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Composite impulsivity-related domains in college students

Sabin Khadka [a, *], Michael C. Stevens [a, b], Farah Aslanzadeh [a], Balaji Narayanan [a], Keith A. Hawkins [a, b], Carol S. Austad [c], Sarah A. Raskin [d], Howard Tennen [e], Rebecca M. Wood [c], Carolyn Fallahi [c], Marc N. Potenza [b, f, g, h, i], Godfrey D. Pearlson [a, b, f]

[a] Olin Neuropsychiatry Research Center, Institute of Living, Hartford HealthCare Corporation, Hartford, CT, USA
[b] Department of Psychiatry, Yale University, New Haven, CT, USA
[c] Central Connecticut State University, New Britain, CT, USA
[d] Trinity College, Hartford, CT, USA
[e] University of Connecticut, School of Medicine, Farmington, CT, USA
[f] Department of Neuroscience, Yale University, New Haven, CT, USA
[g] Child Study Ctr., Yale University, New Haven, CT, USA
[h] The National Center on Addictions and Substance Abuse, Yale University, New Haven, CT, USA
[i] Connecticut Mental Health Center, New Haven, CT, USA

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ABSTRACT

Impulsivity is a complex, multidimensional construct with prior theoretically and empirically derived characterizations of impulsivity-related behaviors varying considerably among studies. We assessed college students (N = 440) longitudinally with five impulsivity-related self-reported assessments and two computerized behavioral measures. Using a combination of exploratory and confirmatory factor analysis (CFA), we derived then validated several composite impulsivity-related domains (CIRDs). These factors replicated, in large part, findings from a previous study conducted by our group in an independent sample that used a similar analytical approach. The four CIRDs derived in current study are: 'Impulsive action', 'Approach/Appetite Motivation', 'Impulsivity/Compulsivity' and 'Experience and thrill seeking/Fearlessness'. Subsequent psychometric analyses found these CIRDs were relatively stable over the two-year period. Moreover, multiple regression analysis found that CIRD profiles associated with clinical and behavioral characteristics including anxiety, depression, attention deficit hyperactivity disorder and substance use symptomology. Overall, our data suggest that empirically-derived CIRDs have potential for organizing previous impulsivity-related constructs into a more naturalistic framework where distinct constructs are often expressed together in the same individuals. This framework might facilitate future research of neuropsychiatric disorder risk and etiology.

1. Introduction

Impulsivity is a complex, multidimensional characteristic that has been characterized as "a predisposition towards rapid, unplanned reactions to internal or external stimuli with diminished regard to the negative consequences of these reactions to the impulsive individuals or others" (Fineberg et al., 2014). However, how best to parse impulsivity-related features is unclear (Fineberg et al., 2014). Appropriate segregation of different theoretical constructs is important to the neurobiological study of impulsivity, as different domains might vary in relationship to brain circuits, neurotransmitter systems and/or genetic mechanisms and contribution or to specific psychopathologies. Two empirically supported impulsivity dimensions are impulsive-choice and impulsive-action (Brevers et al., 2012, Dalley et al., 2011). However, numerous other impulsivity-related constructs, including characteristics of novelty and sensation-seeking (Zuckerman and Neeb, 1979), reward-drive (Carver and White, 1994; Luman et al., 2012; Torrubia et al., 2001), thrill-seeking (Campbell et al., 2010), behavioral inhibition/activation (Carver and White, 1994) also relate importantly to personality and psychopathology. Also, a prior study (Cyders and Smith, 2008) has conducted structural equation modeling using UPPS scale (Berg et al., 2015) to assess longitudinal risky and gambling behaviors. The purpose of the current study was to derive

* Corresponding author.
E-mail address: Sabin.Khadka@hhchealth.org (S. Khadka).

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composite impulsivity domains using a diverse variety of impulsivity-related measures and to explore their longitudinal stability and relationship to clinical and behavioral characteristics. Such research is important for testing the relevance of specific transdiagnostic domains, consistent with efforts like the Research Domain Criteria (RDoC) initiative (Insel et al., 2010).

It is not fully understood how different impulsivity measures relate to each other. To describe such inter-relationships, prior studies examined many computer-based tests and self-report questionnaires (Caswell et al., 2015, Cyders and Coskunpinar, 2011, 2012, Ginley et al., 2014, Meda et al., 2009). Several studies report that scores on various measures can be categorized into separate factors, suggesting that they capture different super-ordinate impulsivity-related domains (Caswell et al., 2015; Lane et al., 2003, Meda et al., 2009). Using seven laboratory measures in healthy adolescents, Reynolds and colleagues used principal component analysis (PCA) to identify impulsive decision-making, impulsive inattention and impulsive disinhibition domains (Reynolds et al., 2008). Our group used PCA-based approach to examine shared variance among several self-report and computer-based psychometric tests from cohorts of healthy controls as well as individuals at-risk-of/engaged in substance abuse (Meda et al., 2009). We identified five impulsivity-related domains that captured self-reported behavioral activation, self-reported compulsivity and reward/punishment sensitivity, self-reported action-oriented impulsivity, behavioral temporal-discounting and behavioral risk-taking. Our subsequent study using only self-report impulsivity measures reported three distinct factors showing considerable conceptual overlap with this five-factor solution (Ginley et al., 2014). Caswell and colleagues examined ten behavioral tasks and one self-report measure assessing impulsivity-related using exploratory factor analysis (EFA), reporting four super-ordinate impulsivity-related factors (Caswell et al., 2015).

These studies support the idea that impulsive behavior might be reducible to a handful of broader constructs. Thus factors derived from data reduction techniques represent similar question content from different scales, or products of similar methodological approaches. For instance, studies using different assessment methods typically find low correlations among scores derived from different approaches and sometimes modest correlations within assessment methods (Cyders and Coskunpinar, 2011, 2012). Also factors with moderate associations among these distinct constructs might reflect a population-based tendency for different forms of impulsivity to co-occur. Since these impulsivity-related domains are conceptually distinct, it might indicate any given individual is likely to simultaneously express several different impulsivity-related behavioral tendencies (Lacey and Evans, 1986).

This is an attractive idea for researchers to show how impulsivity may be a risk for psychopathologies, characterize the neurobiological correlates of impulsive behavior, or identify impulsivity risk genes. In particular, neurobiological studies may wish to identify individual differences in the structure or function of specific underlying brain systems. Studies have linked specific types of impulsivity to distinct brain systems (motor inhibition to dorsolateral and medial frontostriatal circuits and impulsive choice to ventral corticostriatal networks (Fineberg et al., 2014)). Also, prior research has shown laboratory and personality measures of impulsivity may be related to risk of psychopathology (Swann et al., 2002). However, individual studies typically focus on single type of impulsivity. The specificity of isolated impulsivity constructs might map less clearly and reliably to brain measures than broader impulsivity-related domains in large-scale population-based imaging studies.

Even though prior studies have attempted to derive multidimensional relationships among impulsivity constructs, direct comparisons of factor structure across studies are not possible because they used different measures. However, it is noteworthy that although scores on measures within similar theoretical domains (e.g., Go/NoGo and Stop Signal tasks) are not always highly correlated (Caswell et al., 2015), studies that used the same measures tend to find similar factor structure. For instance, two prior studies from our group (Ginley et al., 2014; Meda et al., 2009) found that sensitivity to punishment measured on the Sensitivity to Punishment and Sensitivity to Reward Questionnaire (SPSRQ) (Torrubia et al., 2001) and compulsivity as measured by the Padua Inventory (PI) (Sternberger and Burns, 1990) covaried. Such similarities suggest that a study with sufficient coverage of impulsivity-related measures might produce a viable framework of super-ordinate impulsivity domains. Therefore, the purpose of the current study was to derive composite impulsivity-related domains (CIRDs) from multiple impulsivity-related measures and validate the previously derived factor structure (Meda et al., 2009). Using methods including EFA, confirmatory factor analysis (CFA), intra-class correlation, and different linear association analyses appropriate to the various data types, we tested the structure, internal consistency, test-retest reliability, and association of derived CIRDs with symptoms scores of various psychopathologies in young adults. We hypothesized that (i) EFA-derived CIRDs would share a structure similar to described in our previous study (Meda et al., 2009), (ii) CFA in an independent dataset would validate the CIRD factor structures, (iii) CIRD measures would exhibit reliability over time, and (iv) CIRD measures would be associated with symptom scores of various disorders previously linked in various ways to impulsivity in prior research (First, 2013; Fossati et al., 2004, Grano et al., 2007, Jupp and Dalley, 2014a; Lejuez et al., 2010, Moeller et al., 2001, Piero, 2010).

2. Material and methods

The study sample consisted of young adult freshmen students (N = 440) who participated in NIAAA-funded Brain and Alcohol Research with College Students (BARCS) study (Dager et al., 2013, Khadka et al., 2014). Demographic and characteristics information of study sample are reported in Table 1. We collected data from college students of two different institutions (Central Connecticut State University and Trinity College) in order to capture racial/demographic sample representative of college students in the Greater Hartford Region. All participants provided written informed consent approved by Hartford Hospital, Yale University, Trinity College, and Central Connecticut State University.

2.1. Impulsivity measures

Participants were assessed with five self-report questionnaires and two computer-based laboratory tasks. The impulsivity-related measures assessed were based upon our previous study (Meda et al., 2009). The various impulsivity-related measures chosen emerged from different theoretical construct and sometimes overlapped. Self-report measures included (i) Sensation-Seeking Scale (SSS) (Zuckerman and Neeb, 1979), (ii) Behavioral Activation System/Behavioral Inhibition System Scale (BIS/BAS) (Carver and White, 1994), (iii) Barratt Impulsiveness Scale (BIS-11) (Patton et al., 1995), (iv) Sensitivity to Punishment and Sensitivity to Reward Questionnaire (Torrubia et al., 2001), and (v) Padua Inventory (PI) (Sternberger and Burns, 1990).

Computer-based behavioral tasks included the (i) Balloon Analog Risk Task (BART) (Hunt et al., 2005), and (ii) Experiential Discounting Task (EDT) (Reynolds and Schiffbauer, 2004). Details on impulsivity-measures and questionnaires are reported in supplemental section.