, however, it seems that lab tasks and self-report measures predict largely non-overlapping amounts of variance within types of psychopathology.

To further explore this question of construct and criterion overlap, a recent meta-analysis studied self-report and laboratory tasks assessing impulsigenic traits (Sharma et al., 2014). The analysis of the covariation among self-report questionnaires yielded three factors, which mapped largely onto the familiar "Big Three" dimensions of Negative Emotionality (NE), Positive Emotionality (PE), and Disinhibition/Constraint (DvC;

Watson & Clark, 1993). NE seemed to relate to impulsive actions in response to strong negative emotion, PE to impulsive actions in response to strong positive emotion, and DvC to impulsive actions due to a lack of forethought or perseverance. Four factors were extracted from laboratory tasks: (1) Inattention (difficulty attending selectively to a stimulus), (2) Inhibition (ability to inhibit one's response to a stimulus), (3) Impulsive Decision-Making (difficulty delaying gratification), and (4) Shifting (difficulty engaging in cognitive flexibility). The constructs assessed by the self-report and behavioral tasks did not demonstrate substantial overlap, but their combined validity for impulsive behaviors was stronger than the validity for either set of measures alone (Sharma et al., 2014).[3]

The UPPS-P

The UPPS (Urgency, Lack of Premeditation, Lack of Perseverance, Sensation Seeking; Whiteside & Lynam, 2001) was developed with the goal of deriving an "inclusive" model of the impulsigenic construct. Whiteside and Lynam conducted a factor analysis of 20 scales drawn from nine well-validated self-report measures, including omnibus personality measures as well as measures developed specifically to assess impulsigenic traits (Whiteside & Lynam, 2001). The four factors that emerged from this initial analysis have been replicated in several studies (e.g., Magid & Colder, 2007; Miller et al., 2003; Smith et al., 2007), and the UPPS, as well as its revision, the UPPS-P (which added the Positive Urgency subscale; Lynam et al., 2007), have proven to be reliable measures that appear to exhibit satisfactory construct validity. High scores

[3] Sharma et al. posited that this finding may be due to the "single-item" psychometric nature of laboratory tasks, though this does not account for all discrepancies.

on these measures correlate with a wide range of impulsive behaviors (Lynam & Miller, 2004; Smith et al., 2007), and scores on the UPPS-P subscales correlate with other instruments designed to assess impulsigenic traits, including both self-report measures (e.g., BIS/BAS, BIS-11, Disinhibition Inventory, NEO-PI-R; Duckworth & Kern, 2011; Seibert, Miller, Pryor, Reidy, & Zeichner, 2010; Sharma, Kohl, Morgan, & Clark, 2013; Whiteside & Lynam, 2001) and some behavioral measures (e.g., delayed ocular response tasks, Go-No Go tasks; Roberts, Fillmore, & Milich, 2011; Gay, Rochat, Billieux, d'Acremont, & Van der Linden, 2008). Therefore, the UPPS-P is increasingly being used to examine the relations among impulsigenic constructs, other personality traits, and a wide range of psychopathological features.

The UPPS and UPPS-P include, respectively, four and five subscales purportedly reflecting different "pathways" to impulsive behavior. In other words, the UPPS-P model conceptualizes impulsive behavior as an umbrella category, encompassing a broad range of potential manifestations. The UPPS-P subscales are not orthogonal, nor are they meant to be lower-order factors of a single impulsigenic construct. Instead, they measure separable traits or processes that are hypothesized to predispose to different manifestations of impulsive behavior.

The first of these subscales, Lack of Premeditation, is defined as the absence of a "tendency to delay action in favor of careful thinking and planning" (e.g., "My thinking is usually careful and purposeful," reversed in scoring; Whiteside & Lynam, 2001, p. 677). Negative Urgency, the second proposed pathway, is defined as a "tendency to commit rash or regrettable actions as a result of negative affect" (e.g., "When I am upset I often act without thinking"; Whiteside & Lynam, 2001, p. 677). The third proposed

pathway, Sensation Seeking, is defined as the "tendency to seek excitement and adventure" (e.g., "I'll try anything once"; Whiteside & Lynam, 2001, p. 677). The fourth proposed pathway, Lack of Perseverance, is the absence of an "ability to remain with a task until completion and avoid boredom" (e.g., "I finish what I start," reversed in scoring; Whiteside & Lynam, 2001, p. 677). The fifth proposed pathway, added in the UPPS-P revision (Lynam et al., 2007), is Positive Urgency, which assesses "rash action in response to a positive mood" (Cyders et al., 2007, p. 108).

Review of Current Theory and Findings

Three major lines of research could help to significantly increase our understanding of the UPPS-P subscales and how they relate to broad impulsigenic constructs. These are: (a) a clearer understanding of what these subscales assess, (b) the UPPS-P subscales' interrelations, and (c) the UPPS-P subscales' differential interrelations to measures of psychopathology and personality. The answers to these questions could improve the UPPS-P's place within the field of impulsive behavior – or could pave the way for necessary revisions of the UPPS-P instrument. Therefore, this study aims to examine the UPPS-P within a broad range of psychopathology, both to acquire a more comprehensive understanding of the heterogeneity of impulsive behavior and to examine the UPPS-P itself in closer detail. This study also hopes to clarify the impulsivity-related correlates of psychopathology, potentially bearing implications for the assessment, diagnosis, etiology, and treatment of impulsivity-related disorders.

I will begin with a brief review of potential mechanisms believed to drive each of the UPPS-P subscales. I will also incorporate findings from a recent meta-analysis from our laboratory group (Berg, Latzman, Bliwise, & Lilienfeld, 2015) relating the UPPS-P

subscales to the following features of psychopathology: (1) substance use, including alcohol use, (2) aggression and psychopathy, (3) borderline personality features, (4) suicidality, (5) depression, (6) anxiety and obsessive-compulsive features, and (7) disordered eating.

Lack of Premeditation

High levels of Lack of Premeditation may arise from poor cognitive capabilities of reflection and consideration of consequences, including low levels of executive control (Gay et al., 2010; Ray, Poythress, Weir, & Rickelm, 2009), thereby leading to decision-making with little regard for either past or future outcomes. This dimension may also stem from low self-control (Latzman & Vaidya, 2013), or from a high tolerance for punishment from maladaptive behavior. Meta-analytic findings (Berg et al., 2015) indicated that Lack of Premeditation is significantly associated with substance use, borderline personality features, suicidality, and depression. In contrast, effect sizes for aggression, anxiety, and disordered eating were nonsignificant.

Negative Urgency

Negative reinforcement is likely the mechanism that most contributes to the role of Negative Urgency in psychopathology. Behaviors driven by Negative Urgency may also stem from a "depletion of cognitive resources" (Baumeister, Bratslavsky, Muraven, & Tice, 1998; Dick et al., 2010, p. 223); that is, experiencing strong negative affect may lessen high-urgency individuals' abilities to make adaptive choices or to otherwise cope effectively. Negative Urgency was significantly associated with all categories of psychopathology examined in Berg and colleagues' (2015) meta-analysis. Notably, this subscale displayed the largest effect size for every category of psychopathology with the

exception of substance use, for which Positive Urgency had the largest effect size.

Sensation Seeking

In contrast to Negative Urgency, Sensation Seeking appears to be driven largely by positive reinforcement. Behaviors that are perpetuated by Sensation Seeking may arise from underarousal, which could drive individuals to seek out desirable stimuli – for example, affective arousal – effectively reinforcing the individual for engaging in such behaviors. Sensation seeking behavior may also be driven by a high threshold for fear (Netter et al., 1996), low pain sensitivity (Anestis, Bagge, Tull, & Joiner, 2011), and/or an increased dopamine release in response to stressors (Piazza et al., 1993). The Berg et al. (2015) meta-analysis revealed that Sensation Seeking demonstrated significant effect sizes for substance use, aggression, and suicidality. The effect sizes for borderline personality traits, depression, anxiety, and disordered eating were nonsignificant.

Lack of Perseverance

High Lack of Perseverance may reflect cognitive difficulties with maintaining attention over an extended period of time. This dimension may be related to a low sense of responsibility, thereby leading to dangerous or maladaptive behavioral choices (Magid & Colder, 2007); it may also relate to insufficient reinforcement derived from certain stimuli. In the meta-analysis (Berg et al., 2015), Lack of Perseverance was significantly associated with substance use, borderline personality traits, suicidality, depression, and disordered eating; the effect size for anxiety trended toward significance, and the effect size for aggression was nonsignificant.

Positive Urgency

Positive Urgency may be driven by mechanisms similar to those underpinning

Negative Urgency. Instead of negative reinforcement, however, Positive Urgency is presumably driven by positive reinforcement. Therefore, behaviors associated with Positive Urgency likely stem from an immediate desire to engage in highly rewarding activities. Because of this tendency, it should correlate with high-risk, high-reward behaviors also seen in high-sensation seeking individuals. In our meta-analysis, Positive Urgency demonstrated a significant association with substance use; there were no other categories of psychopathology for which more than 10 studies were collected (Berg et al., 2015).

Integration and Conclusions

For the meta-analysis, we advanced no *a priori* hypotheses regarding which UPPS-P subscale would relate most strongly to each category of psychopathology, or which subscale would be the most dominant across categories. Nevertheless, results were surprisingly consistent, indicating that in every set of analyses, either Negative or Positive Urgency displayed the largest effect size. The close similarity in the correlational patterns of these subscales raises questions regarding their distinctiveness. These two dimensions may be separate but closely related "sub-processes" of a broader dimension implicating strong emotion, regardless of valence, and impulsive action in response to that emotion.

Lack of Premeditation and Lack of Perseverance also demonstrated similar patterns of correlation across psychopathological domains. This finding is unsurprising given that these have been the two UPPS-P pathways most consistently correlated with behavioral tasks assessing impulsigenic traits (Gay et al., 2008; Gay et al., 2010). Nevertheless, as with the two Urgency subscales, this similarity raises the question of

whether the construct(s) assessed by these subscales would be better characterized by one multifaceted dimension rather than by two separate proposed pathways. The separation of Lack of Premeditation and Lack of Perseverance, as well as the separation of Negative and Positive Urgency, could lead researchers to inadvertently overlook potential communalities, and thereby forfeit potentially important information concerning the shared etiology of these pathways to impulsive behavior. Further work on the potential differential personality and psychopathological correlates of these two UPPS-P pathways will be needed before they are combined.

The Present Study

In many ways, the relevance of impulsigenic traits to such a broad range of psychopathology raises more questions than it answers. Specifically, these disorders and symptoms are highly varied in terms of etiology, epidemiology, and underlying theoretical models or mechanisms. Yet impulsigenic traits appear to contribute to each class of disorders, supporting the idea that impulsivity-related constructs are non-interchangeable and contribute differently to different classes of psychopathology.

In keeping with the multidimensionality of the constructs themselves, the five factors of the UPPS-P have demonstrated correlations across different disorders that are, at times, markedly different from one another. However, certain subscales appear to show more similar patterns of correlation than others, suggesting that the UPPS-P may be misleading in its suggestion of five distinct pathways. In particular, the substantial apparent etiological and correlational similarities between Negative and Positive Urgency, as well as between Lack of Premeditation and Lack of Perseverance, warrant further investigation to determine whether these pathways reflect broader, combined

constructs.

Aims and Hypotheses

Thus, the aim of this study is to examine the UPPS-P subscales from both variable-centered and person-centered perspectives. Because the UPPS-P is based in underlying mechanisms, a better understanding of the nomological network surrounding this measure may shed additional light on the role of impulsigenic traits in the development of mental disorders and maladaptive behaviors. I examine the unique contributions of the UPPS-P subscales to psychopathology, as well as areas and degrees of overlap among the UPPS-P subscales, with the goal of more directly linking the UPPS-P model to manifestations of impulsigenic traits.

My hypotheses for the present study are focused on the UPPS-P pathways, and are drawn from a theoretical understanding of the UPPS-P pathways and of a wide range of features of psychopathology that may be relevant to impulsive behavior, as well as from the findings of the Berg et al. (2015) meta-analysis.

Correlational hypotheses. I expect that the strongest associations found in the Berg et al. (2015) meta-analysis for each UPPS-P subscale will be replicated in the present samples. Specifically, compared with other features of psychopathology, Lack of Premeditation should correlate most strongly with substance use; Negative Urgency should correlate most strongly with borderline personality traits; Sensation Seeking should correlate most strongly with substance use; Lack of Perseverance should correlate most strongly with borderline personality traits; and Positive Urgency should correlate most strongly with substance use.

Regression hypotheses. Hierarchical multiple regression analyses will be

conducted to examine the unique contributions of each of the UPPS-P subscales above and beyond the others. I expect Positive Urgency to contribute little to no variance above and beyond that contributed by Negative Urgency, although in disorders with high negative affect Negative Urgency should contribute variance above and beyond Positive Urgency. Lack of Perseverance and Lack of Premeditation are not expected to contribute much variance over each other, although in some cases one may be a significant predictor above and beyond the other (e.g., features of obsessive-compulsive disorder: intrusive thoughts may be related to high Lack of Premeditation, whereas compulsions may be related to low Lack of Perseverance). Sensation Seeking is not expected to contribute a substantial amount of variance above and beyond the two Urgency subscales due to the conceptual overlap between Sensation Seeking and Positive Urgency. However, I expect Sensation Seeking to contribute significant variance beyond the two "Lack" subscales, given that the latter are comparatively less associated with actively seeking out risky behaviors.

Profile analysis hypotheses. Profile analyses will further examine the distinctions among the UPPS-P subscales. If the five subscales are conceptually and etiologically distinct, I would expect their correlational profiles to differ significantly. If, however, there is substantial conceptual overlap among two or more UPPS-P subscales, their patterns would be much more similar. In keeping with the hypotheses proposed for the regression analyses, I expect that the profiles for Negative and Positive Urgency will not be significantly different, and that the profiles for Lack of Premeditation and Lack of Perseverance will not be significantly different. I expect Sensation Seeking to display a profile distinct from each of the other UPPS-P subscales.

Cluster analysis hypotheses. Finally, cluster analyses will examine the distinctions among the UPPS-P subscales from a person-centered approach rather than a variable-centered approach, with the aim of determining whether there are distinct clusters of individuals who display elevations on certain subscales. These analyses may provide clues regarding the etiology of the UPPS-P subscales, as well as the comorbidities of these subscales in the context of different features of psychopathology. Additionally, person-centered analyses leave open the possibility that differing subgroupings of individuals are marked by differing configurations (rather than merely additive combinations) of UPPS-P subscales, and that these configurations exhibit different psychopathological correlates. Such an approach has not yet been applied to the UPPS-P; however, in keeping with previous hypotheses, I expect at least two and perhaps three clusters to emerge. Specifically, I expect to find a cluster of high Lack of Premeditation and high Lack of Perseverance, as well as a cluster of high Negative Urgency and high Positive Urgency, with a third possible cluster of only high Sensation Seeking. If these provisional hypotheses concerning cluster composition are borne out, I predict that the cluster of the two "Lack" subscales will be tied to disorders that are less emotionally laden, including ADHD, psychopathy, and anorexia nervosa. The Urgency subscales will likely be correlated with disorders involving high levels of emotion dysregulation, such as binge eating disorder and bulimia nervosa, as well as substance use and borderline personality features.

Method

Participants

Participants were 414 undergraduate students at Emory University; all

participants received course credit for their participation. Nine participants were excluded due to outlying scores (greater than 2 standard deviations above the mean) on a measure of social desirability, resulting in 405 total participants included in analyses.

The average age of participants was 19.13 (SD = 1.14); 67% (*n* = 133) were female. 51% of participants were in their first year, 31% were in their second year, and the remaining 18% were in their third or fourth years. The sample was relatively diverse, with 38% of participants identifying as Caucasian, 37% as Asian or Asian-American, 8% as African or African-American, 8% as Hispanic or Latino/a, and the remaining 9% as other or mixed-race. The majority of participants (94%) identified as heterosexual.

Measures

Study materials consisted of a set of pencil-and-paper questionnaires that typically took up to 90 minutes to complete.

UPPS-P. The UPPS scale is a 45-item self-report instrument that uses a 4-point Likert scale (Whiteside & Lynam, 2001; factor structure and scale development described previously). Each subscale contains 10-12 items. A revised version of the scale, the UPPS-P (Lynam et al., 2007), also includes Positive Urgency, as distinct from the already-existing (negative) Urgency scale. The Positive Urgency scale consists of 14 self-report items, similarly assessed on a 4-point Likert scale. In the present sample, internal consistency reliabilities as measured by Cronbach's α were high (Lack of Premeditation $\alpha = .85$; Negative Urgency $\alpha = .87$; Sensation Seeking $\alpha = .86$; Lack of Perseverance $\alpha = .83$; Positive Urgency $\alpha = .93$).

Psychiatric Diagnostic Screening Questionnaire. The PDSQ (Zimmerman & Mattia, 2001) was developed to screen for DSM-IV Axis I disorders in psychiatric

outpatient populations. It is a self-report questionnaire consisting of 126 items, asking participants to respond to a series of yes/no questions regarding the symptomology of 13 DSM-IV disorders. It is scoreable on a continuum of number of symptoms endorsed. In the present sample, internal consistency reliabilities as measured by Cronbach's α were moderate to high (MDD α = .84; PTSD α = .88; EDs α = .89; OCD α = .72; Panic α = .83; Psychosis α = .59; Agoraphobia α = .83; Social Anxiety α = .86; Alcohol Abuse α = .66; Drug Abuse α = .67; GAD α = .88; Somatization α = .64; Hypochondriasis α = .78).

Eating Disorder Examination Questionnaire. The EDE-Q (Fairburn & Beglin, 1994) is a well-validated 28-item self-report measure assessing attitudes and behaviors related to food, eating, and weight. Responses are scored on a continuum, allowing examination of disordered eating as a dimension rather than as a taxon (category). In the present sample, reliabilities as measured by Cronbach's α were high (Restraint α = .80; Eating Concern α = .79; Shape Concern α = .91; Weight Concern α = .87).

Personality Diagnostic Questionnaire, Version 4. The PDQ-4+ (Hyler, 1994) is a self-report questionnaire consisting of 99 items. This instrument asks participants to respond to a series of true/false questions regarding the symptomology of the 10 DSM-IV personality disorders, plus the two Appendix disorders (depressive and negativistic). It is scoreable on a continuum of number of symptoms endorsed. In the present sample, reliabilities as measured by Cronbach's α were low to moderate (PAR α = .64; SZD α = .46; SZT α = .57; HIS α = .56; NAR α = .56; BOR α = .55; ANT α = .53; AVD α = .72; DEP α = .64; OCPD α = .43; NEG α = .55; DEPR α = .61).

Levenson Self-Report Psychopathy Scale. Because some psychopathic traits correlate with impulsigenic behaviors (see *Literature Review*), I also administered a

measure of psychopathy. The LSRP (Levenson et al., 1995) is a 26-item self-report measure designed for use in both criminal and non-criminal populations. It yields primary and secondary psychopathy subscales, as well as a total score. The primary psychopathy scale assesses "a selfish, uncaring, and manipulative posture towards others," whereas the secondary psychopathy scale assesses "impulsivity and a self-defeating lifestyle" (Levenson et al., 1995, p. 152). LSRP primary and secondary psychopathy have demonstrated good construct validity by correlating with antisocial behavior and susceptibility to stress, respectively; both scales also correlate with boredom susceptibility and disinhibition (Levenson et al., 1995). In the present sample, reliabilities as measured by Cronbach's α were high (Primary α = .88; Secondary α = .73).

Multidimensional Personality Questionnaire – Short Form. The MPQ-33 (Harkness et al., 1995) is a brief version of Tellegen's (1982) Multidimensional Personality Questionnaire (MPQ). Although this version of the MPQ is not widely used, its three higher-order factors have been well-validated (Harkness et al., 1995; Lilienfeld & Andrews, 1996). The MPQ-33 was administered as a measure of broad personality to provide information regarding the correlations among impulsivity, psychopathology, and general personality traits. In accordance with convention, three higher-order factors were calculated: Positive Emotionality, assessing persuasiveness, desire for social intimacy, positive affect, and goal-setting; Negative Emotionality, assessing vulnerability to stress, mistrust, and hostility; and Constraint, assessing careful decision-making, avoidance of dangerous situations, and adherence to conventional societal standards. The inverse of the Constraint factor is termed Disinhibition, and is thought to represent impulsigenic

traits (Harkness et al., 1995). In the present sample, reliabilities as measured by Cronbach's α were moderate to high (Positive Emotionality α = .80; Negative Emotionality α = .68; Constraint α = .72).

Validity scale. As a safeguard to assess potentially invalid responding, participants completed a measure of social desirability: the Virtuous Responding scale from the Psychopathic Personality Inventory—Revised (PPI-R; Lilienfeld & Widows, 2005), which is a 14-item self-report questionnaire that asks participants to rate themselves on statements endorsing implausible virtues (e.g., having no bad habits).

Data Analysis

Initially, I examined zero-order correlations between the UPPS-P subscales and the criterion measures (~30 in total) using Steiger's test of the significance of the difference between dependent correlations; to minimize the risk of Type I error, I employed a conservative alpha-correction (i.e., due to the five "sets" of analyses – one for each UPPS-P subscale – a *p* value of .01 was used, rather than the conventional .05). In subsidiary analyses, and to minimize the risk of Type I error given the large number of dependent measures, I conducted a principal components analysis (PCA) in order to identify a smaller number of weighted variates that accounted for the majority of variance in the criterion variables. I then reconducted all analyses using this smaller number of components. Additionally, I used simultaneous multiple regressions to examine the unique contributions of each of the UPPS-P subscales to the features of various disorders, using both the original dependent variables and the extracted components.

My primary analyses examined whether there were statistically significant differences among the correlational profiles of the five UPPS-P subscales with types of

psychopathology. The primary criterion measures for these analyses were the PDSQ and PDQ-4+, yielding a total of 23 subscale-level predictands. Subsidiary analyses examined the components identified in the aforementioned PCAs. These analyses were intended to clarify the similarities and differences among the UPPS-P subscales; to this end, I used profile analysis through Cronbach and Gleser's (1953) D^2 statistic, which examines the geometric distance between vectors (i.e., profiles). This statistic takes into account elevation, scatter, and shape of the profiles being examined. Nevertheless, there are several drawbacks to the D^2 statistic, specifically that it is not a standardized metric and has no sampling distribution for significance testing. I therefore supplemented this more traditional analysis using polynomial regression approaches (Edwards, 1993). Such approaches often preserve more information regarding the relationships and profiles in question more than profile similarity indices, such as the D^2 statistic, tend to allow.

In addition to variable-centered analyses, I used person-centered analyses to examine potential heterogeneity in configurations of the UPPS-P subscales, and which, if any, types of disorder features were best predicted by these configurations. I therefore used a model-based cluster analysis, which clusters individuals into statistically distinguishable subgroups (in this case, based on their configurations of UPPS-P subscales) and allows for formal statistical tests of the fit of alternative models. This approach does not require prior knowledge of the nature of the clusters, such as their number, shape, and composition; additionally, model-based approaches do not necessarily yield multiple clusters if the data do not support them, whereas other approaches often automatically generate multiple clusters even in their "natural" absence (Fraley & Raftery, 1998). As mentioned previously, these analyses examined the

questions of whether certain UPPS-P profiles were particularly common within our samples, and if so, whether these profiles were more predictive of certain psychopathological variables, again using both the full dependent variable set and extracted PCA components.

Results

For all analyses, the significance threshold was set as $p < .01$ to account for the elevated risk of Type I error introduced by the large number of analyses.

Sex Differences

Consistent with prior findings, men scored significantly higher than women on the Sensation Seeking subscale of the UPPS-P ($F(1, 394) = 30.17, p < .001, \eta^2 = .07$). There were no other significant sex differences on UPPS-P subscales.

On the PDQ-4, men scored significantly higher than women on the Antisocial subscale ($F(1, 386) = 24.45, p < .001, \eta^2 = .06$); women scored significantly higher on the Avoidant subscale ($F(1, 402) = 19.15, p < .001, \eta^2 = .05$).

On the PDSQ, men did not score significantly higher than women on any subscales; women scored significantly higher on the Eating Disorders subscale ($F(1, 400) = 21.58, p < .001, \eta^2 = .05$), the Panic Disorder subscale, ($F(1, 398) = 9.24, p < .01, \eta^2 = .02$), the Generalized Anxiety Disorder subscale ($F(1, 400) = 15.33, p < .001, \eta^2 = .04$), and the Somatization subscale ($F(1, 399) = 13.83, p < .001, \eta^2 = .03$).[4]

[4] Mean scores on the PDSQ were generally representative of a non-psychiatric sample (Zimmerman & Mattia, 1999; Zimmerman & Mattia, 2001a; Zimmerman & Mattia, 2001b), and all subscales were positively skewed. However, the range of each subscale

Because there were relatively few significant sex differences, and because those that emerged were of a small-to-moderate effect size, analyses were conducted on the full sample rather than separately by sex.

Principal Components Analysis

All subscales from the PDSQ, PDQ-4, EDE-Q, and LSRP (31 in total) were subjected to a principal components analysis to reduce the potential for Type I error, as well as to synthesize these outcome variables into a more interpretable format. The scree plot (Figure 1) and a Horn's parallel analysis (Horn, 1965; Table 1, Figure 2) suggested a five-component solution accounting for 54.51% of the variance within the items. Factor scores were calculated using a least squares regression approach (Thurstone, 1935; see Table 2 for factor loadings). Marker subscales on each factor were designated using a cutoff loading of .40.

The first component included five indicators, all of which reflected disordered eating thoughts or behaviors (i.e., all four subscales from the EDE-Q, as well as the PDSQ subscale for bulimia nervosa and binge eating). This component was termed "Eating Disturbance" (ED).

The second component included nine indicators (i.e., PDQ subscales for dependent, histrionic, negativistic, borderline, and avoidant personality disorders; LSRP Secondary Psychopathy; PDQ subscales for narcissistic and depressive personality disorders; and PDSQ Social Anxiety), and was termed "Insecure Interpersonal Style" (IIS) to reflect item content.

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included scores well within psychiatric diagnostic norms for this instrument, suggesting that this sample did not suffer from a drastically restricted range.

The third component included eight indicators, reflecting anxiety-related symptoms and some detachment from reality (i.e., PDSQ subscales for Panic Disorder, Hypochondriasis, Agoraphobia, GAD, PTSD, Somatization Disorder, MDD, and Psychotic Symptoms). This component was termed "Neurotic/Psychotic" (N/P).

The fourth component included five indicators, reflecting odd or obsessional thinking (i.e., PDQ subscales for schizoid, schizotypal, OCPD, and paranoid personality disorders; PDSQ OCD subscale). Notably, the PDQ-Depressive subscale cross-loaded above .40 on this component as well as on "IIS." This fourth component was termed "Odd/Obsessive" (O/O).

The fifth and final component included four indicators, reflecting antisocial or law-breaking behavior (i.e., the PDQ antisocial personality disorder subscale, LSRP Primary Psychopathy, and the PDSQ drug abuse and alcohol abuse subscales). Notably, LSRP Secondary Psychopathy and PDQ-Narcissistic both cross-loaded above .40 on this component as well as on "IIS." This fifth component was termed "Externalizing Tendencies" (ET).

Zero-Order Correlations

UPPS-P subscale intercorrelations were moderate ($.42 \leq r \leq .46$), with several notable exceptions. First, Negative and Positive Urgency demonstrated a large correlation ($r = .68$, $p < .001$). Second, Sensation Seeking demonstrated small to very small correlations with all other subscales; Sensation Seeking's strongest correlation was with Positive Urgency, which was still only small to medium in magnitude ($r = .19$, $p < .001$; see Table 3).

Correlations with personality and psychopathology variables. A brief summary

of correlational patterns is presented here; see Tables 4-7 for detailed correlational statistics.

All UPPS-P subscales demonstrated expected moderate-to-large negative correlations with MPQ-33 Constraint. With the exception of Sensation Seeking, all UPPS-P subscales demonstrated the same pattern of a negative or near-zero correlation with MPQ-33 Positive Emotionality, and a positive correlation (moderate-to-large) with MPQ-33 Negative Emotionality. Sensation Seeking demonstrated the inverse pattern: a positive correlation with MPQ-33 Positive Emotionality, and a trending-significant negative correlation with MPQ-33 Negative Emotionality.

Lack of Premeditation demonstrated small or near-zero correlations with most outcome variables. Notably, and counter to prediction, the strongest correlations emerged with indicators of antisocial or psychopathic behavior (e.g., PDQ-4 Antisocial subscale; LSRP Secondary subscale). Correlations with the alcohol and substance abuse subscales of the PDSQ were, respectively, small and nonsignificant.

Negative Urgency demonstrated positive, moderate-to-large correlations with almost all indicators of psychopathology. The only exception to this pattern was the PDQ-4 Schizoid subscale, with which Negative Urgency had a small, marginally significant positive correlation. Consistent with prediction, Negative Urgency demonstrated large correlations with borderline personality traits, as well as with other indicators of emotion dysregulation (e.g., the PDQ-4 Histrionic subscale). Notably, Negative Urgency correlated most strongly with the LSRP Secondary subscale, with PDQ-4 Borderline demonstrating the second-strongest correlation.

Sensation Seeking demonstrated small or near-zero correlations with most

outcome variables including, contrary to prediction, the alcohol and substance abuse subscales of the PDSQ. Almost all of Sensation Seeking's correlations with indices of psychopathology were negative. The strongest exception to this trend was with the PDQ-4 Antisocial subscale, with which Sensation Seeking demonstrated a moderate-to-large correlation.

Lack of Perseverance demonstrated small-to-moderate correlations with many indicators of psychopathology. Contrary to prediction – though consistent with the overarching trend across UPPS-P subscales in this sample – Lack of Perseverance demonstrated the largest correlation with the LSRP Secondary subscale (large effect size), whereas the second-largest correlation was with the PDQ-4 Dependent subscale.

Positive Urgency demonstrated a correlational pattern closely paralleling that of Negative Urgency, correlating moderately with most outcome variables. Again, contrary to prediction, Positive Urgency demonstrated the strongest correlation with the LSRP Secondary subscale (large effect size), and also demonstrated moderate-to-large correlations with indicators of emotion dysregulation (e.g., the PDQ-4 Histrionic and Borderline subscales).

With regard to the PCA outcome variables (see "*Principal Components Analysis*" section for details), correlational patterns became somewhat more distinct and consistent with hypotheses. Lack of Premeditation demonstrated the strongest correlation ($r = .38$, $p < .001$) with PCA-ET, which comprises lower-order indices of alcohol and substance use. Negative Urgency demonstrated the strongest correlation ($r = .55$, $p < .001$) with PCA-IIS, which includes indices of emotion dysregulation and borderline features. Sensation Seeking also demonstrated the strongest correlation ($r = .34$, $p < .001$) with

PCA-ET, whereas Lack of Perseverance and Positive Urgency demonstrated the strongest correlations with PCA-IIS (respectively: $r = .32$, $r = .45$, all p's $< .001$).

Steiger's z comparisons

To examine potential significant differences between the UPPS-P subscale correlations with the PDSQ, PDQ-4, and PCA outcome variables, Steiger's z tests were performed for each pair of subscales (Tables 8-10). Broadly, Negative Urgency and Positive Urgency demonstrated significantly stronger correlations than the other UPPS-P subscales across most outcome variables; when compared with each other, Negative Urgency generally demonstrated stronger correlations than Positive Urgency, although these differences tended to be smaller in magnitude. Sensation Seeking demonstrated consistently weaker correlations than the other UPPS-P subscales across all five PCA variables. Interestingly, Lack of Premeditation demonstrated a stronger correlation than Negative Urgency with PCA-ET ($p < .01$).

Partial Correlations

Partial correlations were computed for each UPPS-P subscale controlling for the other four subscales (Table 11), and several notable patterns emerged. Lack of Premeditation's correlation with PCA-IIS became nonsignificant, but this subscale's correlation with PCA-O/O increased in magnitude, indicating a small suppressor effect. Lack of Premeditation's correlation with PCA-ET decreased in magnitude but remained significant at $p < .001$. Negative Urgency's correlations with PCA-ED and PCA-IIS decreased in magnitude but remained significant at $p < .001$; this subscale's correlation with PCA-O/O increased slightly ($r = .17$, $p < .01$), and its correlation with PCA-ET decreased substantially, from a moderate effect size ($r = .24$, $p < .001$) to a near-zero

effect size (r = -.06, p > .10). Sensation Seeking's correlations were largely unchanged. For Lack of Perseverance, all PCA correlations either remained nonsignificant or became nonsignificant. Finally, Positive Urgency's correlation with PCA-ET decreased but remained significant at p < .001; this subscale's correlation with PCA-IIS decreased but remained significant at p < .01.

Virtuous Responding Scale

The Virtuous Responding (VR) scale demonstrated significant (p < .001), small-to-moderate negative correlations with four of the five UPPS-P subscales (Table 7). The exception to this pattern was Sensation Seeking, with which VR did not correlate at all. VR also demonstrated near-zero, nonsignificant correlations with PCA-ED, PCA-N/P, PCA-O/O, and PCA-ET, but had a moderate negative correlation with PCA-IIS (r = -.34, p < .001).

Partial correlations between UPPS-P subscales and PCA outcome variables, controlling for VR, were not significantly different from the zero-order correlations presented in Table 7. Mediation analyses were examined using the bias-corrected bootstrap (Efron & Tibshirani, 1993) in the PROCESS macro (Hayes, 2008), including total, direct, and indirect effects of VR on the relationships between UPPS-P subscales and PCA variables. VR mediated the effects of Lack of Premeditation (p < .001), Negative Urgency (p < .01), Lack of Perseverance (p < .001), and Positive Urgency (p < .01) on PCA-IIS, and mediated the effect of Lack of Premeditation on PCA-O/O (p < .01). All of these mediation effects were small in magnitude.[5]

Simultaneous Multiple Regressions

[5] Contact author for full mediation analyses.

Simultaneous multiple regressions of all five UPPS-P subscales were conducted on the PCA variables.[6] Negative Urgency demonstrated the largest betas for four of the five PCA variables: PCA-ED, PCA-IIS, PCA-N/P, and PCA-O/O (respectively: $\beta = .23$, $\beta = .55$, $\beta = .18$, $\beta = .30$). Lack of Premeditation demonstrated the largest beta for PCA-ET ($\beta = .38$); see Table 12.

Profile Analyses

Squared Euclidean distance. Profile analyses were first computed using Cronbach and Gleser's (1953) D^2 statistic for two sets of values. The first set used the correlation "vectors" for each of the UPPS-P subscales with all PDSQ, PDQ-4, and PCA variables to obtain a measure of the distance among correlational profiles. In these analyses, Lack of Premeditation and Lack of Perseverance had mutually-close proximities (i.e., their profiles were each closest to the other; $D^2 = 24.53$), as did Negative Urgency and Positive Urgency ($D^2 = 15.04$). Sensation Seeking's profile was closest to that of Lack of Premeditation ($D^2 = 41.68$); see Table 13, Figures 3-5.

The second set of D^2 statistic analyses examined the standardized scores for each of the UPPS-P subscales across all respondents to obtain a measure of subscale similarity. In these analyses, the only "reciprocity" emerged between Negative Urgency and Positive Urgency ($D^2 = 235.54$). Lack of Premeditation appeared closest to Negative Urgency ($D^2 = 380.11$); Sensation Seeking appeared closest to Positive Urgency ($D^2 = 584.63$); and Lack of Perseverance appeared closest to Lack of Premeditation ($D^2 = 394.22$; see Table 13).

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[6] Regressions were conducted on all other outcome variables; contact author for full results.

Intraclass correlation coefficient. To obtain an alternate measure of profile similarity, intraclass correlation coefficients (ICCs) were computed for each pair of subscales (i.e., 10 in total; see Table 14). In general, results were consistent with these analyses and the D^2 statistic analyses reported previously. Lack of Premeditation demonstrated equally high ICCs with Negative Urgency and Lack of Perseverance (both ICCs = .62). Consistent with prior analyses, Negative Urgency and Positive Urgency demonstrated a very high ICC (ICC = .81). Sensation Seeking demonstrated the highest ICC with Positive Urgency, and Lack of Perseverance demonstrated the highest ICC with Lack of Premeditation (ICC = .62).

Cluster Analyses

Two approaches to cluster analyses were used: first, a hierarchical cluster analysis using Ward's method, to determine the optimal number of clusters; second, a model-based cluster analysis, to examine the statistical fit of different cluster solutions using a Bayesian Information Criterion (BIC) method (Fraley & Raftery, 1998). Cluster analyses were conducted on the standardized UPPS-P subscale scores.

Ward's method. The dendrogram generated by the hierarchical cluster analysis (Figure 6) was visually suggestive of a four-cluster solution. The first cluster, termed "Normal" (n = 152), consisted of mostly average scores across UPPS-P subscales, but included slightly elevated Negative Urgency, Sensation Seeking, and Positive Urgency. The second cluster, termed "Inhibited" (n = 69), consisted of very low levels of all UPPS-P subscales. The third cluster, termed "Broadly Impulsive" (n = 80), consisted of elevated levels of all UPPS-P subscales. The fourth and final cluster, termed "Sensation Seeking" (n = 63), consisted of low levels of both "Lack" subscales and both "Urgency"

subscales, as well as elevated levels of Sensation Seeking (Table 15; Figure 7).

Mean levels of PDSQ, PDQ-4, and PCA variables across the four clusters were also computed (respectively: Table 16, Figure 8; Table 17, Figure 9; Table 18, Figure 10). The Normal cluster was characterized by largely average scores across PDSQ and PDQ-4 subscales, with the exceptions of slight elevations in PDQ-NAR and PDQ-OCPD, and slightly lower-than-average scores on PCA-N/P. The Inhibited cluster was characterized by elevations in PDSQ-Agoraphobia, PDSQ-GAD, and PDSQ-Somatization, PDQ-SZD, PDQ-AVD, PDQ-DEPR, PCA-N/P, and PCA-O/O; this cluster also demonstrated slightly lower-than-average levels of PCA-IIS, and very low levels of PDSQ-Alcohol Abuse, PDSQ-Drug Abuse, PDQ-HIS, PDQ-NAR, PDQ-ANT, and PCA-ET. The Broadly Impulsive cluster was characterized by elevated levels of almost every outcome variable measured; notable exceptions to this trend were PDQ-OCPD, PCA-ED, and PCA-O/O, which all demonstrated average scores. Finally (and in striking contrast to the Broadly Impulsive scale), the Sensation Seeking cluster demonstrated extremely low levels across every outcome variable.

Model-based cluster analysis. A Gaussian finite mixture model using BIC estimation suggested that a three-cluster solution was the best fit for the data (Figures 11-12). Based on the levels of UPPS-P subscales in each cluster, they were termed "Low" (n = 93), "Medium" (n = 241), and "High" (n = 71; Table 19, Figure 13). It is worth noting that the levels of Sensation Seeking in each cluster varied to a lesser extent than the levels of other subscales.

Mean levels of all outcome variables closely reflected the levels of impulsivity. That is, in the Low cluster, there were very low levels of all psychopathology across

measures; in the Medium cluster, levels of psychopathology were average relative to the population; in the High cluster, all outcome variables were very elevated (respectively: Table 20, Figure 14; Table 21, Figure 15; Table 22, Figure 16).[7]

Discussion

These analyses suggested several potentially illuminating trends regarding the UPPS-P subscales and the types of impulsigenic traits they may assess. First, as predicted, Negative and Positive Urgency demonstrated highly similar results across analyses; in contrast, although Lack of Premeditation and Lack of Perseverance tended to be more similar to each other than to other UPPS-P subscales, they were not as similar as expected. Second, across analyses, Sensation Seeking appeared consistently distinct relative to the other four subscales. Finally, cluster analyses suggested the presence of a latent impulsigenic construct underlying the five UPPS-P subscales, due to the fact that all subscales demonstrated similar patterns on two out of the four clusters generated with Ward's method. Overall, there was less variation across the UPPS-P subscales' correlations with types of psychopathology than was predicted.

Implications of Results for the Structure of the UPPS-P

Although Negative and Positive Urgency may be presumed to occupy opposite ends of a single dimension – or alternatively, to exist as two distinct dimensions akin to the dimensions of Negative and Positive Affectivity (Emotionality) found within many

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[7] For comparison purposes, a four-cluster solution was computed using this same methodology. Clusters were similar, though not identical, to those computed using hierarchical cluster analysis. Contact the author for complete statistics for this third cluster solution.

models of broad personality – the findings here suggest that neither hypothesis holds. Specifically, echoing previous findings (e.g., Berg et al., 2015), Negative and Positive Urgency demonstrated near-parallel results across analytic approaches. A likely explanation for this counterintuitive pattern is that both types of Urgency assess impulsive action taken in response to emotion dysregulation, regardless of the emotional valence. Emotion dysregulation, which encompasses both positively- and negatively-valenced emotions, has long been considered a central component of many types of psychopathology (Shedler & Westen, 2004), although it is perhaps most often discussed in the context of BPD (Conklin, Bradley, & Westen, 2006). Even more so than high negative emotionality, emotion dysregulation[8] appears to contribute a great deal to the development of borderline personality traits (Yen, Zlotnick, & Costello, 2002). Based on this conceptualization, maladaptive impulsive responses may be a more relevant marker of psychopathology in individuals who experience broad emotion dysregulation, as contrasted with individuals who experience elevated negative emotionality alone.

Supporting this hypothesis, Positive Urgency's correlations with psychopathology decreased consistently and markedly when Negative Urgency was controlled in partial correlation analyses. What remains unclear is whether these patterns hold with regard to nonclinical traits and behaviors (e.g., measures of normal-range personality). It is possible that when emotion dysregulation is not a clinically significant factor in one's functioning, impulsive actions in response to strong emotion may be separable by

[8] Defined as affective instability regardless of valence, including increased intensity of emotions and increased sensitivity to positive and negative emotional stimuli (Glenn & Klonsky, 2009).

emotional valence. In other words, individuals with relatively high affective stability may demonstrate a tendency to act impulsively in response to either negative emotion or positive emotion, but perhaps not to both types of emotion. Before revisions occur to the UPPS-P or to the conceptualization of impulsigenic constructs, these relationships must be examined further.

In contrast to the two Urgency subscales, Lack of Premeditation and Lack of Perseverance were more dissimilar than expected. Lack of Premeditation appeared to correlate most strongly with externalizing psychopathology, whereas Lack of Perseverance appeared to correlate most strongly with internalizing psychopathology. Despite these dissimilarities, however, they demonstrated similar profiles as determined by the D^2 statistic, as well as parallel cluster-analytic patterns. Overall, then, they still appear to be the most closely related of all the UPPS-P scales; it is possible that even though they correlate with different psychopathological outcomes, or "phenotypes," they may be assessing the same latent impulsigenic traits, or "genotypes" (I use these terms here as defined by Lewin, 1936).

Perhaps the most striking finding across these analyses was Sensation Seeking's consistent distinctness from all other UPPS-P subscales. When the other subscales were controlled simultaneously, Sensation Seeking's correlations remained essentially unchanged across features of psychopathology. This result raises major questions regarding Sensation Seeking's relevance to the impulsigenic traits assessed by the UPPS-P. There is little doubt that the construct of sensation seeking is relevant to the constructs of disinhibition and impulsivity (as discussed in the Introduction), but the scale included in the UPPS-P may not be accurately or comprehensively assessing its eponymous

construct.

Despite the obvious distinctions among the UPPS-P subscales, all five "behaved" in parallel in two of the four clusters generated using Ward's method (i.e., in one cluster, all subscales were elevated; in the other, all were much lower than average). This finding is strongly suggestive of a latent impulsigenic construct underlying the five UPPS-P subscales: that is, a bifactor model (Chen, West, & Sousa, 2006) may best account for the structure of the UPPS-P. In such a model, a latent construct would account for the common variance among subscales, rendering their unique remaining variance orthogonal after this impulsigenic construct is parsed out. To the knowledge of this author, the analyses required to test this bifactor model hypothesis have not yet been conducted.[9]

Implications of Results for Impulsigenic Contributions to Psychopathology

Given the strong associations between emotion dysregulation and psychopathology discussed previously, as well as findings in the literature that directly relate to the two Urgency subscales of the UPPS-P (Berg et al., 2015), it is unsurprising that both of these subscales, in general, correlated strongly with pervasive psychopathology. As alluded to previously, these two subscales demonstrated such closely parallel profiles as to be almost indistinguishable; however, Negative Urgency appeared to have greater predictive utility, which is to be expected given the confluence of negative affect, emotion dysregulation, and impulsigenic traits that are represented in that subscale.

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[9] These analyses will be important for validating the utility of the UPPS-P, and I intend to begin pursuing this direction in future analyses.

Although these findings are clinically informative, perhaps more interesting are the exceptions to Urgency's broad relevance to psychopathology. Specifically, the outcome variables with which Negative Urgency was essentially uncorrelated were those reflecting psychotic-spectrum symptoms, which is consistent with the flat affect often present in individuals with schizoid or schizotypal personality traits. In addition, partial correlations revealed that Negative Urgency was a notably weaker predictor of PCA-ET compared with Lack of Premeditation and Sensation Seeking. Moreover, in the latter case, Lack of Premeditation and Sensation Seeking each had small or near-zero correlations with most other symptoms of psychopathology, suggesting that these two subscales, especially in combination, may be both sensitive and specific (Glaros & Kline, 1988) with regard to externalizing behaviors. Further testing of this hypothesis is necessary; however, if this is the case, these subscales could be valuable supplementary screening tools for externalizing psychopathology, including aggression or drug and alcohol use.

Sensation Seeking's patterns in the cluster analyses also bear mentioning. Sensation Seeking was the only UPPS-P subscale that was significantly elevated in the "adaptive" cluster – i.e., the cluster with uniformly low levels of psychopathology. Similar trends have been identified in other "constellation" disorders, such as psychopathy; specifically, within one model of psychopathy (Lilienfeld & Widows, 2005), a factor termed Fearless Dominance appears to be correlated with positive or adaptive outcomes (e.g., Lilienfeld et al., 2012). Within the constellation of impulsigenic traits, it may be that, like Fearless Dominance, Sensation Seeking in isolation is an overall adaptive trait. Indeed, high levels of sensation-seeking traits have been

demonstrated in some adaptive occupations, such as firefighting (Zuckerman, 1979). This construct's associated maladaptive outcomes, therefore, may occur largely in the context of statistical interactions with other impulsigenic constructs such as disinhibition.[10]

An RDoC Perspective on the UPPS-P Subscales

The Research Domain Criteria (RDoC) initiative presents a system for conceptualizing and targeting psychopathology research within five psychobiological domains of functioning, and across seven levels of analysis (Cuthbert & Insel, 2013; Cuthbert & Kozak, 2013). This framework integrates normative and pathological dimensions, and as some have argued, it may prove invaluable in developing and refining precision treatments for psychopathology (Insel, 2014). Impulsigenic traits, which are certainly not inherently pathological (see earlier discussion of sensation seeking traits), and which clearly contribute to an extensive range of maladaptive outcomes, are thus a fertile ground for applying an RDoC perspective.

Within this framework, Negative Urgency and Positive Urgency may be more separable. In contrast to the hypothesis suggested previously for Lack of Premeditation and Lack of Perseverance (i.e., similar genotypes, different phenotypes; Lewin, 1936), Negative Urgency and Positive Urgency may represent different "genotypes" but highly

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[10] I have conducted preliminary interaction analyses of Sensation Seeking and other relevant scales using the present data (i.e., other UPPS-P subscales, reversed MPQ Constraint), with no significant findings. However, further examination of this hypothesis is still warranted, particularly with measures that assess a broader range of impulsigenic constructs.

similar "phenotypes." That is, Negative Urgency appears more relevant for negative valence systems as defined by RDoC, such as acute, potential, and sustained threats, whereas Positive Urgency appears more relevant for positive valence systems, such as initial and sustained responsiveness to rewards. It is both conceptually interesting and clinically informative to draw these distinctions, and the units of analysis within RDoC are likely to provide further clarity regarding the separability of the Urgency subscales. Specifically, it may be important to distinguish between Negative and Positive Urgency at the physiological or circuitry level to more effectively develop interventions for the maladaptive manifestations of these constructs.

Lack of Premeditation and Lack of Perseverance both appear to fall largely within the domain of cognitive systems in the RDoC framework. Within this domain, however, they appear to assess distinct constructs or subconstructs. Lack of Premeditation may assess the subconstruct of response selection and inhibition, for example, whereas Lack of Perseverance may assess the construct of attention. Both subscales may be relevant for the subconstruct of goal selection and updating (National Institute of Mental Health [NIMH], 2015). When viewed through this lens, a potentially key difference between the Urgency subscale relationships and the "Lack" subscale relationships emerges. Whereas the constructs assessed by the Urgency subscales may be more distinguishable at "lower" units of analysis (e.g., neural circuits or physiology), the constructs assessed by the "Lack" subscales appear to be more distinguishable at "higher" units of analysis (e.g., behavior or self-reports). If accurate, this hypothesis could provide the groundwork for revamping the assessment of these constructs and more precisely defining the structure of the relevant assessment instruments, including the UPPS-P.

Sensation Seeking appears to assess constructs spread across multiple RDoC domains. For example, as argued by Zuckerman (1994) – though not within an RDoC context – sensation-seeking traits may be relevant to arousal and regulatory systems through an increased drive towards physiologically activating stimuli. Individuals high on sensation-seeking traits often demonstrate lower cortical arousal, and consequent "stimulus hunger" that increases their drive for arousing and novel situations (Zuckerman, 1979). Additionally, the positive valence system, and particularly those constructs relevant to reward-seeking behavior, may be implicated within the nomological network of sensation seeking traits. In light of this conjecture, and given the extent to which UPPS-P Sensation Seeking appeared distinct from the other UPPS-P subscales, it would prove fruitful to examine the sensation seeking construct in a more fine-grained manner. For example, Zuckerman's SSS (Zuckerman et al., 1964) comprises four factors, many of which are only modestly correlated: Thrill and Adventure Seeking, Experience Seeking, Disinhibition, and Boredom Susceptibility. Comparing the correlates of these four factors to those of the UPPS-P Sensation Seeking scale, and mapping these patterns of correlates onto the RDoC criteria, could provide more information about both the Sensation Seeking scale itself as well as about the broader network of sensation-seeking traits.

Interestingly, the RDoC social processes systems appear less relevant to the constructs assessed by the UPPS-P subscales. It is possible that other conceptualizations of impulsigenic traits, such as disinhibition as defined at the outset of this paper (i.e., "… frequently includes aggression or disregard for others' well-being"), may be more closely related to the constructs within this domain. For example, some relevant constructs may

be affiliation and attachment, social communication, and perception and understanding of others. Individuals with high disinhibition may show lower affiliation with others, as well as deficits in social communication and social perception, due to the actively aggressive behaviors that characterize this trait (Horney, 1945). Further assessment and implications of these ostensible "social" impulsigenic traits is necessary to better understand their relationships with other constructs.

Limitations

Two major limitations within this study are clear. First, this sample was not representative of the larger population: it was composed of undergraduate students, which likely resulted in a restriction of the higher range of psychopathology symptom endorsement. Additionally, this sample was predominantly Caucasian and Asian/Asian-American (75% across both categories). Given that many types of psychopathology may be expressed differently across ethnic groups (Eaton et al., 2013), it will be important to replicate these findings in more ethnically diverse and culturally representative (i.e., community members rather than undergraduates) samples.

The second limitation, which derives from the exclusive reliance on self-report measures, is that of method covariance (i.e., the tendency of similar modes of assessment to correlate more strongly than do different modes; though see Conway & Lance, 2010, for an opposing view).[11] Particularly in the realm of impulsigenic traits – which, as discussed previously, have generated disagreement due to the low correlations between

[11] Notably, although method covariance may have inflated the overall magnitude of correlations, it would not account for the differential patterns of associations among measures.

self-report and laboratory task measures – assessment using several different methods (e.g., clinical interviews, laboratory tasks) will be essential to refine our understanding of the facets or subtypes of these constructs.

Conclusions

Although the literature on impulsigenic traits remains murky, the RDoC framework provides a potential means of organizing the existing findings, and perhaps guiding research with a clearer conceptualization of the bases and etiology of these constructs. With this perspective in mind, the UPPS-P may serve as a valuable starting point for furthering this field. This measure does not appear to be a comprehensive representation of impulsigenic traits; however, the present findings suggest that the UPPS-P subscales represent varying "tiers" of impulsigenic traits that align with those found in RDoC. Thus, future directions focusing on the UPPS-P subscales in the context of exploratory statistical interactions, as well as at varying levels of RDoC analysis, may bear the greatest implications for psychopathology as well as for the etiology of impulsigenic traits themselves.

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Table 1

Horn's Parallel Analysis

Root	Raw Data	Means	Percentile
1	9.17	1.61	1.68
2	2.98	1.53	1.58
3	2.04	1.47	1.51
4	1.60	1.42	1.46
5	1.43	1.37	1.40
6	**1.11**	**1.32**	**1.36**
7	1.04	1.28	1.31

Notes. Bolded line indicates cutoff point for component extraction.

Table 2

Rotated Component Matrix

	ED	IIS	Neurotic/ Psychotic	Odd/ Obsessive	ET
EDE-Q WC	.887				
EDE-Q SC	.876				
EDE-Q EC	.844				
EDE-Q Restraint	.798				
PDSQ EDs	.744				
PDQ DEP		.749			
PDQ HIS		.682			
PDQ NEG		.633			
PDQ BOR		.580			
PDQ AVD		.542			
LSRP-2		.540			**.405**
PDQ NAR		.513			**.454**
PDQ DEPR		.470		**.421**	
PDSQ SocAnx		.434			
PDSQ Panic			.738		
PSDQ Hyp			.622		
PDSQ Agora			.581		
PDSQ GAD			.579		

PDSQ PTSD			.546		
PDSQ Somat			.497		
PDSQ MDD			.464		
PDSQ Psychotic			.426		
PDQ SZD				.711	
PDQ SZT				.688	
PDQ OCPD				.510	
PDQ PAR				.508	
PDSQ OCD				.498	
PDQ ANT					.730
LSRP-1					.621
PDSQ Drug Abuse					.544
PDSQ Alc Abuse					.534

Notes. EDE-Q = Eating Disorders Examination—Questionnaire; WC = Weight Concern; SC = Shape Concern; EC = Eating Constraint; MDD = major depressive disorder; PTSD = post-traumatic stress disorder; EDs = eating disorders; OCD = obsessive-compulsive disorder; Panic = panic disorder; Agora = agoraphobia; SocAnx = social anxiety; Alc Abuse = alcohol abuse; GAD = generalized anxiety disorder; Somat = somatization; Hyp = Hypochondriasis; LSRP = Levenson Self-Report Psychopathy scale; PAR = paranoid personality disorder; SZD = schizoid personality disorder; SZT = schizotypal personality disorder; HIS = histrionic personality disorder; NAR = narcissistic personality disorder; BOR = borderline personality disorder; ANT = antisocial personality disorder; AVD = avoidant personality disorder; DEP = dependent personality disorder; OCPD = obsessive-compulsive personality disorder; NEG = negativistic personality disorder; DEPR = depressive personality disorder.

Table 3

UPPS-P Subscale Inter-Correlations

	Lack of Premeditation	Negative Urgency	Sensation Seeking	Lack of Perseverance
Lack of Premeditation				
Negative Urgency	.46**			
Sensation Seeking	.15*	.03		
Lack of Perseverance	.45**	.43**	-.04	
Positive Urgency	.42**	.68**	.19**	.42**

Notes. * $p < .01$, ** $p < .001$.

Table 4

UPPS-P Subscale Correlations with EDE-Q, LSRP, and MPQ-33 Subscales

	EDE-Q Restraint	EDE-Q EC	EDE-Q SC	EDE-Q WC	LSRP-1	LSRP-2	MPQ PE	MPQ NE	MPQ Constraint
LPrem	.04	.15*	.11	.09	.24**	.45**	-.04	.22**	-.61**
Neg. Urg.	.17*	.30**	.34**	.28**	.24**	.63**	-.20**	.53**	-.35**
Sens. Seek.	.02	-.14*	-.13	-.11	.13	.08	.24**	-.12	-.57**
LPers	.01	.16*	.13*	.13	.20**	.55**	-.41**	.23**	-.36**
Pos. Urg.	.13	.20**	.17*	.15*	.36**	.55**	-.12	.39**	-.39**

Notes. * $p < .01$, ** $p < .001$.
LPrem = Lack of Premeditation; Neg. Urg. = Negative Urgency; Sens. Seek. = Sensation Seeking; LPers = Lack of Perseverance; Pos. Urg. = Positive Urgency; EDE-Q = Eating Disorders Examination—Questionnaire; EC = Eating Constraint; SC = Shape Concern; WC = Weight Concern; LSRP-1 = Levenson Self-Report Psychopathy scale, Primary Psychopathy; LSRP-2 = Levenson Self-Report Psychopathy scale, Secondary Psychopathy; MPQ = Multidimensional Personality Questionnaire; PE = Positive Emotionality; NE = Negative Emotionality.

Table 5

UPPS-P Subscale Correlations with PDSQ Subscales

	MDD	PTSD	EDs	OCD	Panic	Psychot	Agora
LPrem	.11	.12	.11	.02	.10	.08	.03
Neg. Urg.	.45**	.18**	.35**	.20**	.32**	.17*	.17*
Sens. Seek.	-.08	-.04	-.08	-.08	-.04	.08	-.15*
LPers	.27**	.09	.18**	.14*	.18**	.07	.08
Pos. Urg.	.30**	.10	.21**	.21**	.22**	.17*	.14*

	SocAnx	AlcAb	DrugAb	GAD	Somat	Hyp
LPrem	.05	.19**	.11	.01	.12	.11
Neg. Urg.	.42**	.22**	.15*	.36**	.22**	.17*
Sens. Seek.	-.16*	.09	.10	-.24**	-.18**	-.13*
LPers	.21**	.08	.14*	.14*	.12	.12
Pos. Urg.	.32**	.21**	.23**	.15*	.12	.16*

Notes. * $p < .01$, ** $p < .001$.
LPrem = Lack of Premeditation; Neg. Urg. = Negative Urgency; Sens. Seek. = Sensation Seeking; LPers = Lack of Perseverance; Pos. Urg. = Positive Urgency; MDD = major depressive disorder; PTSD = post-traumatic stress disorder; EDs = eating disorders; OCD = obsessive-compulsive disorder; Panic = panic disorder; Psychot = psychotic symptoms;
Agora = agoraphobia; SocAnx = social anxiety; AlcAb = alcohol abuse; DrugAb = drug abuse; GAD = generalized
anxiety disorder; Somat = somatization; Hyp = hypochondriasis.

Table 6

UPPS-P Subscale Correlations with PDQ-4 Subscales

	PAR	SZD	SZT	HIS	NAR	BOR
LPrem	.07	-.07	-.02	.30**	.16*	.27**
Neg. Urg.	.36**	.12	.27**	.46**	.33**	.55**
Sens. Seek.	-.01	-.04	.04	.07	.04	.02
LPers	.13	.15*	.11	.25**	.10	.28**
Pos. Urg.	.29**	.13	.31**	.44**	.31**	.45**

Table 6

UPPS-P Subscale Correlations with PDQ-4 Subscales

	ANT	AVD	DEP	OCPD	NEG	DEPR
LPrem	.40**	-.00	.19**	-.15*	.19**	.01
Neg. Urg.	.37**	.41**	.47**	.24**	.53**	.40**
Sens. Seek.	.42**	-.15*	-.15*	-.03	-.04	-.15*
LPers	.26**	.20**	.36**	-.09	.24**	.15*
Pos. Urg.	.44**	.26**	.41**	.14*	.43**	.24**

Notes. * $p < .01$, ** $p < .001$.
LPrem = Lack of Premeditation; Neg. Urg. = Negative Urgency; Sens. Seek. = Sensation Seeking; LPers = Lack of Perseverance; Pos. Urg. = Positive Urgency; PAR = paranoid personality disorder; SZD = schizoid personality disorder; SZT = schizotypal personality disorder; HIS = histrionic personality disorder; NAR = narcissistic personality disorder;
BOR = borderline personality disorder; ANT = antisocial personality disorder; AVD = avoidant personality disorder;
DEP = dependent personality disorder; OCPD = obsessive-compulsive personality disorder; NEG = negativistic personality disorder; DEPR = depressive personality disorder.

Table 7

UPPS-P Subscale Correlations with PCA Outcome Variables and Virtuous Responding Scale

	ED	IIS	Neurotic/ Psychotic	Odd/ Obsessive	ET	Virtuous Responding
LPrem	.07	.26**	.09	-.25**	.38**	-.25**
Neg. Urg.	.22**	.55**	.18**	.12	.24**	-.39**
Sens. Seek.	-.09	-.08	-.15*	-.05	.34**	-.02
LPers	.08	.32**	.11	-.01	.21**	-.27**
Pos. Urg.	.09	.45**	.10	.10	.38**	-.19**
Virtuous Responding	-.10	-.34**	-.00	-.09	-.11	---

Notes. * $p < .01$, ** $p < .001$.
LPrem = Lack of Premeditation; Neg. Urg. = Negative Urgency; Sens. Seek. = Sensation Seeking; LPers = Lack of Perseverance; Pos. Urg. = Positive Urgency; ED = eating disturbance; IIS = insecure interpersonal style; ET = externalizing tendencies

Table 8

Steiger's z for PDSQ Subscale Correlations

	MDD	PTSD	EDs	OCD	Panic	Psychot	Agora
LPrem vs. NegUrg	-6.92**	-1.30	-4.56**	-3.72**	-4.28**	-1.72	-2.76*
LPrem vs. SensSeek	2.68*	2.35	3.16*	1.52	2.18	0.05	2.87*
LPrem vs. LPers	-3.05*	0.62	-1.27	-2.28	-1.60	0.08	-0.90
LPrem vs. PosUrg	-3.61**	0.34	-1.81	-3.46**	-2.12	-1.73	-2.01
NegUrg vs. SensSeek	7.69**	3.17*	6.35**	4.19**	5.23**	1.32	4.74**
NegUrg vs. LPers	3.79**	1.87	3.21*	1.40	2.61*	1.75	1.81
NegUrg vs. PosUrg	4.10**	2.12	3.46**	0.18	2.68*	-0.10	0.89
SensSeek vs. LPers	-4.62**	-1.68	-3.77**	-3.01*	-3.12*	0.01	-3.25*
SensSeek vs. PosUrg	-5.77**	-2.12	-4.74**	-4.46**	-4.01**	-1.51	-4.61**
LPers vs. PosUrg	-0.65	-0.26	-0.57	-1.24	-0.57	-1.79	-1.12

Table 8 (continued)

Steiger's z for PDSQ Subscale Correlations

	SocAnx	AlcAb	DrugAb	GAD	Somat.	Hyp.
LPrem vs. NegUrg	-7.31**	-0.74	-0.82	-6.85**	-1.99	-1.06
LPrem vs. SensSeek	3.35**	1.62	0.26	3.78**	4.43**	3.71**
LPrem vs. LPers	-2.96*	2.18	-0.64	-2.45	-0.04	-0.27
LPrem vs. PosUrg	-5.04**	-0.42	-2.17	-2.70*	-0.15	-0.89
NegUrg vs. SensSeek	8.57**	2.07	0.86	8.61**	5.63**	4.27**
NegUrg vs. LPers	4.26**	2.85*	0.17	4.31**	1.90	0.76
NegUrg vs. PosUrg	2.71*	0.39	-1.83	5.26**	2.36	0.18
SensSeek vs. LPers	-5.15**	0.11	-0.70	-5.18**	-4.04**	-3.55**
SensSeek vs. PosUrg	-7.61**	-2.01	-2.09	-6.11**	-4.66**	-4.54**
LPers vs. PosUrg	-2.16	-2.51	-1.53	-0.32	-0.11	-0.62

Notes. Negative *z* scores indicate that the second UPPS-P subscale in each row had a greater correlation with the outcome variable.

* $p < .01$, ** $p < .001$.

LPrem = Lack of Premeditation; Neg. Urg. = Negative Urgency; Sens. Seek. = Sensation Seeking; LPers = Lack of Perseverance; Pos. Urg. = Positive Urgency; MDD = major depressive disorder; PTSD = post-traumatic stress disorder; EDs = eating disorders; OCD = obsessive-compulsive disorder; Panic = panic disorder; Psychotic = psychotic symptoms; SocAnx = social anxiety; AlcAb = alcohol abuse; DrugAb = drug abuse; GAD = generalized anxiety disorder; Somat = somatization; Hyp = hypochondriasis.

Table 9

Steiger's z for PDQ-4 Subscale Correlations

	PAR	SZD	SZT	HIS	NAR	BOR
LPrem vs. NegUrg	-5.72**	-3.58**	-5.65**	-3.71**	-3.38**	-6.15**
LPrem vs. SensSeek	1.29	-0.49	-0.86	3.58**	2.19	3.81**
LPrem vs. LPers	-1.03	-4.17**	-2.29	0.97	1.17	-0.28
LPrem vs. PosUrg	-4.15**	-3.56**	-6.16**	-2.79*	-2.74*	-3.74**
NegUrg vs. SensSeek	5.49**	2.21	3.43**	6.17**	4.59**	8.23**
NegUrg vs. LPers	4.58**	-0.61	3.29*	4.57**	4.44**	5.73**
NegUrg vs. PosUrg	1.84	-0.15	-0.95	1.06	0.70	2.92*
SensSeek vs. LPers	-1.90	-2.57	-0.88	-2.55	-1.14	-3.65**
SensSeek vs. PosUrg	-4.80**	-2.50	-4.33**	-6.01**	-4.55**	-7.03**
LPers vs. PosUrg	-3.13*	0.49	-3.93**	-3.70**	-3.84**	-3.43**

Table 9 (continued)

Steiger's z for PDQ-4 Subscale Correlations

	ANT	AVD	DEP	OCPD	NEG	DEPR
LPrem vs. NegUrg	0.53	-8.20**	-5.82**	-7.45**	-7.41**	-7.72**
LPrem vs. SensSeek	-0.38	2.49	5.29**	-1.71	3.45**	2.53
LPrem vs. LPers	2.77*	-3.82**	-3.36**	-1.08	-0.91	-2.57
LPrem vs. PosUrg	-0.78	-4.76**	-4.28**	-5.03**	-4.75**	-4.21**
NegUrg vs. SensSeek	-0.77	8.44**	9.28**	4.00**	8.82**	8.13**
NegUrg vs. LPers	2.20	4.31**	2.40	6.23**	6.35**	5.06**
NegUrg vs. PosUrg	-1.71	4.25**	1.79	2.94*	3.20*	4.38**
SensSeek vs. LPers	2.38	-4.99**	-7.20**	0.76	-3.78**	-4.14**
SensSeek vs. PosUrg	-0.27	-6.52**	-8.95**	-2.50	-7.50**	-6.11**
LPers vs. PosUrg	-3.44**	-1.06	-1.01	-3.96**	-3.83**	-1.71

Notes: Negative *z* scores indicate that the second UPPS-P subscale in each row had a greater correlation with the outcome variable.

* $p < .01$, ** $p < .001$.

LPrem = Lack of Premeditation; Neg. Urg. = Negative Urgency; Sens. Seek. = Sensation Seeking; LPers = Lack of Perseverance; Pos. Urg. = Positive Urgency; PAR = paranoid personality disorder; SZD = schizoid personality disorder; SZT = schizotypal personality disorder; HIS = histrionic personality disorder; NAR = narcissistic personality disorder; BOR = borderline personality disorder; ANT = antisocial personality disorder; AVD = avoidant personality disorder; DEP = dependent personality disorder; OCPD = obsessive-compulsive personality disorder; NEG = negativistic personality disorder; DEPR = depressive personality disorder.

Table 10

Steiger's z for PCA Outcome Variable Correlations

	ED	IIS	Neurotic/ Psychotic	Odd/ Obsessive	ET
LPrem vs. NegUrg	-2.75*	-6.19**	-1.77	-6.96**	2.69*
LPrem vs. SensSeek	2.39	5.02**	3.53**	-2.93*	0.55
LPrem vs. LPers	-0.15	-1.21	-0.30	-4.50**	3.31**
LPrem vs. PosUrg	-0.37	-3.80**	-0.11	-6.22**	-0.12
NegUrg vs. SensSeek	4.28**	9.36**	4.62**	2.47	-1.52
NegUrg vs. LPers	2.53	4.87**	1.43	2.41	0.63
NegUrg vs. PosUrg	3.06*	2.89*	2.14	0.69	-3.61**
SensSeek vs. LPers	-2.27	-5.42**	-3.41**	-0.61	1.93
SensSeek vs. PosUrg	-2.75*	-8.29**	-3.70**	-2.26	-0.66
LPers vs. PosUrg	-0.22	-2.61*	0.18	-1.86	-3.31**

Notes: Negative *z* scores indicate that the second UPPS-P subscale in each row had a greater correlation with the outcome variable.

* $p < .01$, ** $p < .001$.

LPrem = Lack of Premeditation; Neg. Urg. = Negative Urgency; Sens. Seek. = Sensation Seeking; LPers = Lack of Perseverance; Pos. Urg. = Positive Urgency; ED = eating disturbance; IIS = insecure interpersonal style; ET = externalizing tendencies.

Table 11

Partial Correlations for PCA Variables

	ED	IIS	Neurotic/ Psychotic	Odd/ Obsessive	ET
LPrem	-.01 *(.07)*	-.02 *(.26)*	.03 *(.09)*	-.34** *(-.25)*	.23** *(.38)*
Neg Urg	.19** *(.22)*	.33** *(.55)*	.13 *(.18)*	.17* *(.12)*	-.06 *(.24)*
Sens Seek	.08 *(-.09)*	-.13 *(-.08)*	-.15* *(-.15)*	-.02 *(-.05)*	.28** *(.34)*
LPers	-.01 *(.08)*	.08 *(.32)*	.01 *(.11)*	.03 *(-.01)*	.03 *(.21)*
Pos Urg	-.05 *(.09)*	.14* *(.45)*	-.01 *(.10)*	.07 *(.10)*	.22** *(.38)*

Notes: Zero-order correlations presented in parentheses. Partial correlations for each subscale were calculated by controlling for the other four UPPS-P subscales.

* $p < .01$, ** $p < .001$.

LPrem = Lack of Premeditation; Neg. Urg. = Negative Urgency; Sens. Seek. = Sensation Seeking; LPers = Lack of Perseverance; Pos. Urg. = Positive Urgency; ED = eating disturbance; IIS = insecure interpersonal style; ET = externalizing tendencies.

Table 12.

Multiple Regressions on PCA Variables

	ED			IIS			Neurotic/ Psychotic			Odd/Obsessive			ET		
	ΔR^2	*b*	*df*	ΔR^2	*b*	*df*	ΔR^2	*b*	*df*	ΔR^2	*b*	*df*	ΔR^2	*b*	*df*
LPrem	.01	.07	378	.07**	.26	378	.01	.09	378	.06**	-.25	378	.14**	.38	378
Neg Urg	.04**	.23	377	.24**	.55	377	.03*	.18	377	.07**	.30	377	.01	.09	377
Sens Seek	.01	-.09	376	.01	-.10	376	.02*	-.16	376	.00	-.00	376	.09**	.30	376
LPers	.00	-.02	375	.01	.10	375	.00	.01	375	.00	.05	375	.00	.07	375
Pos Urg	.00	-.07	374	.01*	.16	374	.00	-.01	374	.01	.10	374	.04**	.27	374

Notes. * $p < .01$, ** $p < .001$.
LPrem = Lack of Premeditation; Neg. Urg. = Negative Urgency; Sens. Seek. = Sensation Seeking; LPers = Lack of Perseverance; Pos. Urg. = Positive Urgency; ED = eating disturbance; IIS = insecure interpersonal style; ET = externalizing tendencies.

Table 13.

D^2 statistics for UPPS-P subscales.

D^2 for correlational profiles					
	LPrem	NegUrg	SensSeek	LPers	PosUrg
LPrem	---	66.53	41.68	24.53*	42.25
NegUrg	66.53	---	159.93	41.03	15.04*
SensSeek	41.68*	159.93	---	67.45	108.54
LPers	24.53*	41.03	67.45	---	33.02
PosUrg	42.25	15.04*	108.54	33.02	---
D^2 for standardized scores					
LPrem	---	380.11	605.06	394.22*	418.86
NegUrg	380.11*	---	691.29	413.64	235.54*
SensSeek	605.06	691.29	---	748.98	584.63
LPers	394.22	413.64	748.98	---	421.36
PosUrg	418.86	235.54*	584.63*	421.36	---

Notes: These are dissimilarity matrices. Asterisks indicate the closest profile for each subscale, to be read column-wise.
LPrem = Lack of Premeditation; Neg. Urg. = Negative Urgency; Sens. Seek. = Sensation Seeking; LPers = Lack of Perseverance; Pos. Urg. = Positive Urgency.

Table 14

UPPS-P Subscale Intraclass Correlation Coefficients

	LPrem	NegUrg	SensSeek	LPers	PosUrg
LPrem	---	.63	.26	.62*	.59
NegUrg	.63*	---	.07	.60	.81*
SensSeek	.26	.07	---	-.08	.32
LPers	.62*	.60	-.08	---	.59
PosUrg	.59	.81*	.32*	.59	---

Notes. * $p < .01$, ** $p < .001$.
LPrem = Lack of Premeditation; Neg. Urg. = Negative Urgency; Sens. Seek. = Sensation Seeking; LPers = Lack of Perseverance; Pos. Urg. = Positive Urgency.

Table 15

Mean Levels of UPPS-P Subscales by Hierarchically-Derived Clusters

	LPrem	NegUrg	SensSeek	LPers	PosUrg
Normal	-.08 *(.73)*	.14 *(.67)*	.30 *(.77)*	-.07 *(.79)*	.27 *(.77)*
Inhibited	-.57 *(.80)*	-.26 *(.89)*	-1.31 *(.51)*	-.13 *(1.01)*	-.62 *(.57)*
Broadly Impulsive	.97 *(.81)*	.96 *(.78)*	.31 *(.91)*	.88 *(.74)*	.98 *(.74)*
Sensation Seeking	-.63 *(.92)*	-1.19 *(.60)*	.29 *(.82)*	-.92 *(.67)*	-1.16 *(.31)*

Notes. Standard deviations presented in parentheses.
Z-scores of all variables were used in cluster analyses.
LPrem = Lack of Premeditation; Neg. Urg. = Negative Urgency; Sens. Seek. = Sensation Seeking; LPers = Lack of Perseverance; Pos. Urg. = Positive Urgency.

Table 16

Mean Levels of PDSQ Subscales by Hierarchically-Derived Clusters

	MDD	PTSD	EDs	OCD	Panic	Psychot.	Agora.
Normal	-.03 *(.98)*	-.02 *(.94)*	.03 *(.99)*	.01 *(.99)*	-.03 *(.94)*	.02 *(1.08)*	-.07 *(.90)*
Inhibited	.03 *(1.03)*	.03 *(1.10)*	-.03 *(.95)*	.05 *(1.20)*	-.01 *(.92)*	-.03 *(.84)*	.26 *(1.18)*
Broadly Impulsive	.34 *(1.06)*	.03 *(1.02)*	.29 *(1.15)*	.05 *(1.04)*	.29 *(1.28)*	.20 *(1.29)*	.11 *(1.14)*
Sensation Seeking	-.49 *(.69)*	-.12 *(.84)*	-.41 *(.60)*	-.24 *(.63)*	-.31 *(.54)*	-.15 *(.75)*	-.33 *(.50)*

Table 16 (continued)

Mean Levels of PDSQ Subscales by Hierarchically-Derived Clusters

	SocAnx	AlcAb	DrugAb	GAD	Somat.	Hyp.
Normal	.07 *(.96)*	.01 *(.95)*	.07 *(1.17)*	-.05 *(.94)*	-.02 *(.96)*	-.12 *(.72)*
Inhibited	.05 *(1.00)*	-.15 *(.80)*	-.21 *(.43)*	.15 *(1.07)*	.20 *(1.14)*	.06 *(1.10)*
Broadly Impulsive	.35 *(1.03)*	.34 *(1.39)*	.27 *(1.34)*	.12 *(1.03)*	.12 *(1.09)*	.26 *(1.32)*
Sensation Seeking	-.60 *(.70)*	-.30 *(.43)*	-.15 *(.63)*	-.41 *(.70)*	-.32 *(.77)*	-.21 *(.62)*

Notes. Standard deviations presented in parentheses.
Z-scores of all variables were used in cluster analyses.
MDD = major depressive disorder; PTSD = post-traumatic stress disorder; EDs = eating disorders; OCD = obsessive-compulsive
disorder; Panic = panic disorder; Psychot = psychotic symptoms; Agora = agoraphobia; SocAnx = social anxiety; AlcAb = alcohol
abuse; DrugAb = drug abuse; GAD = generalized anxiety disorder; Somat = somatization; Hyp = hypochondriasis.

Table 17

Mean Levels of PDQ-4 Subscales by Hierarchically-Derived Clusters

	PAR	SZD	SZT	HIS	NAR	BOR
Normal	.01 *(.89)*	.00 *(.95)*	-.00 *(.99)*	.02 *(.96)*	.10 *(.99)*	-.03 *(.90)*
Inhibited	-.01 *(1.09)*	.19 *(1.25)*	-.02 *(1.04)*	-.30 *(.88)*	-.27 *(.94)*	-.08 *(.93)*
Broadly Impulsive	.24 *(1.03)*	.11 *(1.06)*	.30 *(1.02)*	.57 *(.96)*	.35 *(1.02)*	.58 *(1.03)*
Sensation Seeking	-.41 *(.85)*	-.23 *(.71)*	-.40 *(.82)*	-.55 *(.70)*	-.45 *(.76)*	-.61 *(.59)*

Table 17

Mean Levels of PDQ-4 Subscales by Hierarchically-Derived Clusters

	ANT	AVD	DEP	OCPD	NEG	DEPR
Normal	.06 *(.89)*	-.01 *(.94)*	.03 *(.93)*	.15 *(.92)*	-.02 *(.89)*	-.01 *(.90)*
Inhibited	-.63 *(.37)*	.23 *(1.09)*	.02 *(.87)*	-.04 *(1.16)*	-.11 *(.90)*	.16 *(1.06)*
Broadly Impulsive	.65 *(1.22)*	.22 *(1.03)*	.43 *(1.09)*	.01 *(.98)*	.51 *(1.11)*	.15 *(1.07)*
Sensation Seeking	-.42 *(.67)*	-.51 *(.79)*	-.67 *(.52)*	-.23 *(.91)*	-.59 *(.62)*	-.42 *(.82)*

Notes. Standard deviations presented in parentheses.
Z-scores of all variables were used in cluster analyses.
PAR = paranoid personality disorder; SZD = schizoid personality disorder; SZT = schizotypal personality disorder; HIS = histrionic personality disorder; NAR = narcissistic personality disorder; BOR = borderline personality disorder; ANT = antisocial personality disorder; AVD = avoidant personality disorder; DEP = dependent personality disorder; OCPD = obsessive-compulsive personality disorder; NEG = negativistic personality disorder; DEPR = depressive personality disorder.

Table 18

Mean Levels of PCA Variables by Hierarchically-Derived Clusters

	ED	IIS	Neurotic/ Psychotic	Odd/ Obsessive	ET
Normal	.07 *(1.04)*	.02 *(.89)*	-.11 *(.88)*	.04 *(1.00)*	.07 *(.99)*
Inhibited	.10 *(.89)*	-.16 *(.89)*	.16 *(1.10)*	.21 *(1.12)*	-.53 *(.65)*
Broadly Impulsive	.02 *(1.14)*	.58 *(.96)*	.12 *(1.25)*	-.08 *(1.06)*	.59 *(1.20)*
Sensation Seeking	-.30 *(.71)*	-.74 *(.56)*	-.15 *(.58)*	-.15 *(.82)*	-.33 *(.72)*

Notes: Standard deviations presented in parentheses.
Z-scores of all variables were used in cluster analyses.
ED = eating disturbance; IIS = insecure interpersonal style; ET = externalizing tendencies.

Table 19

Mean Levels of UPPS-P Subscales by Model-Based Clusters

	LPrem	NegUrg	SensSeek	LPers	PosUrg
Low Impulsivity	-.74 *(.79)*	-1.24 *(.53)*	-.19 *(1.06)*	-.72 *(.85)*	-1.20 *(.25)*
Medium Impulsivity	-.03 *(.80)*	.08 *(.57)*	-.02 *(1.00)*	.00 *(.86)*	.09 *(.63)*
High Impulsivity	1.02 *(.99)*	1.37 *(.61)*	.31 *(.83)*	.92 *(.86)*	1.30 *(.82)*

Notes. Standard deviations presented in parentheses.
Z-scores of all variables were used in cluster analyses.
LPrem = Lack of Premeditation; Neg. Urg. = Negative Urgency; Sens. Seek. = Sensation Seeking; LPers = Lack of Perseverance; Pos. Urg. = Positive Urgency.

Table 20

Mean Levels of PDSQ Subscales by Model-Based Clusters

	MDD	PTSD	EDs	OCD	Panic	Psychot.	Agora.
Low Impulsivity	-.44 *(.73)*	-.23 *(.71)*	-.35 *(.77)*	-.28 *(.62)*	-.31 *(.51)*	-.20 *(.62)*	-.21 *(.71)*
Medium Impulsivity	-.03 *(.96)*	.02 *(1.03)*	-.01 *(.95)*	.03 *(1.05)*	-.02 *(.97)*	-.01 *(.95)*	.03 *(1.02)*
High Impulsivity	.68 *(1.08)*	.25 *(1.18)*	.49 *(1.22)*	.29 *(1.15)*	.48 *(1.37)*	.30 *(1.43)*	.18 *(1.21)*

Table 20 (continued)

Mean Levels of PDSQ Subscales by Model-Based Clusters

	SocAnx	AlcAb	DrugAb	GAD	Somat.	Hyp.
Low Impulsivity	-.50 *(.75)*	-.26 *(.54)*	-.22 *(.37)*	-.31 *(.82)*	-.17 *(.90)*	-.23 *(.61)*
Medium Impulsivity	.05 *(.98)*	-.08 *(.85)*	-.05 *(.84)*	-.02 *(.98)*	-.06 *(.90)*	-.00 *(.95)*
High Impulsivity	.50 *(1.07)*	.61 *(1.55)*	.44 *(1.69)*	.46 *(1.23)*	.42 *(1.32)*	.31 *(1.43)*

Notes. Standard deviations presented in parentheses.
Z-scores of all variables were used in cluster analyses.
MDD = major depressive disorder; PTSD = post-traumatic stress disorder; EDs = eating disorders; OCD = obsessive-compulsive disorder; Panic = panic disorder; Psychot = psychotic symptoms; Agora = agoraphobia; SocAnx = social anxiety; AlcAb = alcohol abuse; DrugAb = drug abuse; GAD = generalized anxiety disorder; Somat = somatization;
Hyp = hypochondriasis.

Table 21

Mean Levels of PDQ-4 Subscales by Model-Based Clusters

	PAR	SZD	SZT	HIS	NAR	BOR
Low Impulsivity	-.46 *(.88)*	-.23 *(.73)*	-.40 *(.83)*	-.60 *(.68)*	-.46 *(.74)*	-.61 *(.66)*
Medium Impulsivity	.03 *(.95)*	.03 *(1.04)*	.02 *(.97)*	-.02 *(.94)*	.05 *(1.01)*	-.05 *(.87)*
High Impulsivity	.51 *(1.06)*	.18 *(1.12)*	.45 *(1.10)*	.86 *(.96)*	.44 *(1.03)*	.98 *(1.07)*

Table 21 (continued)

Mean Levels of PDQ-4 Subscales by Model-Based Clusters

	ANT	AVD	DEP	OCPD	NEG	DEPR
Low Impulsivity	-.50 *(.69)*	-.40 *(.88)*	-.59 *(.60)*	-.18 *(.95)*	-.60 *(.62)*	-.39 *(.88)*
Medium Impulsivity	-.09 *(.85)*	.01 *(.92)*	.02 *(.92)*	.02 *(1.01)*	-.02 *(.89)*	-.01 *(.94)*
High Impulsivity	.92 *(1.19)*	.48 *(1.04)*	.72 *(1.19)*	.19 *(.99)*	.85 *(1.15)*	.54 *(1.13)*

Notes. Standard deviations presented in parentheses.
Z-scores of all variables were used in cluster analyses.
PAR = paranoid personality disorder; SZD = schizoid personality disorder; SZT = schizotypal personality disorder;
HIS = histrionic personality disorder; NAR = narcissistic personality disorder; BOR = borderline personality disorder;
ANT = antisocial personality disorder; AVD = avoidant personality disorder; DEP = dependent personality disorder;
OCPD = obsessive-compulsive personality disorder; NEG = negativistic personality disorder; DEPR = depressive
personality disorder.

Table 22

Mean Levels of PCA Variables by Model-Based Clusters

	ED	IIS	Neurotic/ Psychotic	Odd/ Obsessive	ET
Low Impulsivity	-.22 *(.81)*	-.65 *(.63)*	-.13 *(.54)*	-.15 *(.81)*	-.46 *(.73)*
Medium Impulsivity	.02 *(.98)*	.01 *(.91)*	-.05 *(1.01)*	.05 *(1.01)*	-.04 *(.85)*
High Impulsivity	.23 *(1.22)*	.84 *(1.06)*	.33 *(1.33)*	.02 *(1.16)*	.72 *(1.33)*

Notes: Standard deviations presented in parentheses.
Z-scores of all variables were used in cluster analyses.
ED = eating disturbance; IIS = insecure interpersonal style; ET = externalizing tendencies.

Figure 1. Scree plot for principal components analysis of all study outcome variables.

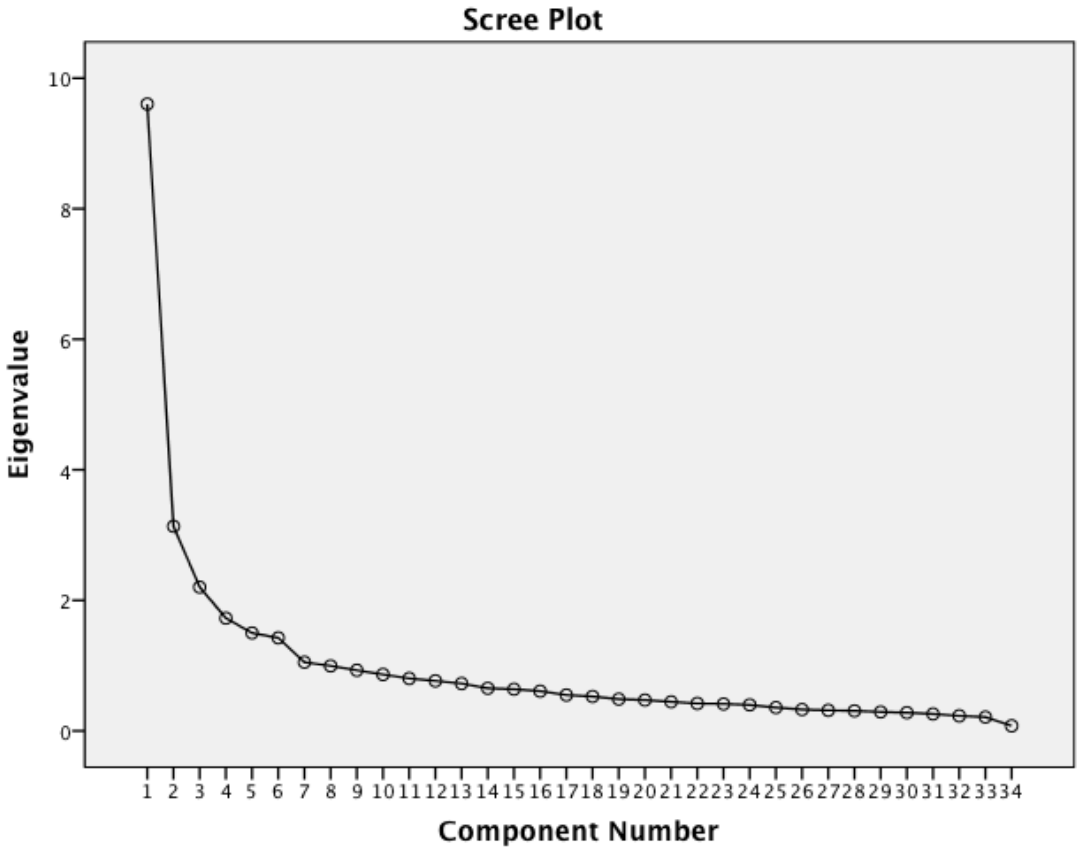

Figure 2. Horn's parallel analysis of 31 outcome variables.

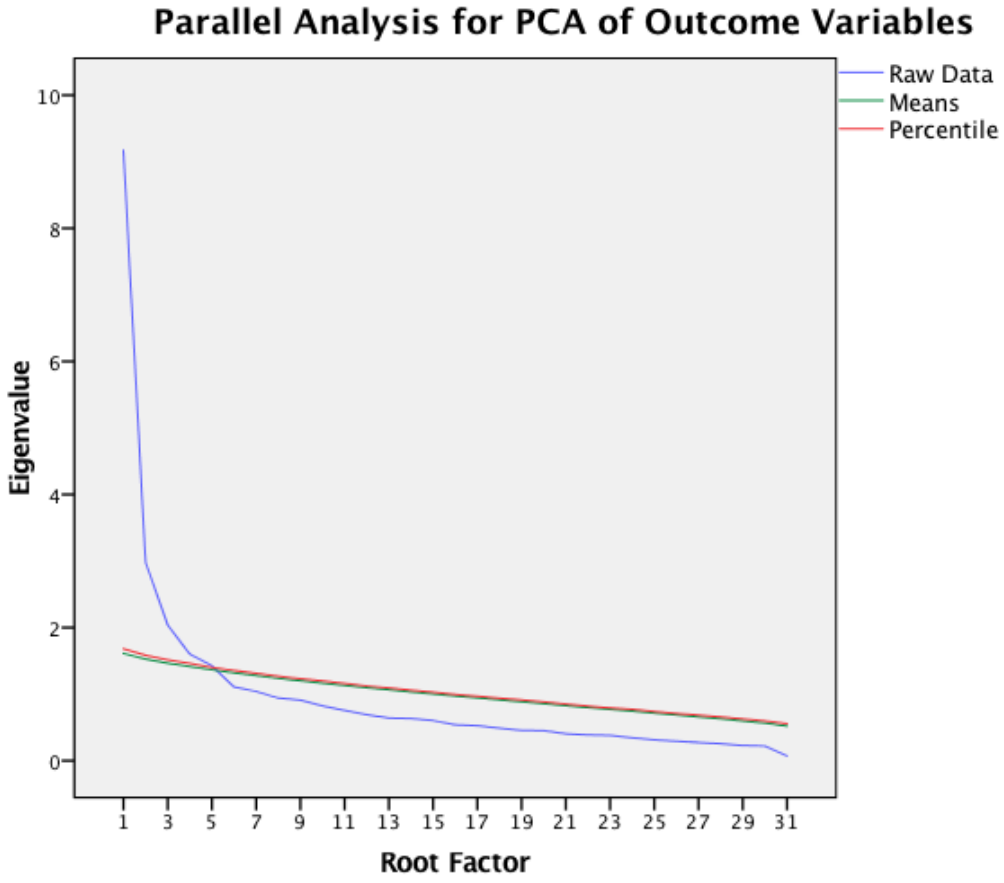

Figure 3. UPPS-P profiles across PDSQ subscales.

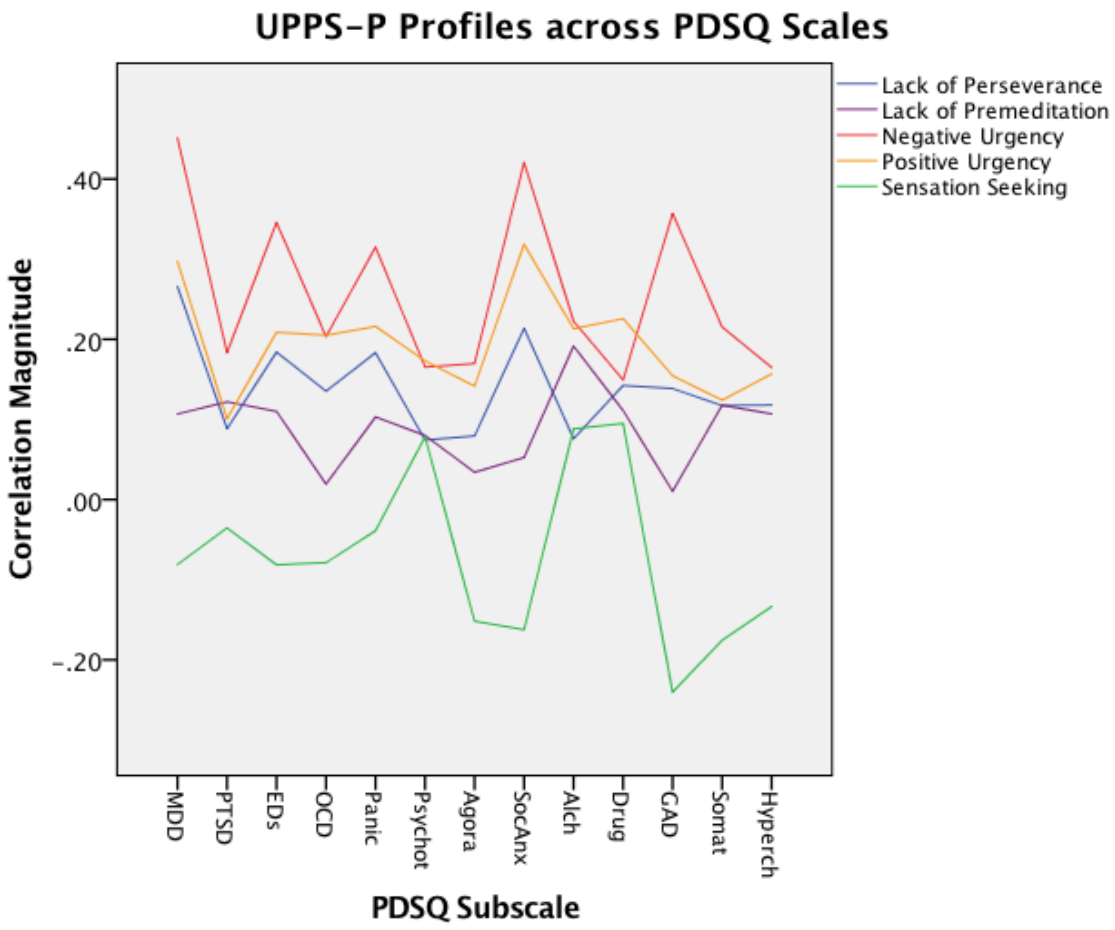

Figure 4. UPPS-P profiles across PDQ-4 subscales.

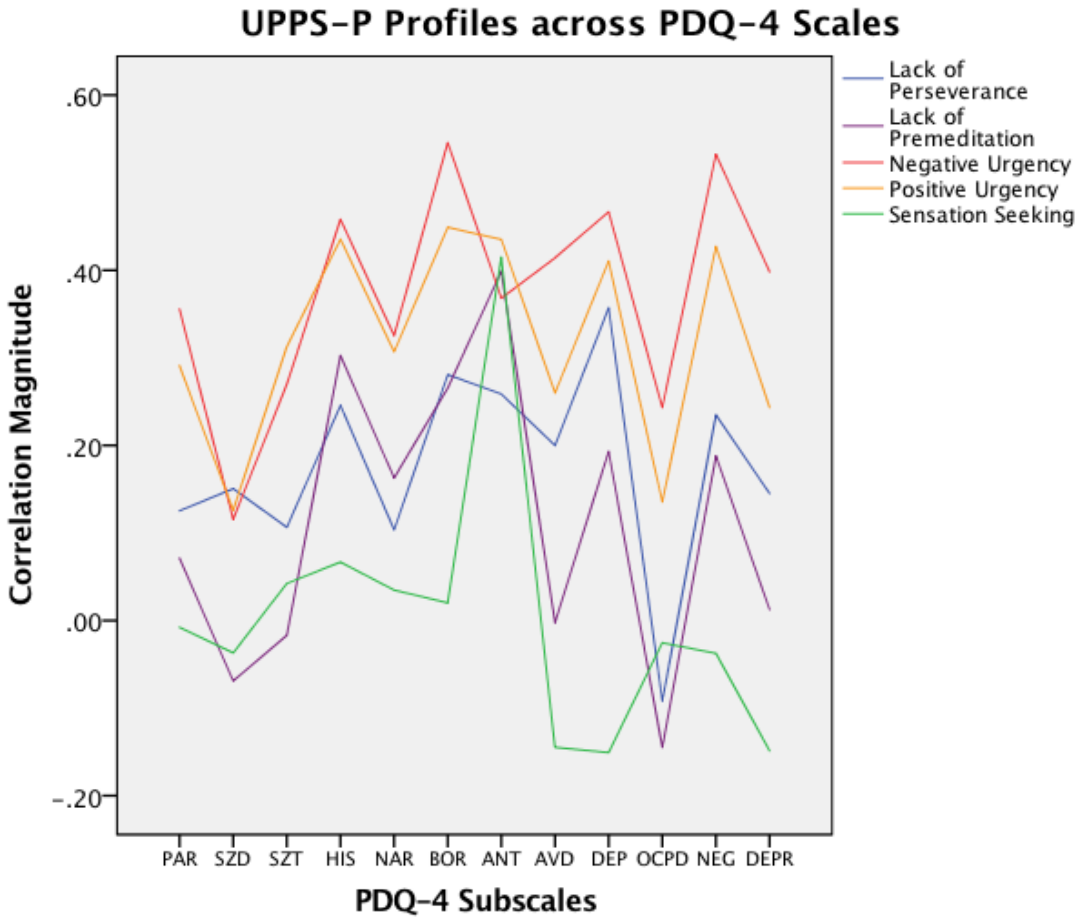

Figure 5. UPPS-P profiles across PCA subscales.

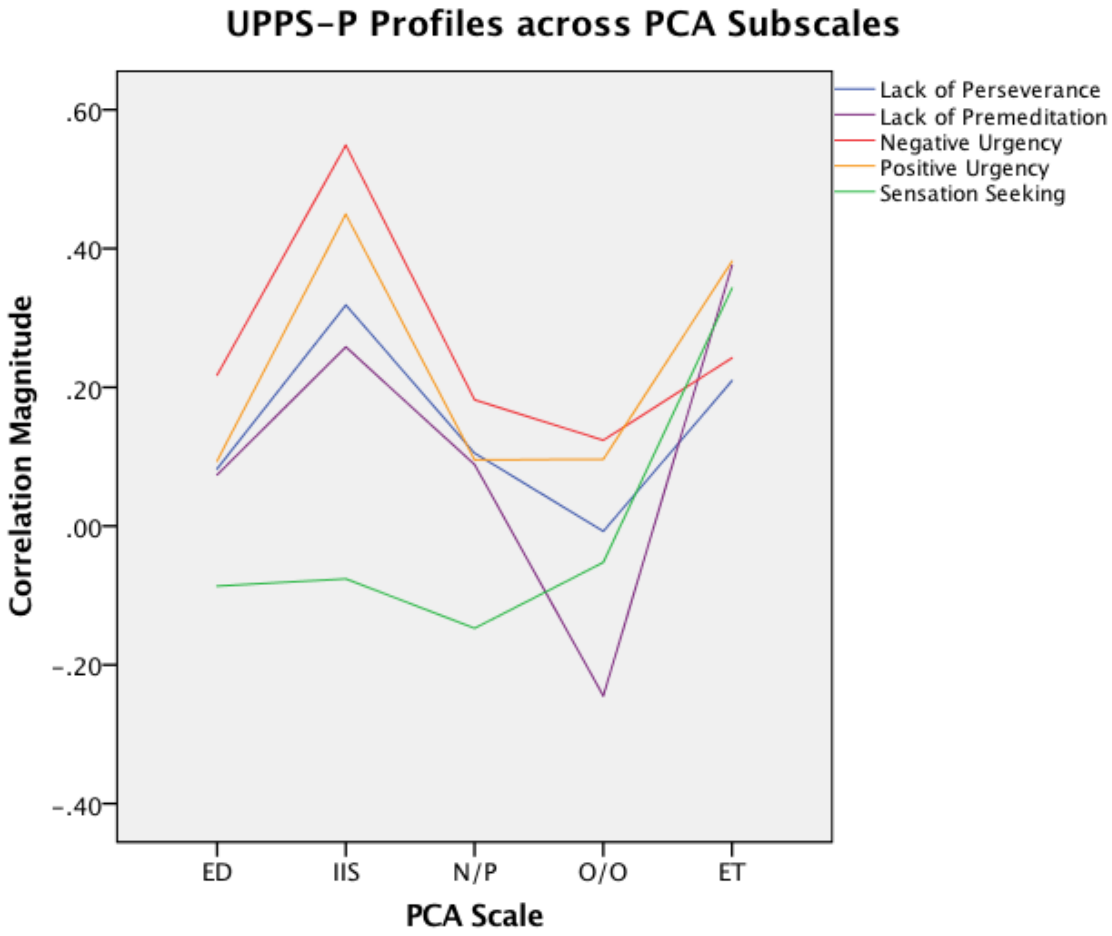

Figure 6. Dendrogram for hierarchical cluster analyses.

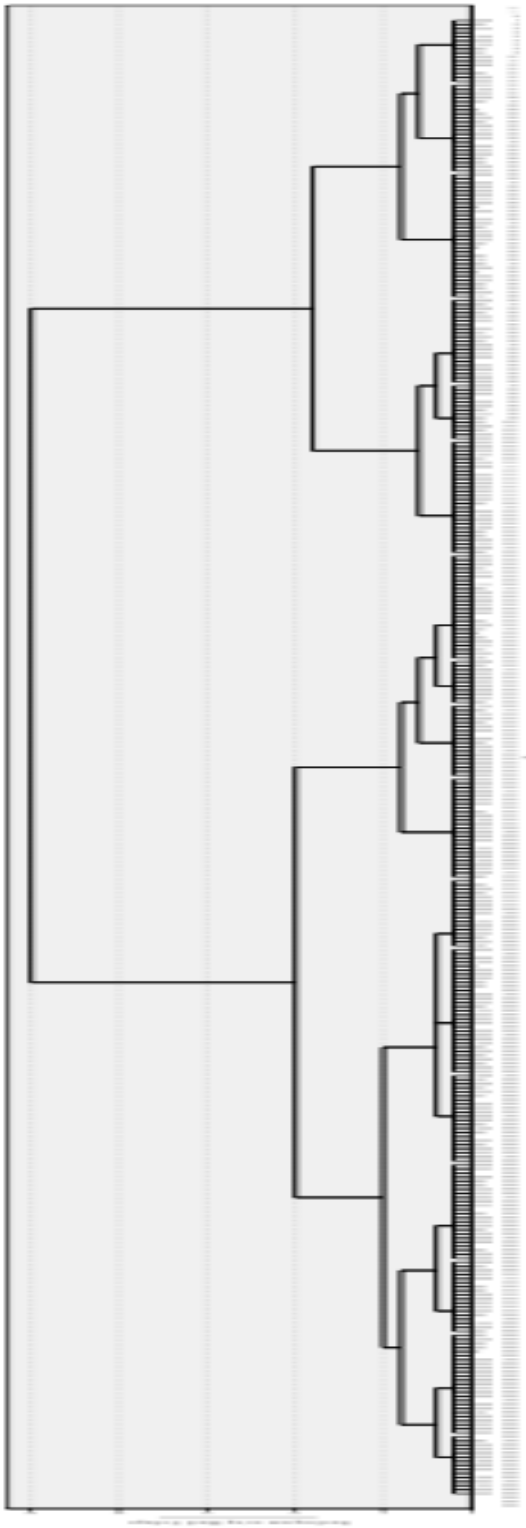

Figure 7. UPPS-P means across hierarchically-derived clusters.

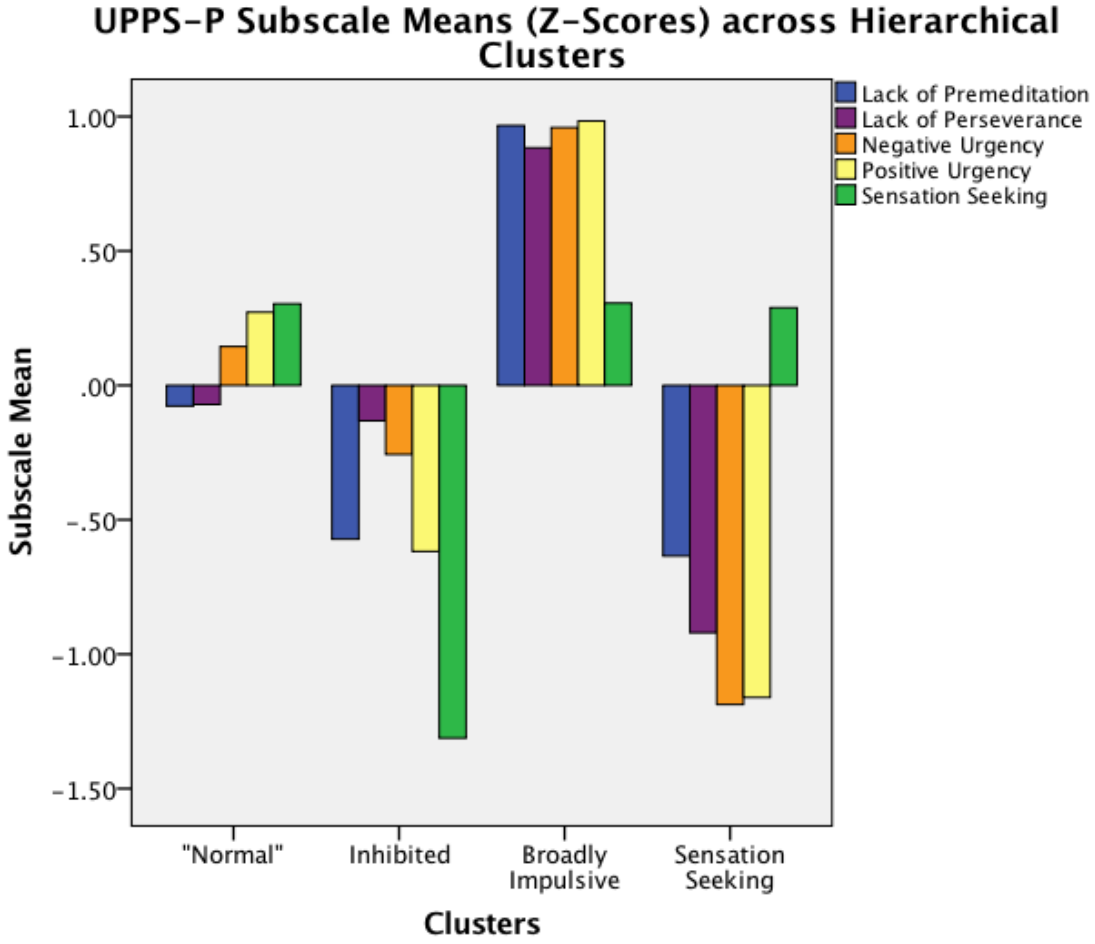

Figure 8. PDSQ means across hierarchically-derived clusters.

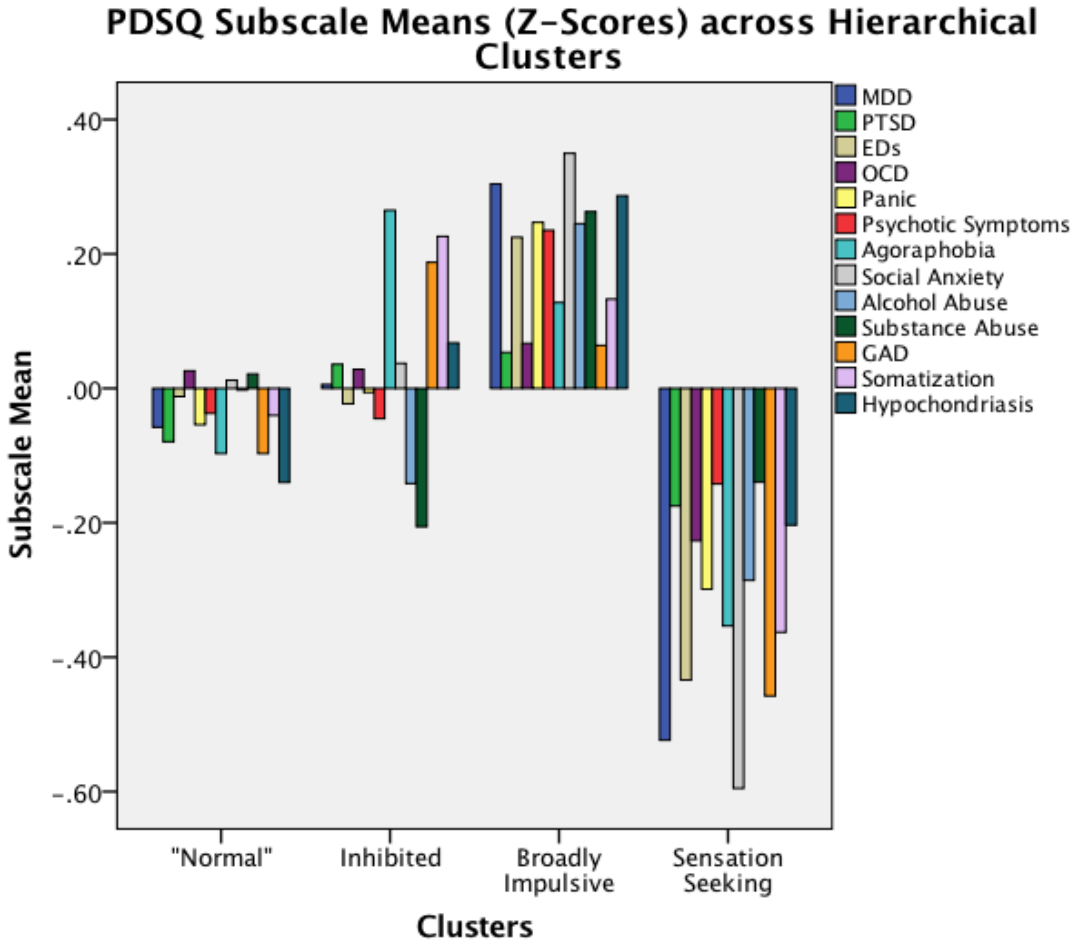

Figure 9. PDQ-4 means across hierarchically-derived clusters.

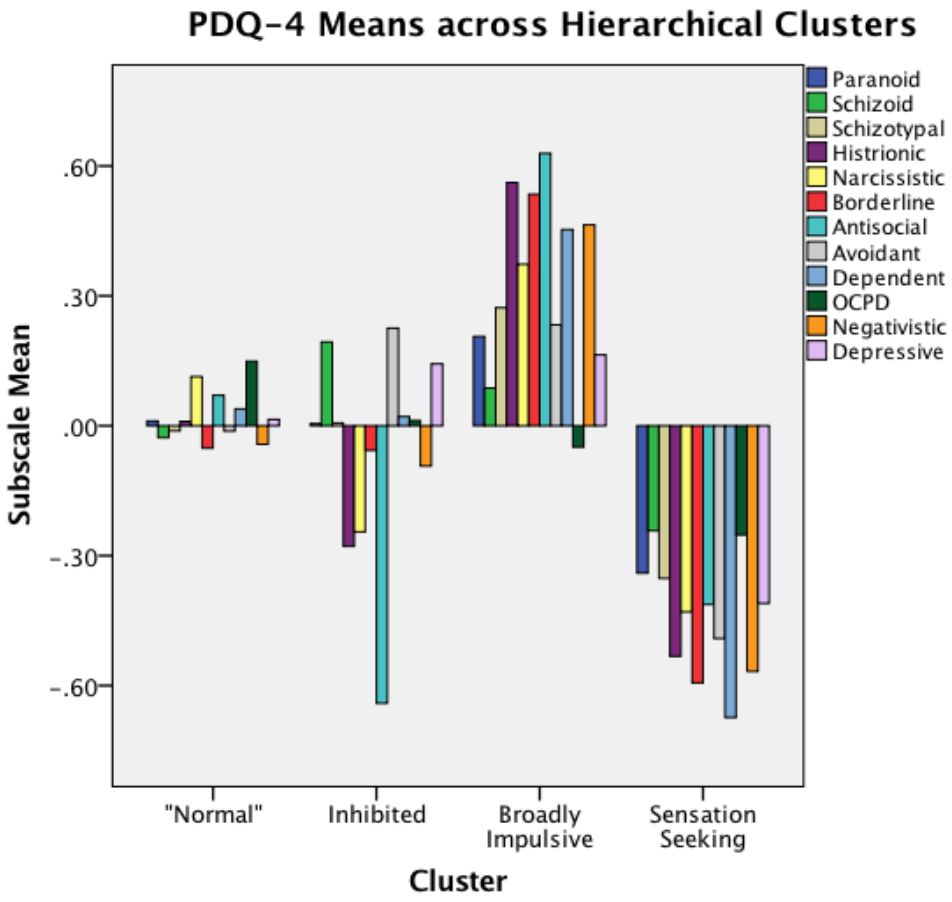

Figure 10. PCA means across hierarchically-derived clusters.

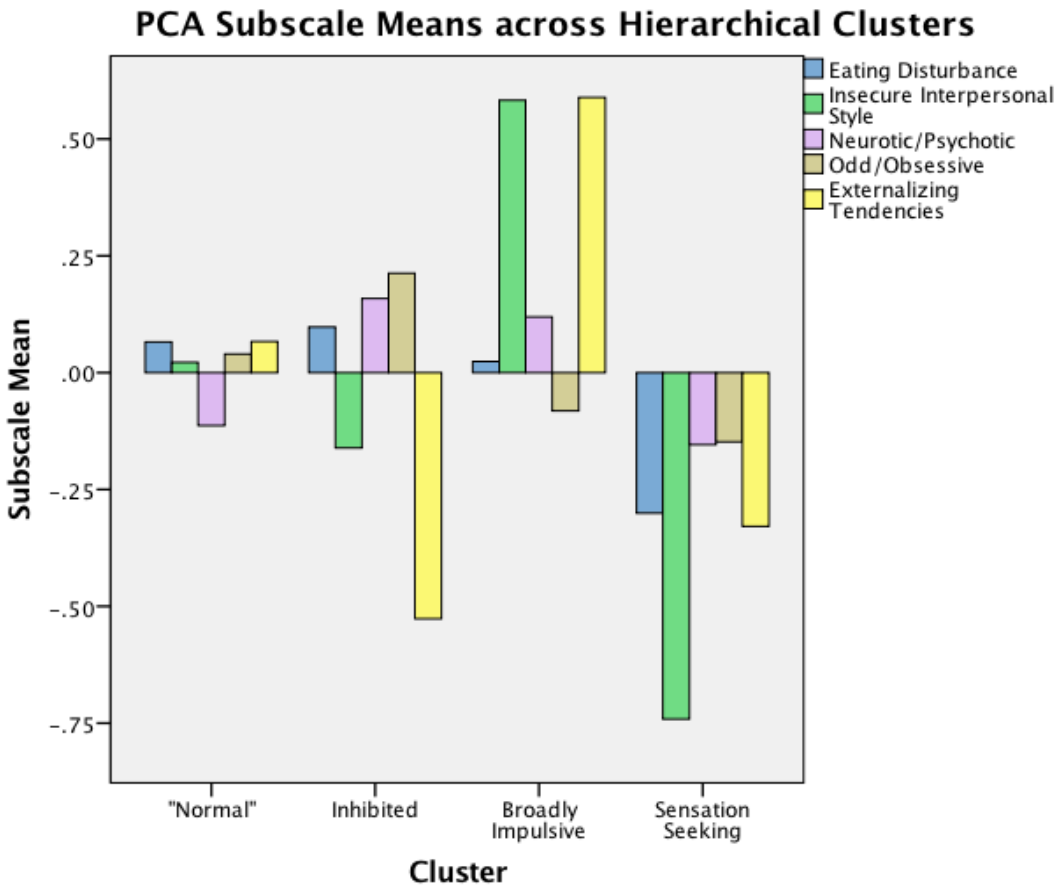

Figure 11. BIC plot for model-based cluster analyses.

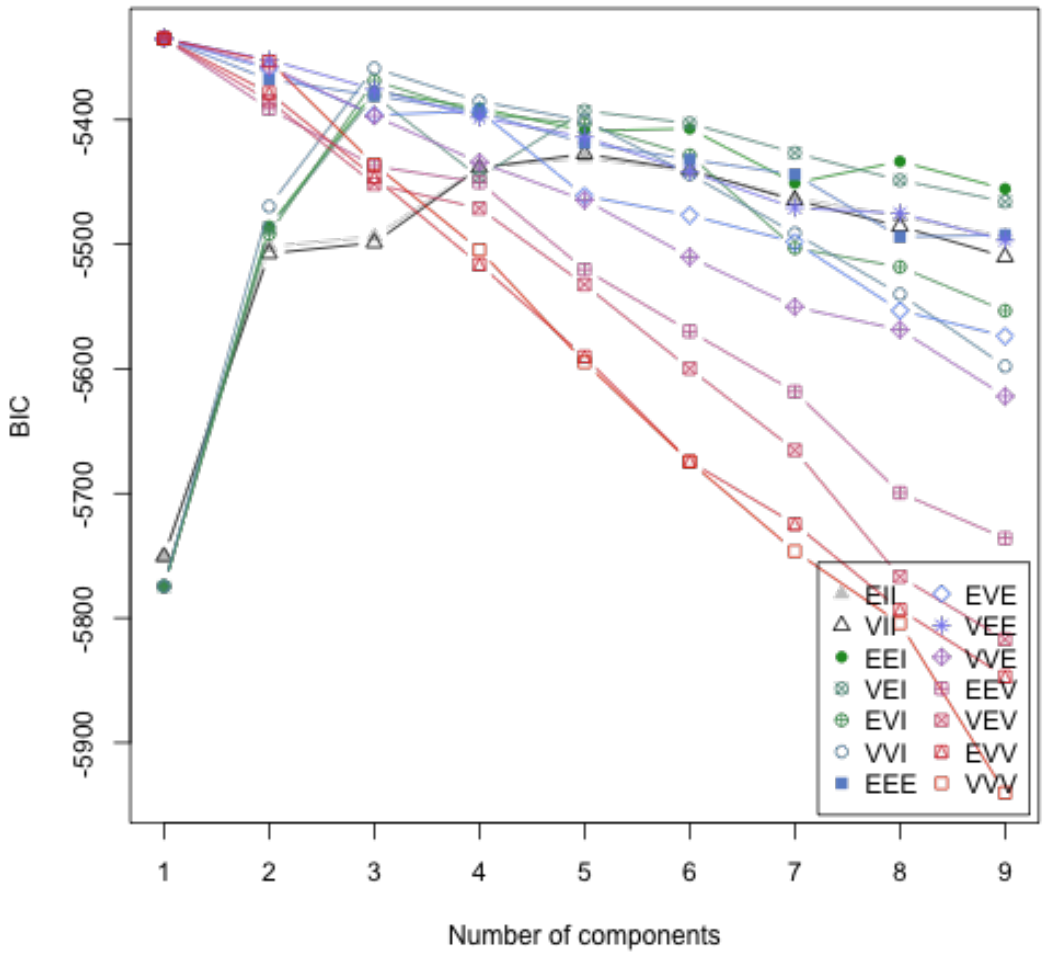

Figure 12. Pairs plot for 3-cluster solution.

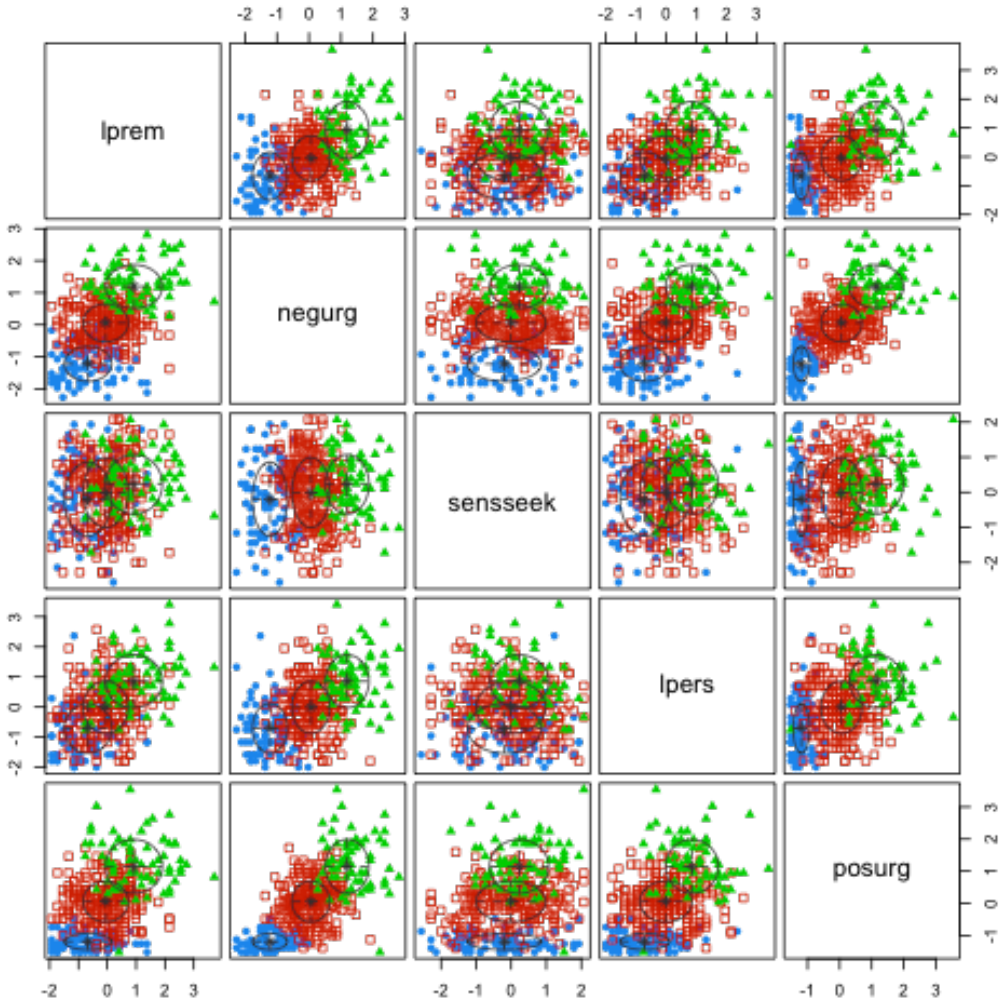

Figure 13. UPPS-P means across model-based clusters.

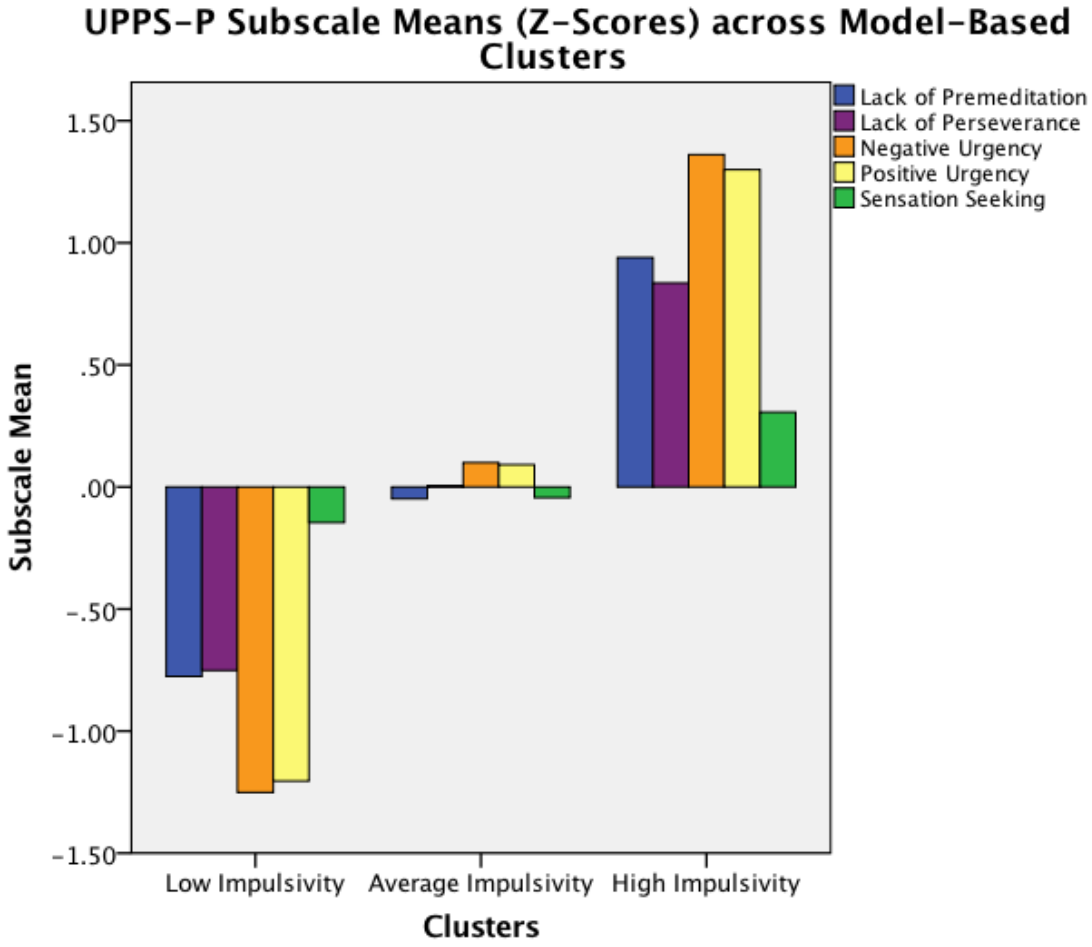

Figure 14. PDSQ means across model-based clusters.

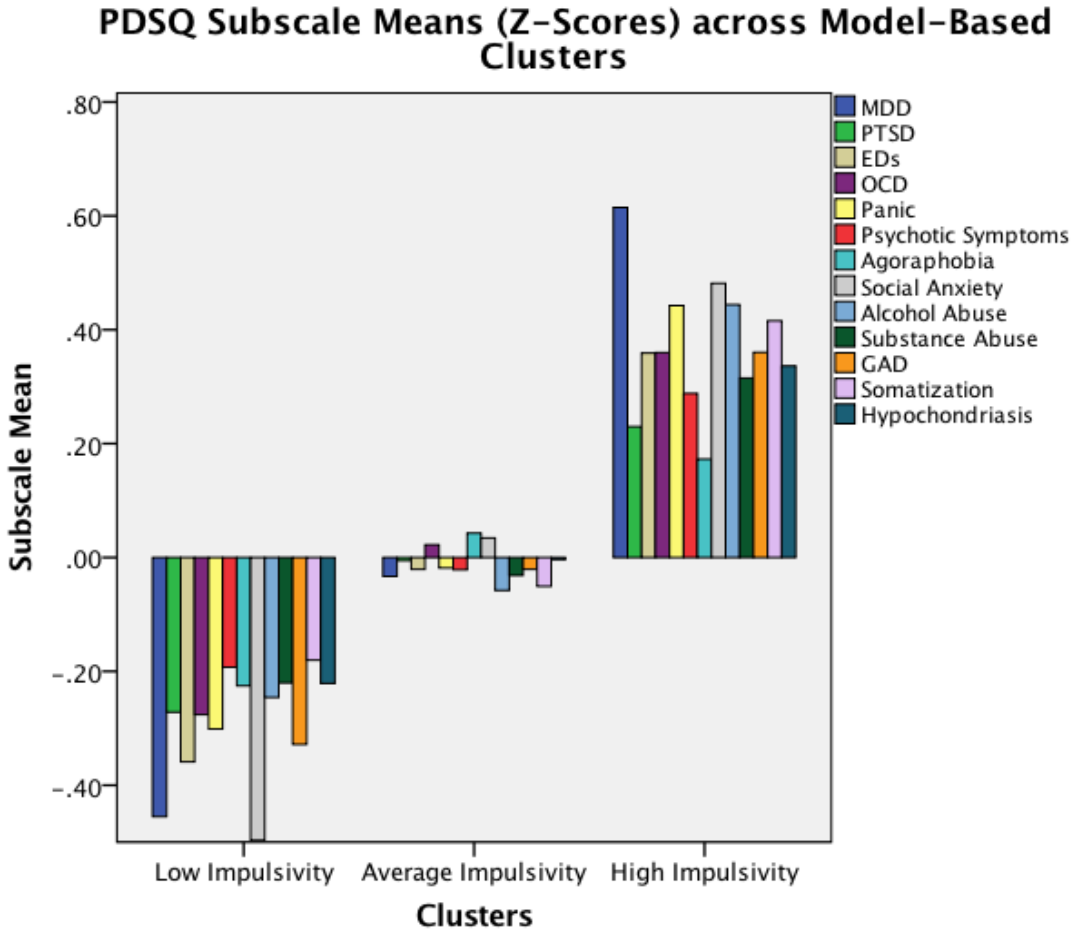

Figure 15. PDQ means across model-based clusters.

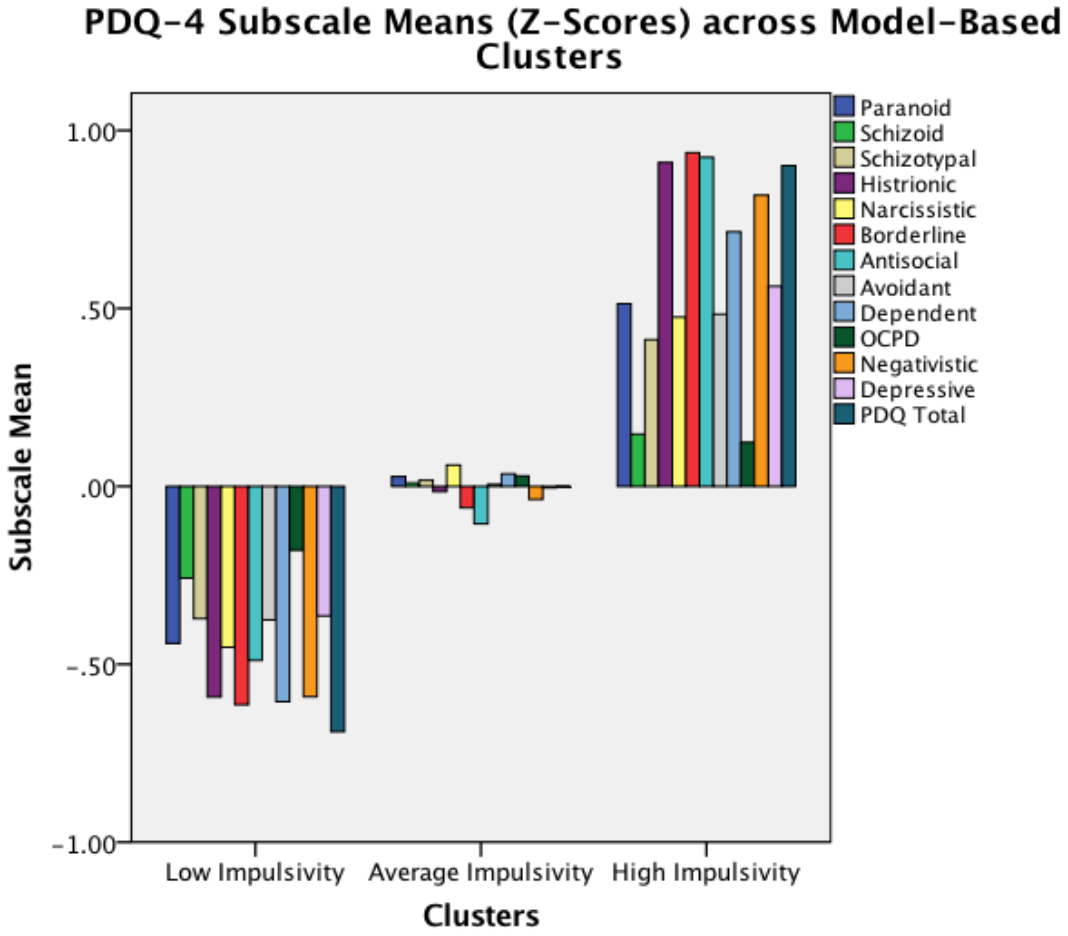

Figure 16. PCA means across model-based clusters.