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Toward a Theory of Distinct Types of “Impulsive” Behaviors: A Meta-Analysis of Self-Report and Behavioral Measures

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Impulsivity is considered a personality trait affecting behavior in many life domains, from recreational activities to important decision making. When extreme, it is associated with mental health problems, such as substance use disorders, as well as with interpersonal and social difficulties, including juvenile delinquency and criminality. Yet, trait impulsivity may not be a unitary construct. We review commonly used self-report measures of personality trait impulsivity and related constructs (e.g., sensation seeking), plus the opposite pole, control or constraint. A meta-analytic principal-components factor analysis demonstrated that these scales comprise 3 distinct factors, each of which aligns with a broad, higher order personality factor—Neuroticism/Negative Emotionality, Disinhibition versus Constraint/Conscientiousness, and Extraversion/Positive Emotionality/Sensation Seeking. Moreover, Disinhibition versus Constraint/Conscientiousness comprise 2 correlated but distinct subfactors: Disinhibition versus Constraint and Conscientiousness/Will versus Resourcelessness. We also review laboratory tasks that purport to measure a construct similar to trait impulsivity. A meta-analytic principal-components factor analysis demonstrated that these tasks constitute 4 factors (Inattention, Inhibition, Impulsive Decision-Making, and Shifting). Although relations between these 2 measurement models are consistently low to very low, relations between both trait scales and laboratory behavioral tasks and daily-life impulsive behaviors are moderate. That is, both independently predict problematic daily-life impulsive behaviors, such as substance use, gambling, and delinquency; their joint use has incremental predictive power over the use of either type of measure alone and furthers our understanding of these important, problematic behaviors. Future use of confirmatory methods should help to ascertain with greater precision the number of and relations between impulsivity-related components.

Keywords: Impulsivity, disinhibition, meta-analysis, trait-behavior link

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While [Daedalus] was working, his son Icarus, with smiling countenance and unaware of danger to himself, perchance would chase the feathers, ruffled by the shifting breeze, and by his playfulness retard the work his anxious father planned. When at last the father finished it, he poised himself, and lightly floating in the winnowed air waved his great-feathered wings with bird-like ease. Before they ventured in the air the father said, “My son, I caution you to keep the middle way, for if your pinions dip too low the waters may impede your flight; and if they soar too high the sun may scorch them. So fly midway . . . and follow my safe guidance.” Then he upon his gliding wings assumed a careful lead solicitous. Proud of his success, the foolish Icarus forsook his guide, and, bold in vanity, began to soar, rising upon his wings to touch the skies; but as he neared the scorching sun, its heat softened the fragrant wax that held his plumes; and heat increasing melted the soft wax—he waved his naked arms instead of wings, with no more feathers to sustain his flight.

—Ovid, *Metamorphoses*

Ah, dear Juliet, Why art thou yet so fair? Shall I believe that unsubstantial death is amorous, and that the lean abhorred monster keeps thee here in dark to be his paramour? For fear of that, I still will stay with thee; and never from this palace of dim night depart again; here, here will I remain with worms that are thy chamber-maids; O, here will I set up my everlasting rest, and shake the yoke of inauspicious starts from this world-wearied flesh. Eyes, looks your last! Arms, take your last embrace! And lips, O you the doors of breath, seal with a righteous kiss a dateless bargain to engrossing death! Come, bitter conduct, come, unsavoury guide! Thou desperate pilot, now at once run on the dashing rocks thy sea-sick weary bark! Here’s to my love! [Drinks] O true apothecary! Thy drugs are quick. Thus with a kiss I die.

—Shakespeare, *Romeo and Juliet*

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> The essential feature of Impulse-Control Disorders is the failure to resist an impulse, drive, or temptation to perform an act that is harmful to the person or to others. (American Psychiatric Association, 1994, p. 609)

> Disruptive, impulse control, and conduct disorders include conditions involving problems in the self-control of emotions and behaviors. While other disorders in the *DSM-5* may also involve problems in emotional and/or behavioral regulation, the disorders in this chapter are unique in that these problems are manifested in behaviors that violate the rights of others (e.g., aggression, destruction of property) and/or that bring the individual into significant conflict with societal norms or authority figures. (American Psychiatric Association, 2013, p. 461)

These quotations, dating back over two millennia, all describe behavior that has been called impulsive. For example, Kilinski (2006) wrote, "In classic mythology, Icarus was the impulsive boy who, being given wings, flew too close to the sun" (p. 257), and Cardullo (1985) wrote of Shakespeare's *Romeo and Juliet,* "Impulsiveness is the real villain in this play" (p. 102). Moreover, in these cases, the consequences are disastrous to the impulsive individuals as well as those affected by their behavior; although we can appreciate the tragedy in the case of literary figures, it is difficult to do so when the impulsive behavior negatively affects the lives of real people and those they harm.

Gordon Allport (1929) described eight characteristics of personality traits, one of which is that a trait is a motivating factor in behavior or, in other words, is "determinative" (p. 369). Indeed, impulsivity has been linked to many types of behaviors with direct impact on daily functioning. Those who score higher on various measures of impulsivity report higher levels of risky motorcycle driving behavior, motor vehicle accidents (Cheng & Lee, 2012), and reckless driving (Teese & Bradley, 2008). Sensation seeking, a facet of many models of impulsivity (e.g., Whiteside & Lynam, 2001), also has been linked to various types of extreme recreational activity, including skydiving (Myrseth, Tverå, Hagatun, & Lindgren, 2012), rock climbing (Llewellyn & Sanchez, 2008), and excessive exercise (Carlson, 2008).

Aside from engaging in more physical activities, those who score higher on measures of impulsivity engage in such problematic behavior as maladaptive cell phone use (Billieux, Van Der Linden, & Rochat, 2008) and Internet pornography viewing (Wetterneck, Burgess, Short, Smith, & Cervantes, 2012). Individuals high in impulsivity are likewise nonplanful, which makes them more likely to procrastinate (Youzhi & Jing, 2009), to incur high levels of unsecured (e.g., consumer) debt (Ottaviani & Vandone, 2011), and to have difficulties in school, work, health, and social adjustment (see Whiteside & Lynam, 2001). Their behavior and thought patterns also set them up for social and cognitive consequences. That is, higher levels of reported impulsivity have been linked to peer rejection (Hays, 2000) and various types of cognitive distortions (Gagnon, Daelman, McDuff, & Kocka, 2013). Taken together, these data indicate those who score higher on some measures of impulsivity are prone to engage in various types of risky and nonplanful behavior, as well as to experience the social and cognitive consequences of these behaviors in their everyday lives.

Such individuals also tend to endorse higher levels of psychopathology, in both clinical and nonclinical samples. Among 34,653 members of the general population, Chamorro et al. (2012) linked impulsivity to a number of mental disorders. Both internalizing (e.g., Kashyap et al., 2012; Marmorstein, 2013) and externalizing (e.g., Loeber et al., 2012) symptoms of psychopathology, as well as compulsive buying (Williams & Grisham, 2012), disordered eating (Davis & Fischer, 2013), and risky sexual behaviors (Hoyle, Fejfar, & Miller, 2000), have been associated with various facets of impulsivity. Substance use disorders also are frequently considered to reflect poor impulse control and, increasingly, are explained in neurobiological terms. For example, Bechara (2005) described addiction as "the product of an imbalance between two separate, but interacting, neural systems that control decision making: an impulsive, amygdala system for signaling pain or pleasure of immediate prospects, and a reflective, prefrontal cortex system for signaling pain or pleasure of future prospects" (p. 1458).

In a survey on criminological theories, experts most frequently cited low self-control as the cause of delinquency and minor adult offending and as the second most frequent (after poor social control) cause of serious and persistent offending (Ellis & Walsh, 1999). Similarly, Lynam and Miller (2004) noted that "impulsivity serves as the centerpiece in several etological theories of crime" (p. 320). The exact extent to which impulsivity figures into criminal behavior is unknown, but the social cost of crime to society is staggering: Applying a recent cost analysis (McCollister, French, & Fang, 2010) to 2010 FBI statistics for seven major crimes (murder, rape, robbery, aggravated assault, burglary, larceny, and motor vehicle theft) yields a yearly cost in the United States alone of almost 300 billion dollars (Federal Bureau of Investigation, 2010). If even no more than 10% of crime variance can be attributed to impulsivity, the cost would still be 30 billion dollars annually. Taken together, these data highlight the importance of impulsivity in both psychological and behavioral terms. Because impulsivity clearly has far-reaching consequences for individuals, their friends and families, their communities, and society at large, understanding this construct is potentially of great import.

Upon further reflection, however, there is reason to question how similar the three examples of impulsive behavior described in our opening paragraphs actually are; indeed, whether even the "impulses" that underlie these behaviors are the same or different. That is, Icarus is not a juvenile delinquent but rather is described as a playful boy, whose downfall lay in pride at his success at flying. Romeo's killing Tybalt may well reflect the lack of concern for the rights or feelings of others that characterizes the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM*) impulse-control disorders, but his suicide seems more driven by his anguish over the death of Juliet. Is it possible that rather than seeking a theory of impulsivity, we actually ought to be seeking to explain the diversity of impulsive behaviors? That is, is it appropriate to persist in conceptualizing impulsivity as a single characteristic, or is this everyday-language term too broad and imprecise to differentiate important psychological differences in impulses and the behaviors they lead to? Alternatively, is there a way to have our cake and eat it, too; that is, to simultaneously explain both the commonalities among and the differences between seemingly diverse types of impulsive behavior? This is the puzzle that we tackle in this article.

Overview

For most of the 20th century, there was no consensus among researchers regarding either the structural boundaries of trait impulsivity, whether the construct was uni- or multidimensional, or whether it was better conceptualized as simply a colloquial label encompassing several distinct traits that manifested in phenotypically similar behavioral patterns. Due to the complexity of the field, it was common for researchers to develop their own models and measures of impulsivity to address these questions. Whiteside and Lynam (2001) reviewed theories and measures of impulsivity in the context of the five-factor model (FFM) of personality and concluded that there were four types of impulsive behavior, each associated with a different FFM domain or facet: (a) Urgency, associated with Neuroticism, (b) (lack of) Premeditation, associated with the Deliberation facet of the NEO Personality Inventory—Revised (NEO-PI–R; Costa & McCrae, 1992) Conscientiousness; (c) (lack of) Perseverance, associated with the Self-discipline facet of NEO-PI–R Conscientiousness; and (d) Sensation Seeking, associated with the Excitement Seeking facet of NEO-PI–R Extraversion. In further development of this work, Smith and colleagues demonstrated that (lack of) planning and perseverance comprised lower order facets of a broader Conscientiousness-related factor (Cyders & Smith, 2007; Smith et al., 2007).[1] Recently, DeYoung (2010) has argued that this model should be extended to encompass Agreeableness—with impulsive aggression on its opposite end—and Openness, which relates to some types of substance abuse.

We concur that the concept of impulsivity encompasses (at least) three largely distinct psychological concepts, which we call impulsigenic traits, arguing that they are best conceptualized as separate traits underlying various forms of impulsive behaviors (Sharma, Kohl, Morgan, & Clark, 2013). For the most part, such behaviors are spontaneous, unplanned, reckless or potentially dangerous, rash, and/or performed without due consideration of their consequences. However, some potentially dangerous behaviors, such as bungee jumping or parachuting, actually require careful planning, yet they often are lumped without distinction along with other dangerous behaviors. Further, certain nontrait phenomena (e.g., attention-deficit/hyperactivity disorder; ADHD) also are associated with impulsive behavior, which we contend is due partly to the fact that personality traits underpin a great deal of psychopathology (see Clark, 2005; Kotov, Gamez, Schmidt, & Watson, 2010). However, we focus primarily on impulsigenic traits and their corresponding specific behavioral manifestations rather than on diagnoses, although, when appropriate, we reference relevant diagnoses.

Thus, in Study 1, we integrate data using both the most common self-report measures of impulsivity and less central, but still related, constructs to develop a structural model of impulsigenic traits. We focus on the diversity of impulsive behaviors from a quantitative psychometric perspective and present meta-analytic results evidencing (a) that the three types of impulsive behavior reflected in Icarus' flight, Romeo's suicide, and the *DSM* impulse-control/substance use disorders, can and should be distinguished; (b) that each relates to and reflects a more fundamental personality trait; and therefore (c) engenders a different type of so-called impulsive behavior.

Neuropsychologists have pursued another line of impulsivity research, largely distinct from personality trait psychology, and yet also focused on the question of factors that underlie problematic impulsive behavior (e.g., substance abuse, gambling). They have developed laboratory behavioral tasks to assess such constructs as the ability to suppress a dominant response, delay gratification, ignore distracting stimuli, and shift one's mental focus. However, how these tasks are related to each other, what cognitive processes they actually measure, their relations to personality traits, and the degree and nature of their relations to daily-life problematic behaviors all remain unclear. In Study 2, we examine, again via quantitative meta-analysis, the first of these questions—the interrelations and broad structure of these tasks—and we use the results to consider the second question: what constructs these tasks measure and how they are related to executive functioning and intelligence.

In Study 3, we tackle the next question. We first review and critically examine the literature that has sought to understand whether, and if so how, these two domains—personality traits and cognitive processes—relate to each other, considering both methodological issues and conceptual arguments. We then examine their interrelations via quantitative meta-analysis. We argue that, although the research needed to understand their interrelation fully has yet to be conducted, our results indicate that these laboratory tasks most likely tap constructs largely distinct from personality traits. In light of these results, we turn to the last question and examine—once again using quantitative meta-analysis—the extent to which both personality trait dimensions and laboratory-task factors contribute to the prediction of both deviant and nondeviant daily-life impulsive behaviors. These behaviors are performed by individuals in their natural settings (e.g., substance use, adolescent delinquent behavior, gambling, sexual behavior) and often wreak havoc on individual lives and on society. We then use the results to simulate, using self-reported traits and laboratory tasks jointly, predictions of daily-life behaviors. Finally, we offer a unified theoretical model for understanding the results of these three studies, which suggests avenues for future research.

Impulsigenic Traits

Study 1: Introduction

Early in the modern era of personality research, theorists viewed impulsivity as a unidimensional personality trait. Guilford and Zimmerman (1949) included a Restraint (vs. Impulsiveness) scale in their Guilford–Zimmerman Temperament Survey (GZTS). They argued Restraint was a lower order construct of their Introversion–Extraversion (I-E) factor, together with Thoughtfulness (vs. Unreflectiveness), and distinct from their Sociability scale, which was a lower order construct of their Social Activity factor along with Ascendance and General Activity. This view of Introversion–Extraversion was close to Jung's original conceptualization.

Eysenck and Eysenck (1968), however, combined the dimensions of Impulsivity (vs. Restraint) and Sociability to form the Extraversion scale of the Eysenck Personality Inventory (EPI).

[1] They also demonstrated that Urgency exists in both negative and positive forms (Cyders & Smith, 2007). This review addresses only the former, as the latter had too few published data to include in our meta-analysis.

Guilford (1975), holding to Jung's conceptualization, argued that this combination was a "shotgun wedding" of two unrelated domains, but Eysenck (1977) disagreed, stating that Impulsivity and Sociability together defined the higher order domain of Extraversion. However, Eysenck and Eysenck (1978) first theorized that impulsivity was an interstitial trait that combined high Psychoticism, Extraversion, and Neuroticism, which they contrasted with venturesomeness, a combination of high Extraversion and Psychoticism with low Neuroticism. Consequently, in the Eysenck Personality Questionnaire (EPQ; Eysenck & Eysenck, 1975), most of the impulsivity items were shifted onto a revised Psychoticism factor, leaving EPQ Extraversion defined primarily by its sociability content, as well as some venturesomeness.

This shift was supported by Revelle, Humphreys, Simon, and Gilliland (1980), who agreed that two scales best modeled this diverse content and, using item-level analyses, re-created the EPI Impulsivity and EPI Sociability subscales from the EPI Extraversion scale items. Thus, importantly, and perhaps a major source of confusion over the years, Guilford's and Eysenck's conceptualizations of Introversion–Extraversion were distinct. Guilford's view was close to Jung's original concept, Eysenck and Eysenck's 1975 conceptualization formed the foundation of current views of the construct, and Eysenck's and Eysenck's 1968 version was a transitional step in the transformation from Jung's (and Guilford's) conceptualization of Introversion–Extraversion into the current one.

Separation of impulsivity from sociability largely clarified and solidified the current conceptualization of Extraversion but did not solve the problem of impulsivity entirely, in part because of the remaining venturesomeness variance that was distinct from, yet correlated with, impulsivity. The field quickly realized that unidimensional models of trait impulsivity still failed to account for the patterns of data resulting from the diversity of impulsivity measures, and the idea emerged that a broad, multidimensional construct might better explain research findings. Several authors posited models of impulsivity composed of lower order factors, though there was little consensus as to what the factors were or how they combined to form a hypothesized higher order construct. Eysenck and Eysenck (1977) reflected this lack of consensus when they stated, "One problem attends all these discussions, namely, the somewhat arbitrary assignment of the term 'impulsiveness' to a variety of different items, some of which have only marginal relationships with acting on impulse" (p. 58). They argued that several prominent impulsivity scales measured content more relevant to extraversion than impulsivity, which, ironically, most likely was because of Eysenck and Eysenck's own 1968 conceptualization of Extraversion that combined sociability and impulsivity. It is notable that some of the scales they were referencing have versions that are still used today (e.g., the Barratt Impulsivity Subscales [BIS]; Barratt, 1959, 1965; Patton, Stanford, & Barratt, 1995).

In addition to including uni- or multidimensional measures focused specifically on impulsivity, omnibus personality measures often include a scale intended to assess impulsivity. Some of these scales were developed to measure a hypothesized unidmensional construct, as in the Impulsivity scale of Jackson's Personality Research Form (PRF; Jackson, 1967), whereas others were intended to measure a broader, multidimensional impulsivity construct. For example, the Impulsivity scale of Buss and Plomin's (1975) Emotional Activity, Sociability and Impulsivity Inventory (EASI) has four subscales: Inhibitory Control, Decision Time, Sensation Seeking, and Persistence. Confusion arises, however, when comparing across measures or attempting to integrate findings obtained using different measures with the same label. For example, as just noted, the PRF and EASI Impulsivity scales differ in how they represent the trait. The PRF Impulsivity scale includes content relevant to emotional reactivity and expression that is not in EASI Impulsivity, whereas the EASI Impulsivity Sensation Seeking subscale represents content largely absent from PRF Impulsivity. These discrepancies are not evident from the scale names, however, which are the same; Kelly (1927) had termed this phenomenon the "jingle" problem. They only become clear when one examines their content and/or performs item-level analyses.

Additional confusion arises when scales do not share a name but model similar content, a phenomenon termed the "jangle" problem by Thorndike (1904). For example, Carver and White (1994) developed the BIS/BAS scales to measure Gray's (1972, 1991) behavioral inhibition and activation systems. Their Fun-Seeking Scale is very similar to Farmer and Sundberg's (1986) Boredom Proneness. Both tap what one might consider a construct related to impulsivity, yet neither was developed to be nor is identified as a measure of this domain. These scales describe individuals who seek out new and exciting experiences and who have low tolerance for monotony and tedium, a description often applied to individuals identified as impulsive.

The work of Lynam (Lynam & Miller, 2004; Whiteside & Lynam, 2001) and Smith (Cyders & Smith, 2007; Smith et al., 2007) brought considerable order to the impulsivity chaos, suggesting either that there is some yet-to-be-clarified commonality across diverse impulsigenic trait factors and/or that common measures of impulsivity contain content that confounds distinct traits, and thus fail to "carve nature at the joints." We say "and/or" above because the data indicate both of these interpretations are needed to explain the observed relations.

First, previous research has shown that the impulsigenic traits of Distractibility/Urgency and Behavioral (Dys)Control, which relate to the factors of Neuroticism/Negative Emotionality (N/NE) and Disinhibition versus Constraint (DvC) in three-factor models of personality, respectively, are strongly negatively related (e.g., $r = -.61$; Sharma et al., 2013), suggesting a superordinate construct. Moreover, if sufficient markers are available, Behavioral (Dys) Control has been shown to have two subfactors, (lack of) Planning and (lack of) Persistence (Cyders & Smith, 2007), suggesting a hierarchical structure with both superordinate and subordinate factors. Further, given that the two correlated factors are related to higher order factors N/NE and DvC, respectively, these results are consistent with the hierarchical structure of personality (see Markon, Krueger, & Watson, 2005), in which N/NE and DvC combine at the next higher level to form Digman's "alpha" factor, which has been interpreted recently as representing psychological (in)stability (e.g., DeYoung, Peterson, & Higgins, 2002; Vecchione, Alessandri, Barbaranelli, & Caprara, 2011) and that figures prominently in DeYoung's (2010) consideration of impulsivity. Thus, at least with regard to these two types of impulsigenic traits (or three if one considers impulsive aggression distinct from disinhibition), the debate regarding whether impulsivity is better conceptualized as a single, though multifaceted, higher order trait or distinct traits is resolved in the same way as the debate regarding whether three or five is the "correct" number of personality dimensions: Both views are correct, depending upon the hierarchical level that is most useful for a given purpose.

In contrast, although Sensation Seeking scales are often considered to assess "impulsivity," they appear to be characterized better as measuring a distinct construct, in that this factor shows low correlations with the other two factors in previous research (e.g., $r = .18$; Sharma et al., 2013). Thus, the moderately strong correlations between Sensation Seeking and other impulsigenic trait scales that primarily mark one of the other two impulsigenic trait factors (e.g., BIS-11 Motor Impulsivity, UPPS [lack of] Premeditation; Sharma et al., 2013), seem to reflect confounded content that should be removed from these scales. Indeed, the label "Reckless Sensation Seeking" often is given to such scales, directly implying that the Sensation Seeking content is blended with that of Behavioral (Dys)Control. Such blended scales likely assess, at least in part, sensation-seeking behaviors that are necessarily engaged in without planning (e.g., joy riding). In contrast, a nonpathologically focused Sensation Seeking scale might assess only behaviors *neutral* as to Behavioral (Dys)Control (e.g., enjoying amusement park rides that neither implicate impulsivity nor require careful planning) and/or those that specifically *require* careful planning (e.g., parachuting). Such scales more typically are labeled Excitement Seeking or Fun Seeking and relate clearly to Extraversion (e.g., Naragon-Gainey, Watson, & Markon, 2010). Thus, more than 30 years after Eysenck first separated impulsivity and venturesomeness, the data are bearing out—and the field is converging on—this view.

Our first study in this article builds on this work by (a) extending the range of constructs addressed as relevant to impulsive behavior through a broad-based quantitative meta-analysis and (b) clarifying the structure and deepening our understanding of what is arguably the "core impulsivity" domain—Disinhibition in three-factor models of personality (e.g., Clark, 2005; Clark & Watson, 2008) and lack of Persistence and Perseverance in the Lynam and Smith model.

Table 1 presents an overview of two kinds of measures: First, it includes the most common measures of impulsivity, as well as related constructs such as Boredom Proneness, along with their psychometric properties. Second, previous research has demonstrated that some of these impulsivity measures show relations to Neuroticism/Negative Emotionality (N/NE), Extraversion/Positive Emotionality (E/PE), and other well-established personality dimensions, so scales of constructs that have been used in conjunction with impulsivity measures in previous studies also are included. We performed an analysis of the interrelations of these measures to address two hypotheses. First, we hypothesized these measures tap several well-defined, distinct yet related constructs, which we refer to collectively as impulsigenic traits. Second, contrary to researchers who have argued that impulsivity is best defined as affect free (e.g., Patton et al., 1995), we hypothesized that this is only true of impulsigenic traits related to the higher order construct of Disinhibition (vs. Constraint/Conscientiousness), thus concurring with Smith and colleagues that some impulsigenic traits have a strong affective component and that their behavioral manifestations may in fact be affect driven.

Table 1
Psychometric Properties of Measures of Impulsivity and Scales Used in Structural Analyses

Measure	No. items	α	M_{IIC}
Impulsivity scales			
BAS Total	13	.79	.22
BAS Drive	4	.76	.44
BAS Fun-Seeking	4	.66	.33
BAS Reward Responsiveness	5	.72	.34
BIS	7	.80	.36
BIS-11 Total	30	.81	.12[a]
BIS-11 Motor	11	.55	.10[a]
BIS-11 Nonplanning	11	.59	.12[a]
BIS-11 Attention	8	.64	.18
Boredom Proneness	28	.79	.12[a]
DII Functional Impulsivity	11	.83	.31
DII Dysfunctional Impulsivity	12	.82	.28
EAS Activity	4	.68	.35
EASI Impulsivity	20	.68	.35
EPQ-R Psychoticism	32	.71	.07[a]
GZTS General Activity	30	.79	.11[a]
GZTS Rhathymia	30	.80	.12[a]
I_7 Impulsivity	24	.85	.19
I_7 Venturesomeness	17	.80	.19
MPQ Constraint		—	—
Narrow-I	13	.65	.13[a]
NEO-PI–R Conscientiousness	48	.84	.10[a]
Competence	8	.67	.20
Order	8	.66	.20
Dutifulness	8	.62	.17
Achievement Striving	8	.67	.20
Self-Discipline	8	.78	.31
Deliberation	8	.77	.29
NEO-PI–R Extraversion			
Activity	8	.63	.18
Excitement-Seeking	8	.65	.19
NEO-PI–R Neuroticism			
Impulsiveness	8	.79	.32
PRF Impulsivity	16	.60	.09[a]
PRF Play	16	.67	.11[a]
PRF Orderliness	16	.87	.29
PRF Cognitive Structure	16	.49	.06[a]
SNAP-2 Disinhibition	36	.73	.13
Disinhibition (Pure)[b]	16	.73	.15
Impulsivity	19	.79	.17
Propriety	20	.78	.15
Workaholism	18	.81	.19
SSS Total-Form V	40	.82	.10[a]
Thrill and Adventure Seeking	10	.82	.31
Disinhibition	10	.62	.14[a]
Experience Seeking	10	.61	.13[a]
Boredom Proneness	10	.57	.12[a]
STI-R Strength of Excitation	24	.81	.15
STI-R Strength of Inhibition	24	.80	.14[a]
UPPS Urgency	12	.82	.28
UPPS (lack of) Premeditation	11	.77	.23
UPPS (lack of) Perseverance	10	.67	.17
UPPS Sensation Seeking	12	.84	.30
Scales used for structural analyses			
EAS Emotionality	12	.73	.18
EAS Sociability	4	.73	.17
EPI Extraversion	24	.78	.13[a]
EPI Sociability	13	.73	.17
EPI Neuroticism	24	.84	.18
EPQ-R Extraversion	23	.82	.16
EPQ-R Neuroticism	24	.84	.18

Table 1 (*continued*)

Measure	No. items	α	M_{IIC}
MPQ Positive Emotionality		—	—
MPQ Negative Emotionality		—	—
NEO-PI–R Extraversion	48	.82	.08[a]
Warmth	8	.73	.25
Gregariousness	8	.72	.25
Assertiveness	8	.77	.30
Positive Emotions	8	.73	.25
NEO-PI–R Neuroticism	48	.84	.10[a]
Anxiety	8	.78	.31
Angry Hostility	8	.80	.33
Depression	8	.84	.39
Self-Consciousness	8	.68	.21
Vulnerability	8	.77	.30
SNAP-2 Negative Temperament	28	.92	.29
Mistrust	19	.87	.26
Manipulativeness	20	.79	.16
Aggression	20	.85	.22
Self-Harm	16	.83	.23
Eccentric Perceptions	15	.81	.22
Dependency	18	.79	.17
SNAP-2 Positive Temperament	27	.86	.19
Exhibitionism	16	.81	.21
Entitlement	16	.76	.17
Detachment	18	.84	.23
STI-R Mobility	24	.89	.24

Note. Alpha values are averages of Cronbach's alphas reported in the identified studies and in scale manuals. The PRF reliability estimates are based on 16 items, rather than the original 20-item versions (Jackson, 1984, pp. 41–42). BIS/BAS = Behavioral Inhibition System/Behavioral Activation System (Carver & White, 1994); BIS-11 = Barratt Impulsiveness Subscales, Version 11 (Patton et al., 1995); DII = Dickman Impulsiveness Inventory (Dickman, 1990); EAS = Emotionality, Activity Level, and Sociability (Buss & Plomin, 1984); EASI = Emotional Activity, Sociability and Impulsivity Inventory (Buss & Plomin, 1975); EPI = Eysenck Personality Inventory (Eysenck & Eysenck, 1968); EPQ-R = Eysenck Personality Questionnaire (Eysenck & Eysenck, 1968); GZTS = Guilford–Zimmerman Temperament Survey (Guilford & Zimmerman, 1949); I_7 = Eysenck Impulsiveness Questionnaire (Eysenck & Eysenck, 1978); MPQ = Multidimensional Personality Questionnaire (Tellegen, 2000); Narrow-I (Eysenck & Eysenck, 1977); NEO-PI–R = NEO Personality Inventory—Revised (Costa & McCrae, 1992); PRF = Personality Research Form (Jackson, 1984); SNAP-2 = Schedule for Nonadaptive and Adaptive Personality, 2nd ed. (Clark et al., 2008); SSS = Sensation Seeking Scale (Zuckerman, 1979); STI = Strelau Temperament Inventory (Strelau et al., 1990); UPPS = UPPS Impulsive Behavior Scale (Whiteside & Lynam, 2001).
[a] M_{IIC} falls outside of the adequate range $.15 \leq M_{IIC} \geq .50$ (Clark & Watson, 1995). [b] SNAP-2 Disinhibition (Pure) does not include items that overlap with other SNAP-2 scales.

Study 1: Method

We obtained studies using three search strategies. First, we ran a series of PsycINFO searches using the names of every combination of two impulsivity measures listed in Table 1 in "any field" ($n = 887$ articles). Additionally, we identified articles citing the original publication of the measure, if it was originally published in a journal, or the first time the measure was mentioned in a journal ($n = 3{,}135$ articles); 71% of the articles in the first search also were found in the second. We reviewed the abstracts of each article and eliminated those that obviously were not relevant to our research question, which yielded 433 articles. We then reviewed the results section of each remaining article and eliminated studies that did not report either correlational data between scales/subscales or factor-analytic results. Finally, we gathered the manuals of the measures listed in Table 1, if they had been published, to include their reported normative data in our analyses. These processes resulted in 125 studies (121 using normal populations; i.e., undergraduates or community adults), 21 of which reported factor analyses (so factor loadings were used to estimate correlations), 16 manuals with normative data, and four clinical samples.

To ensure that the measures included in the analysis were generally at the same hierarchical level—that is, neither overly broad, indicating a heterogeneous higher order construct, or too narrow, indicating a highly specific facet—the mean interitem correlation (M_{IIC}; see Table 1) was calculated on the basis of an average of all Cronbach's alpha values in the identified studies plus scale manuals. Scales with M_{IIC} falling outside of the recommended range for basic scales (i.e., between .15 and .50; Clark & Watson, 1995) were omitted from further analysis ($n = 20$ scales). We did, however, include the three higher order factor scales of Tellegen's (2000) Multidimensional Personality Questionnaire (MPQ)—Constraint, Negative Emotionality (NEM), and Positive Emotionality (PEM)—given their theoretical relevance, though indices of internal consistency could not be calculated because they are derived using factor-scoring weights of the MPQ's 11 primary scales. Finally, we used the nonoverlapping version of the SNAP-2 (Clark, Simms, Wu, & Casillas, 2008) Disinhibition scale.

We then computed weighted correlations averaged over all available analyses, first performing *r*-to-*z* transformations on the raw correlations, including those calculated from factor loadings. The weighted correlations typically were derived from several studies and in most cases represent total sample sizes of several hundred individuals (see Supplemental Table 1 for these sample sizes across all scales, including those with low M_{IIC}). The majority (84%) of participants assessed in all included studies were undergraduates.

This methodology resulted in a 58 × 58 correlation matrix; however, because not all combinations of scales/subscales have been paired in research, the correlation matrix was incomplete; nevertheless, only 21% of the 3,306 possible correlations were unreported. Missing correlations were estimated with composite maximum likelihood (ML) methods (Lindsay, 1988; Markon, 2011), in an approach similar to that outlined by Cudeck (2000). In this approach, an exploratory factor model was first fit to the available correlations of the matrix; this model was used to generate model-predicted correlations, which were used as imputed values for the missing correlations in the matrix. In composite ML, the fitting function is a sum of the log-likelihoods of the model as fit to the bivariate correlations. In the current analyses, an exploratory factor analysis (EFA) model including two factors was used to impute the missing correlations; models including more factors did not converge. The analyses reported in the article were based on the matrix with meta-analytic correlations used when available, and imputed correlations were used in other cases.

Study 1: Results

We submitted the resulting correlation matrix to an exploratory principal-components factor analysis, with promax rotation, which yielded a three-factor solution that accounted for 59% of the common variance (see Table 2). Velicer's minimum average partial (MAP) procedure (Velicer, Eaton, & Fava, 2000) confirmed that a three-factor structure was most appropriate for these data (O'Connor, 2000). The three obtained factors strongly resemble Tellegen's (and historically Eysenck's) Big Three and were labeled accordingly: Extraversion/Positive Emotionality (E/PE), Disinhibition (vs. Constraint/Conscientiousness; DvC/C), and Neuroticism/Negative Emotionality (N/NE). Two of the three factor intercorrelations were modest (N/NE correlated .32 and .22, respectively, with DvC/C and E/PE), whereas DvC/C and E/PE were unrelated ($r = .08$).

Extraversion/Positive Emotionality was anchored by EPQ Extraversion and MPQ Positive Emotionality and included scales assessing sensation seeking (e.g., NEO Excitement Seeking, UPPS Sensation Seeking, and I_7 Venturesomeness). Disinhibition versus Constraint/Conscientiousness was anchored on one end by all six NEO Conscientiousness facets and by SNAP Disinhibition and Impulsivity plus UPPS (lack of) Perseverance and Premeditation on the other end; 5 of the 19 scales loading on this factor loaded negatively (i.e., in the disinhibited direction). Further, 5 of the 19 had cross-loadings on N/NE above .30: Neuroticism/Negative Emotionality was anchored by SNAP-2 Negative Temperament and EPQ Neuroticism and included NEO Impulsivity and UPPS Urgency. Interestingly, although EPI Neuroticism loaded .52 on this factor, it had its strongest loading (−.58) on the DvC/C factor.

On the basis of previous research (e.g., Smith et al., 2007), we next turned to an examination of whether higher order DvC/C potentially could be considered to have two distinct facets or subfactors. To examine this possibility, we submitted the scales from this factor to an exploratory principal-components factor analysis, with promax rotation, which resulted in a two-factor solution with minimal cross-loadings (see Table 3). The two factors clearly were related ($r = .55$) but not so strongly that DvC/C must be considered a single, unidimensional scale. Rather, the data suggest a higher order DvC/C factor with two subfactors having distinct content. The first of these factors included "traditional" impulsivity scales (e.g., I_7 Impulsivity, Dickman Impulsivity Inventory [DII] Dysfunctional Impulsivity, SNAP-2 Disinhibition), anchored on the opposite end by MPQ Constraint and NEO Deliberation, both of which imply refraining from hasty action. In contrast, the second was anchored by five of the six NEO Conscientiousness facets and included, on the opposite end, the two N/NE scales (EAS Emotionality and EPI Neuroticism) that crossloaded between DvC and N/NE in the initial factor analysis. Thus, we labeled these subfactors Disinhibition (vs. Constraint; DvC) and Conscientiousness/Will versus Resourcelessness (C/WvR). Will has been used as an alternative label for Conscientiousness in FFM history (e.g., Digman & Takemoto-Chock, 1981; Fiske, 1949). Resourcelessness is a term used in the personality disorder literature meaning "lack of inner resolution or will to deal with adversity or challenge . . . lacks perseverance . . . gives up very easily" (Tyrer et al., 2007). Thus, Resourcelessness serves to reflect the loadings of EASI Emotionality and EPI Neuroticism on the low end of the factor.

Study 1: Discussion

Following Lynam and colleagues' UPPS model (e.g., Whiteside & Lynam, 2001), we hypothesized that the construct of impulsivity—or at least the phenomenon of impulsive behavior—is not best characterized as simply unitary. Instead, it is better conceptualized as reflecting a set of distinct traits that have been grouped together previously based on their phenotypically similar, seemingly impulsive behavioral manifestations. Our meta-analytic results support this hypothesis. The observed relations among commonly used measures of impulsivity and related domains demonstrate clearly that impulsivity has at least three manifestations as a facet of three distinct personality traits—N/NE, Disinhibition versus Constraint/Conscientiousness (DvC/C), and Extraversion/Positive Emotionality (E/PE), respectively—which underlie distinct types of impulsive-appearing behaviors.

In this study Disinhibition (vC/C) and N/NE are modestly correlated, consistent with both previous research on impulsivity outlined above and the two-factor level of the established personality structure hierarchy (Markon et al., 2005), in which they combine to become the "superfactor" that Digman (1990) termed simply "alpha" and that more recently has been interpreted as representing psychological (in)stability (e.g., DeYoung et al., 2002; Vecchione et al., 2011). Extraversion/PE is the most distinct of the three higher order traits, correlating only .22 with N/NE and .08 with DvC. Further, the data support the results of Smith and colleagues (Cyders & Smith, 2007; Smith et al., 2007), who demonstrated that the UPPS' model PP represents two correlated but distinguishable facets of a higher order factor, each of which also underlie distinctive impulsive behaviors.

Neuroticism/NE is the basis for "impulsive behaviors" known as (Negative) Urgency—the inability to control cravings and the tendency to rash action in response to negative mood states. The Disinhibition end of subfactor DvC reflects impulsive behavior related to lack of Planning or Premeditation, whereas Resourcelessness (vs. Conscientiousness/Will) reflects impulsive behavior that arises due to an inability to persist in the fact of challenges; that is, lack of Perseverance. Finally, E/PE underpins Sensation Seeking behavior that often is impulsive (i.e., joyriding) but is not necessarily so (e.g., riding roller coasters) and, in fact, may require careful planning (e.g., parachuting).

We also hypothesized that not all impulsigenic traits are affect free, in contrast to some previous assertions to the contrary. These data specifically demonstrate that some scales are strongly associated with the affective dimensions of E/PE (e.g., DII Functional Impulsivity; UPPS Sensation Seeking) or N/NE (e.g., UPPS Urgency, NEO-PI–R Impulsivity). Indeed, some clearly affective scales (e.g., EPI Neuroticism, EASI Emotionality) load strongly on the higher order DvC/C dimension and reflect the resourcelessness of low Conscientiousness/Will. Taken together, these data indicate that the impulsigenic traits are not all affect free and that, in fact, many, perhaps most, types of impulsive behavior are affect driven. This makes sense in that emotional reactions to stimuli are primary motivators of behavior. Thus, individual differences in the strength of impulses to respond positively to "approach" stimuli are necessarily emotion based and have been related to Extraversion; in contrast, individual differences in the fear-based behavioral inhibition system, which initially restrains one's response to stimuli but simultaneously prepares one for fight or flight, have been

Table 2
Promax-Rotated Exploratory Principal Components Factor Analysis of Self-Report Scales

Measure	Scale	E/PE	DvC/C	N/NE
EPQ	Extraversion	**.84**	−.03	.06
MPQ	Positive Emotionality	**.72**	.15	−.07
EAS	Sociability	**.70**	−.22	−.10
NEO	Activity	**.70**	.29	.18
EPI	Sociability	**.70**	−.16	−.14
NEO	Gregariousness	**.68**	.04	.05
SNAP	Positive Temperament	**.68**	**.34**	.06
NEO	Assertiveness	**.66**	.21	.02
SNAP	Exhibitionism	**.66**	−.01	.24
NEO	Positive Emotions	**.65**	.25	.01
SNAP	Detachment (−)	**.65**	.10	−.06
NEO	Excitement-Seeking	**.64**	−.05	.15
UPPS	Sensation Seeking	**.58**	−.16	−.15
STI	Mobility	**.58**	−.01	−.22
DII	Functional Impulsivity	**.58**	−.17	−.11
STI	Thrill/Adventure Seeking	**.57**	.10	−.29
EAS	Activity	**.53**	−.22	−.07
I_7	Venturesomeness	**.51**	−.18	−.16
BAS	Drive	**.42**	−.23	.04
BIS	Behavioral Inhibition	**−.36**	−.12	**.36**
NEO	Warmth	**.62**	**.35**	.03
BAS	Fun-Seeking	**.60**	**−.41**	.06
NEO	Achievement	**.33**	**.83**	.22
NEO	Deliberation	−.22	**.76**	−.08
NEO	Competence	**.31**	**.75**	−.02
NEO	Dutifulness	.10	**.72**	−.02
NEO	Orderliness	−.04	**.71**	.09
NEO	Self-Discipline	.19	**.71**	−.12
MPQ	Constraint	−.07	**.67**	−.12
SNAP	Propriety	.17	**.61**	.29
PRF	Orderliness	.04	**.60**	**−.39**
SNAP	Workaholism	.21	**.57**	**.34**
SNAP	Manipulativeness	.23	**−.45**	**.34**
UPPS	(lack of) Premeditation	.15	**−.65**	.00
DII	Dysfunctional Impulsivity	.29	**−.66**	.15
I_7	Impulsivity	**.42**	**−.68**	.22
UPPS	(lack of) Perseverance	−.18	**−.72**	.09
SNAP	Disinhibition[a]	.28	**−.73**	.08
SNAP	Impulsivity	.27	**−.75**	.04
EPI	Neuroticism	−.27	**−.58**	**.52**
EAS	Emotionality	−.20	**−.45**	**.41**
BIS	Attentional Impulsivity	.22	**−.31**	**.40**
UPPS	Urgency	.23	**−.31**	**.59**
NEO	Anxiety	−.09	**.36**	**.83**
SNAP	Negative Temperament	.01	.14	**.89**
EPQ	Neuroticism	−.08	.09	**.89**
NEO	Depression	−.21	.02	**.72**
NEO	Angry-Hostility	−.05	−.01	**.70**
NEO	Self-Consciousness	−.27	.14	**.65**
SNAP	Mistrust	−.03	−.05	**.62**
NEO	Vulnerability	−.24	−.09	**.62**
MPQ	Negative Emotionality	−.11	−.05	**.61**
NEO	Impulsivity	.17	−.10	**.58**
SNAP	Eccentric Perceptions	.15	−.02	**.53**
SNAP	Self-Harm	−.10	−.24	**.50**
SNAP	Aggression	.07	−.15	**.46**

Note. Boldface data indicate factor loadings above |.30|. E/PE = Extraversion/Positive Emotionality; DvC/C = Disinhibition vs. Constraint/Conscientiousness; N/NE = Neuroticism/Negative Emotionality; BIS = Barratt Impulsiveness Subscales, Version 11 (Patton et al., 1995); BIS/BAS = Behavioral Inhibition System/Behavioral Activation System (Carver & White, 1994); DII = Dickman Impulsiveness Inventory (Dickman, 1990); EAS = Emotionality, Activity Level, and Sociability (Buss & Plomin, 1984); EPI = Eysenck Personality Inventory (Eysenck & Eysenck, 1968); EPQ = Eysenck Personality Questionnaire (Eysenck & Eysenck, 1968); I_7 = Eysenck Impulsiveness Questionnaire (Eysenck & Eysenck, 1978); MPQ = Multidimensional Personality Questionnaire (Tellegen, 2000); NEO = NEO Personality Inventory—Revised (Costa & McCrae, 1992); PRF = Personality Research Form (Jackson, 1984); SNAP = Schedule for Nonadaptive and Adaptive Personality, 2nd ed. (Clark et al., 2008); STI = Strelau Temperament Inventory (Strelau et al., 1990); UPPS = UPPS Impulsive Behavior Scale (Whiteside & Lynam, 2001).
[a] The nonoverlapping version of Disinhibition was used.

Table 3
Promax-Rotated Exploratory Factor Analysis of Disinhibition Versus Constraint/Conscientiousness Scales

Scale	Subscale	Disinhibition vs. Constraint	Conscientiousness/ Will vs. Resourcelessness
I_7	Impulsivity	**.95**	.09
DII	Dysfunctional Impulsivity	**.87**	.02
SNAP	Disinhibition	**.83**	−.01
SNAP	Manipulativeness	**.79**	.13
SNAP	Impulsivity	**.75**	−.09
UPPS	(lack of) Premeditation	**.47**	−.28
PRF	Orderliness	**−.48**	**.41**
NEO	Deliberation	**−.63**	.25
MPQ	Constraint	**−.82**	.06
NEO	Achievement	.09	**.91**
NEO	Competence	−.06	**.79**
SNAP	Workaholism	.28	**.76**
NEO	Dutifulness	−.10	**.72**
NEO	Self-Discipline	−.15	**.71**
NEO	Orderliness	**−.30**	**.46**
SNAP	Propriety	−.14	**.42**
EAS	Emotionality	.28	**−.44**
EPI	Neuroticism	**.32**	**−.59**
UPPS	(lack of) Perseverance	.07	**−.81**

Note. Boldface data indicate factor loadings above |.30|. DII = Dickman Impulsiveness Inventory (Dickman, 1990); EAS = Emotionality, Activity Level, and Sociability (Buss & Plomin, 1984); EPI = Eysenck Personality Inventory (Eysenck & Eysenck, 1968); I_7 = Eysenck Impulsiveness Questionnaire (Eysenck & Eysenck, 1978); MPQ = Multidimensional Personality Questionnaire (Tellegen, 2000); NEO = NEO Personality Inventory—Revised (Costa & McCrae, 1992); PRF = Personality Research Form (Jackson, 1984); SNAP = Schedule for Nonadaptive and Adaptive Personality, 2nd ed. (Clark et al., 2008); UPPS = UPPS Impulsive Behavior Scale (Whiteside & Lynam, 2001).

related to Neuroticism (for reviews, see Clark & Watson, 1999, 2008; Watson, Wiese, Vaidya, & Tellegen, 1999). Thus, only the third type of impulsive behavior—which, we argue, may be the core of impulsivity and reflect the raw strength of individuals' stimulus response system, unconnected to any particular stimulus—may be said to be affect free. In fact, Tellegen (1985) has described this factor as an "affect-relevant indicator of a person's 'preparedness' to respond to a range of emotion-related circumstances (impulse, physical danger, adventure, authority, taboos) with either caution, timidity, and respect or with recklessness, boldness, and defiance" (p. 697). As such, it is itself not tied to a specific affect but rather indexes the strength and style of individuals' affective responses. Thus, for example, an individual high in Negative Urgency and Disinhibition would be likely to act more readily and strongly in the context of negative emotions than would one high in Negative Urgency but low in Disinhibition.

It is worth considering briefly that the structure of impulsivity may vary across gender. Previous research has shown evidence both for (e.g., Ireland & Archer, 2008) and against (Gomez, 2006; Petrides, Jackson, Furnham, & Levine, 2003) structural differences in the impulsigenic traits across gender, with many, perhaps most, studies yielding mixed findings (e.g., partial invariance; Anestis, Caron, & Carbonell, 2011; Doran, Aldridge, Roesch, & Myers, 2011; Ehrhart, Roesch, Ehrhart, & Kilian, 2008). Given that the gender composition of studies varied unsystematically across the studies included in our meta-analysis and that we did not have access to the data separately by gender, we could not examine possible structural differences in these data, which is a study limitation. Gender differences in impulsigenic traits remains an important issue for future research.

In summary, our results extend existing research in three ways: (a) by establishing meta-analytically that four distinct types of impulsive behavior can be fit into the well-known personality-trait hierarchy at the three-factor level, with DvC/C having correlated but distinguishable subfactors; (b) by demonstrating that impulsigenic traits are not affect free (indeed, three of the four traits have an affective component); and (c) by clarifying the nature of the subdivision of higher order DvC/C. One of the two subfactors, DvC is, in fact, affect-free and, as such, may be the purest representative of "classic" impulsive behavior. Notably, it is the only factor for which a midrange score is the most adaptive—both undercontrol and overcontrol have negative psychosocial consequences (Lynch & Cheavens, 2008). The second subfactor, C/WvR, is more clearly identified and specified in these analyses than in previous work. Importantly, its separability from subfactor DvC is consistent with Lynch, Hempel, and Clark's (in press) neuroregulatory model, which distinguishes self-control from self-regulation. The model explicitly states that, whereas one can have too much self-control, one can never have too much self-regulation, because it is, by definition, self-correcting. Similarly, although we speak informally of overconscientiousness, one actually cannot have too much "true" conscientiousness, which is the essence of subfactor CWvR. In contrast, its low end, Resourcelessness—lack of perseverance in the UPPS model—represents the tendency to give up in the face of adversity or challenge and the lack of will or desire to excel, which is, indeed, the opposite of "true" conscientiousness.

Impulsive Laboratory Behavioral Tasks

Study 2: Introduction

Laboratory behavioral tasks often are intended to capture behavioral manifestations of underlying traits—in this case, the impulsigenic traits. That is, these tasks serve as "behavioral snap shots" (Cyders & Coskunpinar, 2011, p. 967), assessing what participants actually do in a given situation, in contrast to participants' reports of what they tend to do over time and across situations, as assessed by questionnaires. Thus, although such tasks are expected to reflect an underlying personality trait (e.g., Odum, 2011), they actually may capture more state-like phenomena than the traits assessed by self-report measures (Cyders & Coskunpinar, 2011).

Neuropsychologists, who are typically the developers of these measures, have defined impulsivity in various ways, indicating either that the construct is multidimensional or that researchers are using the same term to designate distinct constructs. One of our goals is to determine which of these views more accurately describes the construct(s) of impulsivity as assessed by laboratory tasks. One aspect of neuropsychologists' definition of impulsivity is the inability to suppress prepotent responses. The tasks developed to assess this construct require participants to inhibit an automatic or learned response and instead to offer a different response consistent with the task demands (Lane, Cherek, Rhodes, Pietras, & Tcheremissine, 2003; Verdejo-García, Perales, & Pérez-

García, 2007). Among the tasks developed to assess this construct are the Matching Familiar Figures Task (MFFT; Rosenbaum & Baker, 1984) and the Go/No Go Task (G/NG; Hartung, Milich, Lynam, & Martin, 2002; Rubia, Smith, & Taylor, 2007). This inhibition ability may be the central component in tasks measuring executive function (Miyake & Friedman, 2012), a point we discuss further subsequently.

Another aspect of neuropsychologists' definition of impulsivity, termed "choice impulsivity" by some (e.g., Paloyelis, Asherson, Mehta, Faraone, & Kuntsi, 2010, p. 2414), is the inability to delay gratification or to choose smaller, immediate rewards over larger, distant ones (Bechara, Damasio, Damasio, & Anderson, 1994; Lane et al., 2003). Examples of this type of task are the Delay of Gratification/Differential Reinforcement for Low-Rate Responding/Delay Discounting Tasks (Delay Gratif/Disc; Zaparniuk & Taylor, 1997), and, as mentioned earlier, Odum (2011) suggested that such test scores reflect an underlying trait.

The inability to sustain attention in the face of distracting stimuli is a third aspect of "cognitive" impulsivity. Examples of this type of task are the Stroop Color–Word Test (Stroop) and the Continuous-Performance Test, one version of which is the Delayed and Immediate Memory Task (DMT/IMT; Dougherty et al., 2007). Finally, some researchers have included the ability to respond quickly or shift mental sets when task demands change, as a feature of impulsivity, comparable to mental flexibility (e.g., Miyake, Friedman, Emerson, Witzki, & Howerter, 2000); the Wisconsin Card Sort Task (WCST; Heaton, Chelune, Talley, Kay, & Curtiss, 1993) is a task often used to assess this cognitive ability. However, the fact that this type of task is considered to measure an adaptive cognitive skill—in contrast to most laboratory behavioral tasks of impulsivity, which are considered to reflect intellectual liabilities—calls into doubt their inclusion in assessing cognitive/behavioral impulsivity.

Empirical relations between and among these tasks and their indices have not been established conclusively, and few studies have examined two or more of these tasks in combination. Moreover, theory development to guide research in this area is still in its early stages. Table 4 outlines the results obtained in 11 studies that examined relations among two or more laboratory behavioral tasks using factor analysis. Using the labels proposed by some studies' authors for their factors, the tasks are grouped into Inhibition (e.g., MFFT, G/NG), Impulsive Decision-Making (e.g., Delay Gratif/Disc), and Inattention (e.g., DMT/IMT). However, it is apparent from the table that some tasks do not load consistently onto one of these factors (particularly the WCST and Stroop). Others have been investigated only minimally in relation to other behavioral impulsivity tasks (e.g., the Iowa Gambling Task), so they are difficult to place within these constructs.

Relations among the factors obtained in these studies range from low to moderate (Dougherty et al., 2009) to moderate to high (Miyake et al., 2000), depending on the tasks examined and, presumably, other unknown variables. Miyake and Friedman (2012) have argued that "systematic non-EF [executive function] variance and measurement error are substantial" in these tasks (p. 8), which they refer to as the "task-impurity problem." This problem necessarily complicates measurement of—and understanding the structure underlying—these tasks, not to mention understanding of the constructs they assess. Regardless of these interrelations, however, researchers are now tending to agree that these task groupings measure consistent behavioral tendencies that most likely reflect distinct underlying psychological phenomena (e.g., Lamm, Zelazo, & Lewis, 2006). There is some evidence to suggest that the tendencies assessed by these tasks are best considered distinct yet correlated, in the way personality traits are often referenced, with relations among them ranging from small to moderate (e.g., Lamm et al., 2006; Martel, Nikolas, & Nigg, 2007; Miyake et al., 2000).

In addition to grouping these tasks among themselves either empirically in terms of their interrelations or in terms of what they are intended to assess, researchers have grouped these types of laboratory-assessed behaviors together with other constructs on a more theoretical basis. Some have grouped them with such personality trait labels as self-control (Strayhorn, 2002) or effortful control (Hoyle, 2006) versus impulsivity (e.g., Paloyelis et al.,

Table 4
Overview of Factor Analyses of Two or More Impulsive Laboratory Behavioral Tasks

	Inhibition				Impulsive Decision-Making				Inattention			
Study	G/NG inhibition	MFFT latency	Circle tracing	Stop Task	WCST pers.	Hypothetical delay	Contingent delay	BART	Stroop error	Delayed Memory	Immediate Memory	IGT
Dougherty et al. (2009)	1					2	2			3	3	
Miyake et al. (2000)				1	2				1			
Verdejo-Garcia et al. (2007)	1				1				3			4
Avila et al. (2004)		1	1	1	2	2	2		2			
Forbush et al. (2008)	1				1				2			
Young et al. (2009)				1					1			
Reynolds et al. (2008)	1					2	2			3	3	
Reynolds et al. (2006)		1			1		2	2	2			
S. L. Olson et al. (1999)		1	1									
Nigg et al. (2005)					1	1				2		

Note. Numbers represent the extracted factor on which a variable loaded (e.g., in Dougherty et al., 2009, G/NG inhibition loaded on the first extracted factor, hypothetical delay and contingent delay loaded on the second factor, and delayed memory and immediate memory loaded on the third factor). G/NG inhibition = Go/No Go Task inhibition; MFFT = Matching Familiar Figures Task; Circle tracing = Circle-Tracing Task slow time; Stop Task = Stop-Signal Reaction Time Task; WCST pers. = Wisconsin Card Sort Task perseverative errors; Hypothetical delay = hypothetical delay of Gratification Task; Contingent delay = contingent delay of Gratification Task; BART = Balloon Analogue Risk Task pumps; Stroop = Stroop Color–Word Test; IGT = Iowa Gambling Task.

2010) or behavioral disinhibition (e.g., Young et al., 2009), the "C" and "D" poles of the DvC dimension, respectively. Others assert they are aspects of executive function, defined as a group of cognitive processes that serve problem-solving behavior geared toward the attainment of a future goal (Barkley, 1997; Pennington & Ozonoff, 1996). Finally, some consider deficits in these so-called cognitive control functions to be the core impairments in individuals with ADHD (Avila, Cuenca, Félix, Parcet, & Miranda, 2004; Rubia, 2002). However, the extent to which—and exactly how—these different constructs and conceptualizations may be interrelated is unclear.

As personality traits, individual differences in self-control or self-regulation versus impulsivity/disinhibition emerge early in life and are consistent over context and time (Block, 1996; Roberts & DelVecchio, 2000). Further, these constructs are strongly associated with well-defined behavioral consequences in everyday life (Block, 1996). In general, if individuals demonstrate difficulty with one type of everyday self-control dilemma (e.g., substance abuse) they frequently have difficulty with others (e.g., delinquency; Jessor, Donovan, & Costa, 1991; Krueger, Markon, Patrick, & Iacono, 2005). However, as we discuss in more detail in connection with Study 3, repeated attempts to link laboratory tasks of impulsivity versus response inhibition with self-reported impulsivity measures indicate they are inconsistently and, at most, modestly correlated (e.g., Paloyelis et al., 2010; Young et al., 2009; White et al., 1994).

Research also consistently demonstrates significant impairment in laboratory behavioral tasks designed to measure impulsive behavior in individuals with ADHD compared to healthy controls. One meta-analysis found that a wide variety of neuropsychological tests, including the Stop-Signal Reaction Time Task (SSRT), Trail Making A and B (Trails), MFFT, WCST, and Stroop, all were significantly sensitive to ADHD, although the effect sizes varied widely across tasks, from .15 to 1.0 (Frazier, Demaree, & Youngstrom, 2004). Many of these deficits remain even after controlling for ADHD subtype, comorbid psychiatric diagnoses, IQ, and gender (Martel, Nikolas, & Nigg, 2007; Nigg et al., 2005). A similar meta-analysis also reported that groups with ADHD exhibited significant impairment on all executive function tasks examined, albeit with medium effect sizes and with no single deficit universally present (Willcutt, Doyle, Nigg, Faraone, & Pennington, 2005). In any case, prominent theories of ADHD include deficits in executive function as an important component (e.g., Willcutt et al., 2005), and some authors have hypothesized that laboratory-measured impulsive behavior in ADHD is one indicator of a broader, general task-independent, premature, and inconsistent response style (Rubia, 2002).

Other researchers have compared the performance of individuals with obsessive-compulsive disorder (OCD) to that of healthy controls on laboratory impulsive-behavior tasks and found consistent deficits among those diagnosed with OCD (e.g., Bannon, Gonsalvez, Croft, & Broyce, 2002; Penadés et al., 2007). Some theorize that the repetitive behaviors evident in OCD result from an underlying deficit in the ability to inhibit responses (Purcell, Maruff, & Pantelis, 1998) and from inhibitory control dysfunction, especially cognitive inhibition (Gambini, Abbruzesse, & Scarone, 1993; Oades, 1997; Purcell et al., 1998; Veale, Sahakian, Owen, & Marks, 1996).

Taken together, these data suggest that the laboratory impulsive-behavior tasks are intended to measure constructs similar in their manifestations to the type of impulsive behavior associated in particular with the higher order dimension DvC/C, even more particularly that of the DvC subfactor, but perhaps also reflecting the lack of persistence assessed by Resourcelessness. The performance deficits shown by patients diagnosed with ADHD and those diagnosed with OCD demonstrate that these tasks are sensitive to dysfunctional inhibitory control, which conceptually seems very similar to that manifested by individuals high in DvC impulsigenic traits. Yet, research also indicates that these tasks measure consistent behavioral tendencies that reflect, at least in part, a broad, higher order cognitive psychological domain, such as cognitive control or executive function. Nonetheless, no consistent factor structure of these tasks has been found. Relations among observed factors are inconsistent across studies, as are the tasks' and factors' relations to those phenomena with which they are hypothesized to be associated, such as ADHD or other externalizing disorders and behaviors. Therefore, our goal in Study 2 was to clarify the structure of this broad domain.

Study 2: Method

We identified relevant studies using similar strategies to those described above for Study 1. First, we ran a series of PsycINFO searches using the names of every task listed in Table 4 in "any field," specifically focusing on studies that included two or more such measures, as well as the Porteus Maze Task (Porteus), which has been used consistently in neuropsychological research and examined in conjunction with various other tasks (n = 405 articles).[2] We reviewed the abstracts of each article and eliminated those that were obviously not relevant to our research question, which yielded 162 articles. We then reviewed the Results section of each remaining article and eliminated studies that did not report either correlational data between tasks/indices or factor analyses; 11 articles reported factor analyses, and their factor loadings were used to estimate correlations. These processes resulted in 98 studies: 46 using abnormal samples (5 with a control group); 47 using undergraduate or community adult samples; and 5 using adolescent samples.

We then computed weighted correlations averaged over all available, relevant data in these articles; r-to-z transformations were performed on the raw correlations before they were weighted and averaged and were transformed back to rs. In many cases for which we used correlations calculated from factor loadings, other studies had reported correlations between the same scales as in the factor analyses; the weighted correlation was calculated with both types of data together. The weighted correlations used in the analyses reported below typically were derived from several studies and most often represent total sample sizes of approximately 100 individuals (see Supplemental Table 2 for the overall sample sizes included in the analyses).

This methodology resulted in a 15 × 15 correlation matrix (see Supplemental Table 3). Given that not all tasks/task indices have been used in research together, the correlation matrix was incom-

[2] The Porteus Mazes do not appear in Table 4 because they have not been factor analyzed with other measures, whereas all of the other measures had been included in a factor analysis at least once.

plete; 52% of the 105 possible correlations were unreported. Missing correlations were imputed with composite maximum likelihood methods, as in Study 1 (cf. Cudeck, 2000). Also as in Study 1, a two-factor EFA model was used to impute correlations; models with more factors were attempted but did not converge. As in Study 1, the matrix including meta-analytic and imputed correlations was used for subsequent analyses.

Study 2: Results

Using procedures similar to those described above in Study 1, we submitted the correlation matrix resulting from the above processes to an exploratory principal-components factor analysis, with promax rotation, which resulted in a four-factor solution that explained 53% of the common variance (see Table 5). The names we chose for these factors were based on their similarity to factors obtained in previous factor analyses of these tasks (see Table 4): Inattention, Inhibition, Impulsive Decision-Making, and Shifting. Correlations among the resulting factors were uniformly low, ranging from .13 (Inhibition with Impulsive Decision-Making and Shifting) to −.03 (Inattention with Inhibition), $M = 0.04$. These data indicate that the four factors represent independent sets of laboratory behavioral tasks, likely based on shared characteristics of the tasks forming each factor. However, the moderate (.36, .38) to high (−.60) cross-loadings of G/NG, Iowa Gambling Task (IGT), and SSRT also indicate these three tasks tap more than one of the constructs assessed by these laboratory impulsive-behavior tasks, reflecting the task-impurity problem noted earlier (Miyake & Friedman, 2012).

The tasks that load highest on Inattention all require participants to attend selectively to a target stimulus, and the Stroop and IMT/DMT tasks also present a distractor stimulus to divert participants' attention. In the Porteus Mazes, the complexity of the task and its blind alleys and dead ends serve as distractor stimuli. The tasks that load highest on Inhibition all require participants to respond selectively to target stimuli and, in the case of the G/NG and Circle-Tracing Tasks, to inhibit a prepotent response or response style. Both Delay of Gratification indices load exclusively on the Impulsive Decision-Making factor; these tasks require participants to select between a small, immediate reward and a larger, delayed reward. The SSRT and the IGT split between the Inhibition and the Impulsive Decision-Making factors, indicating that these tasks involve components from both.

Finally, the two WCST indices formed their own factor (labeled here Shifting; in a three-factor extraction they failed to load on any factor). In this task, participants are asked to pair nonidentical cards based on a principle they must learn from feedback as to whether or not each choice is correct. When the participant has learned the principle, it is abruptly and without notice changed to a new principle for the participant to learn, again based on feedback. The primary dependent measures are perseverative errors (i.e., continuing to sort based on previously correct principles) and nonperseverative errors (all other types of errors; Avila et al., 2004). Although the factor formed from these indices may be a method factor, the fact that neither WCST index loaded on any factor in the three-factor solution suggests that this task may assess a rather different aspect of executive or cognitive functioning from the other tasks intended to assess impulsive cognitive and/or behavioral tendencies.

Study 2: Discussion

As discussed in the introduction to this study, neuropsychologists have defined the construct of impulsivity in various ways, which suggests either that the construct these tasks are intended to measure is multidimensional or that the tasks assess distinct, though perhaps correlated, constructs. Thus, the situation with regard to laboratory tasks of impulsivity is similar to that for self-reported trait impulsivity before Whiteside and Lynam's (2001) work began to clarify that there were several distinct personality traits underlying phenotypically similar behaviors. The nature of the construct(s) that researchers are trying to assess remains unclear.

However, there are two difficulties in the neuropsychological literature that make researching impulsivity in laboratory tasks more difficult than in self-report. First, laboratory tasks are seldom

Table 5
Varimax-Rotated Exploratory Principal Components Factor Analysis of Behavioral Tasks

Behavioral task (index)	Inattention	Inhibition	Impulsive Decision-Making	Shifting
Stroop (error)	**.97**	−.09	.09	.02
Delayed Memory	**.96**	.26	.08	−.01
Immediate Memory	**.55**	.03	−.24	−.05
Porteus Maze Task	**−.99**	−.01	−.06	−.01
Go/No Go (inhibition)	**−.60**	**.77**	−.02	−.00
MFFT (latency)	.10	**.81**	.05	.13
Circle Tracing Task (slow time)	.08	**.56**	.03	.03
MFFT (error)	−.10	**−.91**	−.05	.04
IGT	−.07	**.51**	**.38**	−.09
Stop-Signal Reaction Time	.27	**.36**	**−.54**	−.09
Delay of Gratification (hypothetical)	.04	−.05	**.53**	−.06
Delay of Gratification (contingent)	.14	.17	**.35**	−.01
BART (pumps)	−.00	.11	.12	−.01
WCST (perseverative errors)	−.02	.03	−.07	**.62**
WCST (nonperseverative errors)	−.01	−.06	.02	**−.60**

Note. Loadings > .30 are shown in bold. MFFT = Matching Familiar Figures Task; BART = Balloon Analogue Risk Task; WCST = Wisconsin Card Sort Task.

subjected to the same psychometric scrutiny as self-report measures, which yields two problems:

1. Such basic indices as test–retest reliability are rarely examined, and when they are, the results are not encouraging. Kindlon, Mezzacappa, and Earls (1995) examined the short-term (2–5 months) retest reliability of 13 laboratory measures of impulsivity and found that only 46% had age-corrected stability coefficients of .60 or above and a third were below .30. This finding supports the notion that it is best to consider that many of these tasks reflect states rather than traits, although they were developed to assess a consistent cognitive style.

2. Unlike in personality research, in which it is relatively easy to administer measures of a wide range of constructs to large samples of individuals, administering multiple neuropsychological tests to large samples of individuals is much more time-consuming and thus quite rare. As such, considerably less is known about the convergent and discriminant validity of these tasks, and there are comparatively fewer published correlations and factor analyses available for meta-analyses. Nevertheless, sufficient data have accrued that we were able to metafactor analyze the impulsivity behavioral task literature, which revealed a four-factor structure: Inattention (Stroop, CPT), Inhibition (MFFT, G/NG), Impulsive Decision-Making (DelayGratif/Disc), and Shifting (WCST).

This pattern of results mirrors that of Cyders and Coskunpinar (2011), who, building on the work of Friedman and Miyake (2004), conceptually grouped laboratory-based impulsivity tasks into five categories, four of which clearly map onto factors that our metafactor analysis revealed. Specifically, tasks marking the Inhibition (MFFT, G/NG), Impulsive Decision-Making (DelayGratif/Disc), and Inattention (Stroop, DMT/IMT) factors in our study marked, respectively, the groups Prepotent response inhibition, Delay response, and both Resistance to Distractor Interference (Stroop) and Resistence to Proactive Interference (DMT/IMT) in theirs. They labeled their last group Distortions in time elapsed, represented by only two tasks that have not been used widely in the field and thus are not included in our meta-analysis. Cyders and Coskunpinar (2012) then collected data on the set of measures they had reviewed and conducted an exploratory factor analysis, extracting six factors.[3] Again, the three factors of Inattention/Resistence to distractor interference, Inhibition/Prepotent response inhibition, and Impulsive Decision-Making/Delay responding emerged. Two of their other three factors were blends of these three (Delay responding plus Prepotent response inhibition and Delay responding plus Distortions in time elapsed) and the two types of Resistence to interference (distractor and proactive) formed separate factors, suggesting the possibility of overextraction. Thus, taken together, these data indicate that the field is converging on a model of the features assessed by these tasks, but it is premature to say that a clear consensual model has emerged.

Miyake and Friedman (2012) recently updated their previous model of executive function (Miyake et al., 2000), proposing three interrelated factors: a common executive function factor with Inhibition as its core and two more specific factors, Updating and Shifting. Comparison of their model of executive function and the results of our metafactor analysis of laboratory tasks of executive function is instructive in several ways. First, it appears we can match their Shifting factor with the Shifting factor that emerged in our meta-analysis, in that the tasks composing both tap cognitive flexibility. Second, each analysis also contains an Inhibition factor, composed of tasks that require overriding a prepotent response, although the specific measures marking the factors differ. Indeed, overall, the two sets of tasks are not highly overlapping—reflecting a general problem in the neuropsychology literature: that somewhat different tasks are developed within each subfield and rarely are studied in conjunction with each other, thus complicating integration across subfields. Nonetheless, it seems likely that two of the four factors of tests that have been considered within the laboratory-task impulsivity literature are aspects of executive function.

This raises the interesting general question of the extent of overlap between laboratory tasks of impulsivity and tests of executive function, which, at least originally, were considered distinct domains. Further, some (e.g., WCST [Shifting], Stroop [Inattention]) but not all (e.g., G/NG, MFFT [Inhibition]) laboratory measures used to assess impulsivity are commonly included among measures of executive function (see Chan, Shum, Toulopoulou, & Chen, 2008). Second, delay discounting—which typically has been conceptualized as a motivation-based impulsivity variable associated with ADHD and other externalizing disorders (e.g., Barkley, Edwards, Laneri, Fletcher, & Metevia, 2001; Hirsh, Morisano, & Peterson, 2008), rather than a cognitively based ability—is not typically considered an executive function. However, researchers have found modest, but significant relations between delay discounting and executive functioning (Weatherly & Ferraro, 2011), as well as intelligence (Hirsh et al., 2008; Shamosh & Gray, 2008), a variable we consider next.

Relations with intelligence. Miyake and Friedman's third factor, Updating, contained no specific measures that are commonly used in the laboratory-task impulsivity literature. Further, in other studies from that lab, only the Updating factor, which involves working memory, correlated with IQ, whereas the two factors that appear to overlap with our meta-analytic results did not (Friedman et al., 2006). Thus, it is of interest whether this pattern holds generally in the literature. A pairwise search of PsycINFO for studies with IQ or intelligence, executive function, working memory, inhibition, inattention, and impulsivity quickly revealed that the first three topics are frequently studied together and that there is little question of their overlap, which is substantial, but with considerable unique variance within each construct as well (e.g., Barbey et al., 2012; Davis, Pierson, & Finch, 2011; Friedman et al., 2006). Importantly, the correlational level between intelligence and different aspects of executive function varies considerably. Tests involving concept generation and working memory appear to overlap the most with intelligence, whereas executive function tests assessing shifting and inhibition (e.g., Arffa, 2007; Nussbaum, Choudhry, & Martin-Doto, 1996)—which are more relevant to impulsivity—show weaker and more variable relations with intelligence.

Interestingly, Inattention is sometimes (e.g., Barkley et al., 2001) but not always (e.g., Miyake & Friedman, 2012) considered part of executive function and rarely is the focus of study in relation to intelligence (e.g., a PsycINFO search with both inat-

[3] They actually included self-report measures of impulsivity in their factor analysis and extracted seven factors, but the self-report measures largely formed their own factor, so we do not discuss that factor here. We do discuss it in relation to Study 3.

tention and intelligence/IQ either as major subjects or in the title found no articles). The exception is when inattention is embedded in multitask batteries; such studies are found in the impulsivity literature, and results are consistent with the executive-functioning literature. In particular, laboratory-based tasks of impulsive Inattention—often assessed by the Continuous Performance Task, from which the DMT/IMT tasks included in our analysis were derived—generally do not relate significantly to IQ (e.g., Campbell, D'Amato, Raggio, & Stephens, 1991; Naglieri, Goldstein, Delauder, & Schwebach, 2005). Finally, the last factor in our meta-analysis—Impulsive Decision-Making—which was marked by measures of Delay Gratif/Disc, impulsive reactivity (Stop-Signal), and secondarily by the IGT, is not considered part of executive function; interestingly, though, some studies suggest that it is modestly related to intelligence (e.g., de Wit, Flory, Acheson, McCloskey, & Manuck, 2007; Duckworth & Seligman, 2005).

In summary, when taken together, these findings indicate that those aspects of executive functioning that overlap the most with intelligence (e.g., working memory, concept formation) are the least correlated with the factors assessed by impulsivity laboratory tasks, whereas those aspects of executive function (e.g., inhibition, shifting, and perhaps inattention) that are most relevant to laboratory tasks of impulsivity are less related, less consistently related, or unrelated to IQ. In other words, the three domains of laboratory-based impulsivity, executive functioning, and intelligence are overlapping, but the factors they share are distinct. Executive function and intelligence overlap most in the domain of working memory, whereas laboratory-based impulsivity overlaps with executive functioning largely via inattentiveness and (poor) inhibition, which some consider a core factor. Set shifting often is, and impulsive decision making typically is not, considered an aspect of executive functioning, although both show some relation to the construct, as well as sometimes showing modest relations with intelligence. It would be instructive in future research to examine these patterns gleaned from the literature, assessing all three broad domains with multiple measures of each.

Relations Among Impulsigenic Traits, Impulsive Laboratory Behavioral Tasks, and Daily-Life Behaviors

Study 3: Introduction

The Study 1 analyses demonstrated the existence of three higher order factors—N/NE, E/PE, and DvC/C, with DvC/C further divided into subfactors DvC and C/WvR—each of which subsumes an impulsigenic trait (i.e., Negative Urgency, Sensation Seeking, lack of Planning, and lack of Perseverance, respectively). The Study 2 analyses then revealed four factors of laboratory-behavior tasks: Inattention, Inhibition, Impulsive Decision-Making and Shifting. Given that each of these sets of measures are purported to tap aspects of impulsivity, the obvious question is how do they relate to each other, given that significant relations between them would support the construct validity of both sets of measures. However, since at least the mid-1990s (White et al., 1994), pursuit of a positive answer to this question has been largely in vain.

There have been two primary responses of the field to this consistent evidence of weak correlations between these two types of measures. The first is to seek methodological explanations for the low correlations. These arguments share the assumption that there should be a relation between self-report and laboratory behavioral measures, as both are hypothesized to assess similar underlying mechanisms of behavioral dyscontrol, and both assert that shortcomings in research methodology have masked any true relations. The second response has been a more conceptual reconsideration of what laboratory tasks of impulsivity actually measure. We discuss each of these two types of responses—which are not necessarily mutually exclusive—augmenting them with our own observations on each of these approaches, and then offer a third alternative that also does not preclude the first two. In other words, there may be multiple distinct reasons for the observed weak correlations.

First, some researchers have asserted that the studies' sample sizes are too small to have sufficient power to detect significant relations and/or that the studies have been conducted with nonpathological samples, which are unlikely to demonstrate sufficiently impulsive behavior to detect hypothesized relations (e.g., Lane et al., 2003). Others have taken a psychometric perspective, noting that the laboratory tasks are administered in controlled settings and typically measure fairly specific behaviors within a discrete, short amount of time. Thus, the low correlations between the two types of measures may reflect the inherent limitation in relating states to traits (e.g., Cyders & Coskunpinar, 2011, 2012). This argument has some merit given that, as mentioned previously, performance on these tasks has been assumed to be indicative of trait-like behavioral patterns over time, but this assumption has not been found to be valid for many of these types of tests (e.g., Kindlon et al., 1995).

Another methodological issue that may contribute to the consistently low relations found between self-report measures and tasks is the tendency for each researcher or research group to use one particular task for a given construct, which hinders generalizability studies. For example, some use a particular hypothetical delay of gratification task, in which the reward is imaginary (e.g., Dom, De Wilde, Hulstijn, & Sabbe, 2007); others actually give participants a smaller, token reward determined at random, as opposed to the larger hypothetical one that they were instructed to consider during the task (e.g., \$0.01–\$10.00 vs. \$1,000; Lane et al., 2003); and others use a contingent delay of gratification task, in which participants receive the actual reward at the end of the procedure (e.g., Mobini, Grant, Kass, & Yeomans, 2007). Still other studies do not specify clearly which delay of gratification task they used (e.g., Alessi & Petry, 2003).

Not surprisingly, there is evidence that using different parameters for a particular laboratory impulsive-behavior task influences its relation to self-report measures of impulsigenic traits. For example, relations between self-report measures of impulsigenic traits and the Stop-Signal Reaction Time Task vary depending on the percentage of stop trials: Studies with a smaller percentage of stop trials (25%) have found significant correlations between these two types of assessment, whereas those with a larger percentage (40% to 50%) of stop trials have found no correlation (see Lansbergen, Schutter, & Kenemans, 2007, for a review of this finding). It has been hypothesized that a low probability of stop signals advantages an impulsive response style characterized by faster reaction times to "go" stimuli. In other words, those with low inhibitory control are more likely to err when a stop signal does occur, thus creating a correlation between the task and impulsigenic traits, whereas a higher percentage—near 50–50 chance—of stop signals leads to all participants "playing it safe" because of the high degree of uncertainty, regardless of their typical impulsiveness. This eliminates any correlation with impulsigenic traits (Lansbergen et al., 2007). Otto, Markman, and Love (2012) demonstrated that participants who scored lower versus higher on the BIS-11 were differentially (dis)advantaged depending on whether the laboratory task favored immediate over delayed rewards or vice versa.

Thus, changing the parameters of a task can substantially affect the relation between laboratory behavioral tasks and self-report measures. Such measurement-based differences are fine if the goal is to examine how individuals' behavior changes in response to various contingencies and situations but are problematic if the goal is to assess a more trait-like phenomenon, because they lead to inconsistent findings that cancel each other out when 25% and 50% stop-trial tasks are considered equivalent for the purposes of reviews or meta-analyses. Thus, all such inconsistencies interfere with making meaningful comparisons across tasks, experimental procedures, and different studies (Halperin, Sharma, Greenblatt, & Schwartz, 1991).

Some researchers have argued that the low correlations result from inconsistent definition of impulsivity across self-report and laboratory-behavior measures, not only operationally—a methodological issue—but also conceptually. That is, although behavioral impulsivity initially was considered as part of a general response style, it became clear as research in executive function developed that there was overlap between the two types of tasks. Many came to view impulsivity as an ability dimension related to cognitive control or part of executive function. Whereas conceptualization as a response style is compatible with trait definitions of impulsivity, conceptualizing personality-trait impulsivity as ability based is inconsistent with research examining personality–intelligence relations, which generally yields, at most, only modest correlations. For example, the strongest average correlation across four, recent large-scale (total $N = 3{,}356$) studies of FFM personality and intelligence was .17 for Openness, and the average correlations between N, E, and C—the FFM factors most strongly related to impulsigenic traits—were only .01, −.03, and .04, respectively. Thus, it is unreasonable to expect to find more than moderate correlations between measures of impulsivity that reflect abilities and those that reflect traits, although this does not preclude the possibility of finding relations between self-report and task-based measures of impulsivity, if the construct is actually motivational in nature or reflects a response style. A pessimistic conclusion of this view is that the two methodologies assess different phenomena entirely—a large-scale version of the jingle phenomena—such that it is fruitless to pursue any integration of these literatures.

However, we offer a third, more optimistic possibility that both builds upon and integrates the other two. If laboratory-task measures are used in a way that is consistent with sound psychometric principles to overcome various methodological difficulties, and if both self-reports and laboratory tasks—regardless of their degree of overlap—are related to a third type of "impulsive" behavior—specifically, daily-life behaviors—then we (a) can increase the observed low correlations to at least moderate strength via methodological improvements, supporting that both types of measures are tapping into a broad, higher order construct, and (b) have a prime opportunity to investigate the unique contribution that each type of measure makes in relation to constructs of great importance using multiple regression. That is, for maximal prediction in multiple regression, the independent variables are each related to the dependent variables but independent of each other. Thus, ideally in this situation, if self-report scales and laboratory behavioral tasks each correlate moderately to highly with a daily-life behavior (e.g., risky sexual behavior), but at a moderate level with each other, this outcome would indicate that each assessment strategy is tapping unique variance in daily-life behavior that the other is not. So, the resultant predictive power would reflect the convergence of quasi-independent approaches to the assessment of these behaviors.

Fortunately, some researchers have examined relations among self-report scales, laboratory behavioral tasks, and daily-life behaviors. Among the most consistently assessed daily-life behaviors are those of the externalizing spectrum (for reviews of these behaviors, see Burt, McGue, Iacono, & Krueger, 2006; Hicks et al., 2007; and Krueger, Markon, Patrick, Benning, & Kramer, 2007). Externalizing behaviors that fall into several broad categories have been studied fairly widely: aggression, substance use and substance problems, pathological gambling (which is included as gambling disorder in the same chapter as substance use disorders in the *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.; *DSM-5*; American Psychiatric Association, 2013), and symptoms of conduct disorder, oppositional defiant disorder and antisocial personality disorder, including delinquency and risky sexual behaviors. Therefore, Study 3 considers not only relations between self-reported impulsigenic traits and laboratory-task-based impulsivity but also relations of each of these types of measures with daily-life behaviors, both problematic and nondeviant.

Study 3: Method

We obtained studies with similar strategies to those described for Studies 1 and 2. We ran a series of PsycINFO searches with the names of every measure listed in Tables 1 and Table 4 in "any field," specifically focusing on studies that included at least one self-report measure or laboratory task and a daily-life behavior ($n = 369$ articles). We reviewed the abstracts of each article and eliminated those that were obviously not relevant to our research questions, leaving 155 articles. We then reviewed the Results section of each remaining article and eliminated studies that did not report correlational data between scales/subscales and/or tasks/indices and daily-life behaviors. This process yielded 40 studies, including 27 undergraduate or community adult samples (17 of which were clinical samples) and 13 adolescent samples (9 of which were clinical samples).

Using methodologies similar to those described previously, we developed correlation matrices to examine (a) weighted correlations between self-report scales and laboratory behavioral tasks (see Table 6) and (b) weighted correlations between either self-report scales or laboratory behavioral tasks and daily-life impulsive behavior (see Table 7). We keyed all measures so that higher scores represent more impulsive responses or performance. Again, the coefficients shown in the tables represent weighted correlations averaged over all available data. Sample sizes in studies that

Table 6

Weighted Relations Between Self-Report Scales and Laboratory Behavioral Tasks of Impulsivity

	Laboratory behavioral tasks[a]												
	Inattention			Inhibition			Impulsive Decision-Making				Shifting		
Self-report scale	Stroop error	Delayed Memory	Immediate Memory	G/NG inhibition	MFFT latency	Circle tracing	IGT	Stop Task	Hypothetical delay	Contingent delay	WCST pers.	WCST nonpers.	r_{mean}
Disinhibition vs. Constraint scales													
I_7 Impulsivity	−0.16	0.03	0.11	−0.10	−0.02	0.11	0.12	−0.07	0.14	0.05	−0.38	*−0.20*	−0.04
DII Dysfunctional Impulsivity				−0.06			0.01	0.08	*0.20*	−0.18	−0.07		0.01
UPPS (lack of) Premeditation	−0.15			0.06	−0.11		−0.09	*0.30*	0.11	0.11	0.13	0.08	
MPQ Constraint										−0.07			−0.07
r_{mean}	−0.01	0.03	0.11	−0.03	−0.07	0.11	0.02	0.10	0.15	−0.07	−0.11	−0.04	0.02
Conscientiousness/Will vs. Resourcelessness scales													
UPPS (lack of) Perseverance	*0.20*			.00	−0.18		0.05	*0.31*	0.09	0.16	0.16	0.10	
EPI Neuroticism					−0.12								−0.12
r_{mean}	**0.20**	—	—	.00	−0.15	—	0.05	**0.31**	0.09	—	0.16	0.16	0.10
Extraversion/Positive Emotionality/Sensation Seeking scales													
I_7 Venturesomeness	*−0.39*	−0.01	0.04	0.03	−0.02	0.13		−0.10	−0.12	0.02	*0.41*	*−0.34*	−0.03
DII Functional Impulsivity			0.06			*0.26*	−0.10	0.19				0.10	
UPPS Sensation Seeking	−0.17			0.00	0.08		0.03	−0.16	0.12		−0.04	0.00	−0.02
EPQ Extraversion				−0.11		−0.04	0.09					−0.02	
BIS/BAS Behavioral Inhibition			−0.14		0.23	−0.03						0.02	
BIS/BAS Fun-Seeking					0.16	−0.21						−0.03	
BIS/BAS Drive						0.05	−0.08						−0.02
r_{mean}	**−0.28**	−0.01	0.04	−0.01	−0.02	0.14	−0.01	−0.07	0.06	0.02	0.19	−0.17	−0.01
Neuroticism/Negative Urgency scales													
BIS Attentional Impulsivity	0.05	*0.25*	*0.24*	0.12	*−0.34*			0.16	0.07	−0.04			0.06
UPPS Urgency	−0.15			−0.01	0.08		0.09	0.21	0.03	*0.24*	*0.25*	0.09	
EPQ Neuroticism				−0.02		−0.17	−0.12					−0.1	
r_{mean}	−0.05	**0.25**	**0.24**	0.06	−0.09	—	−0.04	0.08	0.05	−0.04	**0.24**	**0.25**	0.09
$r_{GrandMean}$	−0.07	−0.07	0.13	0	−0.08	0.14	−0.01	0.05	0.09	−0.04	0.06	0	0.02

Note. Correlations (effect sizes) > .20 are bolded for both individual scales and means; those for individual scales are also italicized. Stroop = Stroop Color–Word Test; G/NG inhibition = Go/No Go Task inhibition; MFFT = Matching Familiar Figures Tasks; Circle tracing = Circle Tracing Task slow time; IGT = Iowa Gambling Task; Stop Task = Stop-Signal Reaction Time Task; Hypothetical delay = hypothetical delay of Gratification Task; Contingent delay = contingent delay of Gratification Task; WCST pers. = Wisconsin Card Sort Task perseverative errors; WCST nonpers. = Wisconsin Card Sort Task nonperseverative errors; I_7 = Eysenck Impulsiveness Questionnaire (Eysenck & Eysenck, 1978); DII = Dickman Impulsiveness Inventory (Dickman, 1990); UPPS = UPPS Impulsive Behavior Scale (Whiteside & Lynam, 2001); MPQ = Multidimensional Personality Questionnaire (Tellegen, 2000); EPI = Eysenck Personality Inventory (Eysenck & Eysenck, 1968); EPQ = Eysenck Personality Questionnaire (Eysenck & Eysenck, 1968); BIS/BAS = Behavioral Inhibition System/Behavioral Activation System (Carver & White, 1994); BIS = Barratt Impulsiveness Subscales, Version 11 (Patton et al., 1995).

[a] Factor labels are centered over the tasks that load primarily on that factor. Lines indicate all tasks that loaded > |.35| on the factor.

Table 7
Weighted Relations Between Self-Report Scales, Behavioral Tasks, and Daily-Life Impulsive Behavior

Scale or task	Daily-life impulsive behavior: Alcohol	Drugs	Cigarettes	Aggression	Delinquency	Gambling	Sex	r_{mean}
Self-report questionnaires								
Disinhibition (vs. Constraint) scales								
I_7 Impulsivity	*.35*	*.41*	.23	*.41*	*.66*	.31	.13	.36
DII Dysfunctional Impulsivity	.13	.15		.28			.13	.17
MPQ Constraint	*.24*	*.31*	*.32*		*.44*			.33
UPPS (lack of) Premeditation	.42	.29	.15	.03		.08	.10	.18
r_{mean}	**.29**	**.29**	**.23**	**.23**	**.55**	**.20**	.12	**.27**
Conscientiousness/Will vs. Resourcelessness scale								
UPPS (lack of) Perseverance	*.22*	*.25*	.16	−.03		.03	.08	.12
Extraversion/Positive Emotionality/Sensation Seeking scales								
EPQ Extraversion		*.20*	.12	−.02	*.28*			.15
UPPS Sensation Seeking	.28	*.26*	−.02	.13		.16	.09	.15
I_7 Venturesomeness	*.32*	*.36*	.17	−.02	*.38*	*.41*	*.28*	.27
BIS/BAS Fun-Seeking	*.24*	.17	.13	.06	*.23*	.03	*.21*	.15
BIS/BAS Drive	.10	.07	.06	.30	.14	.06	.17	.13
BIS/BAS Behavioral Inhibition	.08	.01	.02	.04	.08	.20	.01	.06
r_{mean}	**.20**	.18	.08	.12	**.22**	.17	.15	.16
Neuroticism/Negative Urgency scales								
EPQ Neuroticism	*.45*	.13	*.25*	.08	.10			*.20*
UPPS Urgency	*.34*	*.31*	*.28*	.19		.19	.19	*.25*
BIS Attentional Impulsivity	*.37*	*.51*		*.40*	*.71*			*.50*
r_{mean}	**.39**	**.32**	**.27**	**.22**	**.41**	.19	.19	**.28**
Laboratory tasks[a]								
Inattention								
Stroop error	.41	.23	.06	*.48*	*.21*	*.44*		*.31*
Immediate Memory				*.31*	*.42*			*.37*
Delayed Memory				*.11*	*.27*			.19
r_{mean}	**.41**	**.23**	.06	**.30**	**.30**	**.44**	—	**.29**
Inhibitory Dyscontrol								
IGT	*.41*	.08	.04	.17		.00	.11	.14
G/NG inhibition	.18	.06	*.42*					.22
r_{mean}	**.30**	.07	**.23**	.17	—	.00	.11	.17
Impulsive Decision-Making								
Stop Task	.17	.12	*.22*					.17
Hypothetical delay	.09	.04	*.52*		.13	*.39*	*.23*	
Contingent delay		*.44*	*.34*					*.39*
r_{mean}	.13	**.20**	**.36**	—	.13	**.39**	—	**.24**
Set-shifting								
WCST pers.	*.42*	.18	.05	.15	.04	*.49*		*.22*
$r_{GrandMean}$	**.28**	.16	**.24**	**.24**	**.21**	**.21**	.11	**.21**

Note. Correlations (effect sizes) > .20 are bolded for means and italicized for individual scales. I_7 = Eysenck Impulsiveness Questionnaire (Eysenck & Eysenck, 1978); DII = Dickman Impulsiveness Inventory (Dickman, 1990); MPQ = Multidimensional Personality Questionnaire (Tellegen, 2000); UPPS = UPPS Impulsive Behavior Scale (Whiteside & Lynam, 2001); EPQ = Eysenck Personality Questionnaire (Eysenck & Eysenck, 1968); BIS/BAS = Behavioral Inhibition System/Behavioral Activation System (Carver & White, 1994); BIS = Barratt Impulsiveness Subscales, Version 11 (Patton et al., 1995); Stroop = Stroop Color–Word Test; IGT = Iowa Gambling Task; G/NG inhibition = Go/No Go Task inhibition; Stop Task = Stop-Signal Reaction Time Task; WCST pers. = Wisconsin Card Sort Task perseverative errors.
[a] Keyed in the "impulsive" direction.

analyzed relations between the self-report scales and laboratory behavioral tasks are typically between 50 and 150 individuals. In contrast, sample sizes in studies that examined relations of self-report scales and behavior tasks to daily-life behaviors are moderate to high, averaging approximately 400 and 150, respectively.

Study 3: Results

Table 6 presents correlations among several of the impulsigenic-trait measures shown in Table 2 and many of the most commonly used impulsive laboratory behavioral tasks shown in Tables 4 and 5. Each of the impulsigenic traits is represented by at least two self-report scales, and all of the laboratory tasks except the Porteus Mazes are included. The great majority of correlations presented in Table 6 are low; only six are above $r = |.30|$, and only one is above $r = |.40|$. Thus, it is the exception to find statistically significant correlations, few are even moderate, and none are high. Further, many of the highest relations reported (e.g., between I_7 Venturesomeness and the WCST) were obtained from a single study. When one examines the mean correlations across behavioral tasks or across self-report measures, it is evident that no task or measure is consistently more highly related to the other type of measure; the highest mean relation is a mere .14, and the grand mean is .02 (that is, essentially zero).

Table 7 presents intercorrelations of daily-life, impulsive behaviors with many of the self-report measures presented in Table 2 as well as many of the laboratory-behavioral measures reported in Table 5. Among the most striking aspects of Table 7 is the range of relations presented, from .00 (Gambling with IGT, ironically) to .66 (Delinquency with I_7 Impulsivity). However, mean relations indicate that, with a few exceptions, both self-report scales and laboratory behavioral tasks show small to moderate relations with daily-life behaviors. Adolescent delinquent behavior is the most strongly related, on average, to the self-report scales (rs = .55, .22, and .41 with Disinhibition, E/PE-SS, and N/NE scales, respectively), whereas gambling is the behavior most strongly related to the laboratory tasks (r = .53).

Multiple self-report scales represent each impulsigenic trait, except for Constraint, which is represented by a single scale. Within the impulsigenic traits, certain self-report scales are more strongly related to daily-life behaviors than others. Specifically, for the Disinhibition scales, daily-life behaviors are more strongly correlated with I_7 Impulsivity and MPQ Constraint (r_{means} = .36 and .33, respectively) than with Dysfunctional Impulsivity and UPPS (lack of) Premeditation (r_{means} = .17 and .18, respectively). For the Sensation Seeking scales, daily-life behaviors are more strongly correlated with I_7 Venturesomeness than any other scale (r_{mean} = .27 vs. range of .06 to .15), and of the Negative Urgency scales, BIS Attentional Impulsivity was the most highly correlated (r_{mean} = .50 vs. .20 and .25 for EPQ N and UPPS Urgency). As mentioned, the impulsigenic trait Conscientiousness/Will (vs. Resourcelessness) is represented by a single scale, so we offer only cautious conclusions regarding relations of this trait to daily-life behaviors.

Across various daily-life behaviors, the most strongly related of the impulsigenic traits were Disinhibition (vs. Constraint) and N/NE; the grand mean for the scales assessing these traits were .27 and .28, respectively. These correlations are consistent with theory in that this set of daily-life behaviors reflects externalizing, which is related to both of these personality factors (e.g., Kotov et al., 2010). In contrast, the grand means for UPPS lack of Perseverence (the only scale representing [CW vs.] Resourcelessness) and for scales assessing E/PE were .12 and.16, respectively.

Finally, of the laboratory tasks, Contingent Delay, the Stroop, and the IMT are the most strongly related to daily-life behaviors (r_{means} = .39, .37, and .37, respectively). Across the laboratory task indices described previously, the grand mean for the Inattention tasks was .29, compared to .24, .22, and .17 for tasks assessing Impulsive Decision-Making, Shifting, and Inhibition, respectively. Overall, there were far fewer studies for this analysis compared to that examining relations between self-reported traits and daily-life behaviors. More data are needed to examine specific patterns within these data, but, in general, these results indicate that daily-life behaviors are moderately related to both the impulsigenic traits and the laboratory task indices.

Taken together, the pattern of correlations presented in Tables 6 and 7 offers support for a combinatory approach to the prediction of daily-life impulsive behavior. There are several daily-life behaviors that are moderately related to both self-reported personality traits and laboratory tasks, which themselves are largely uncorrelated. For example, UPPS (lack of) Premeditation is very weakly related to both IGT and WCST Perseverative Errors (rs = −.09 and .11, respectively); however, all three relate moderately to alcohol use (rs = .42, .41, and .42, respectively). Similarly, Contingent Delay of Gratification is unrelated to both I_7 Impulsivity and BIS Attentional Impulsivity (rs = .05 and −.04, respectively), but all three relate moderately to drug use (rs = .44, .41, and .51, respectively). There are comparable examples of such relations for every daily-life behavior in Table 7, with the exception of risky sexual behavior, which was modestly correlated with self-reported impulsigenic traits and essentially uncorrelated with laboratory tasks.

Table 8 presents a hypothetical demonstration of results that might be obtained if a battery of self-reported impulsigenic traits and laboratory impulsive-behaviors tasks were administered jointly along with assessment of a range of daily-life impulsive behaviors. The top half of the table shows an ideal situation in which, using the data presented in Table 7, the personality factor and behavioral-task factor that show the highest correlation with a given daily-life behavior are used to predict the behavior. This might be the situation if we knew precisely how personality traits and the more cognitive variables assessed by the behavioral tasks interacted to contribute to the emergence of impulsive, daily-life behaviors. In this ideal scenario, the median multiple R for predicting daily-life behaviors would be .45, ranging from .22 for risky sexual behavior to .63 for delinquency, a considerable increment over the predictive power of either traits or lab tasks alone. The incremental predictive power (R^2s) for personality, when the behavioral tasks are entered first, and vice versa, are shown immediately below the multiple R; they range from .03 to .30 (Mdn = .07) for personality and from .01 to .23 (Mdn = .09) for the behavioral tasks.

The bottom half of the table shows a more realistic scenario, in which we know that both personality traits and cognition as measured by laboratory tasks influence impulsive, real-life behaviors but do not yet understand precisely which or how these traits and cognitive variables do so, so the average values for personality and behavioral tasks from Table 7 are used. In this case, the median multiple R for predicting daily-life behaviors would be .31, ranging from .16 for risky sexual behavior to .45 for gambling, which still is a notable increment over the predictive power of either type of measure alone. The incremental predictive power (R^2s) for personality, when the behavioral tasks are entered first, and vice versa, are shown immediately below the multiple R; they range from .01 to .15 (Mdn = .04) for personality and from .01 to .18 (Mdn = .03) for the behavioral tasks. Although these values are not as high as in the ideal scenario, they are typical for multiple regressions of this type and offer support for the incremental validity of each assessment method for the prediction of daily-life behavior.

Study 3: Discussion

The data obtained from a single measurement strategy are equivocal; they may indicate true variance but also may indicate method or error variance or some combination of the three. Adding a second strategy reduces this equivocality and limits the number of constructs that could account for both sets of data (Campbell &

Table 8
Hypothetical Results of Regression Analyses Considering Self-Reported Impulsigenic Traits, Impulsive-Behavior Laboratory Tasks, and Daily-Life Impulsive Behaviors

Scale or task	Daily-life impulsive behavior: Alcohol	Drugs	Cigarettes	Aggression	Delinquency	Gambling	Sex
Ideal personality factor							
Disinhibition (vs. Constraint)	—	—	—	.23	.55	.20	—
N/NE/Negative Urgency	.39	.32	.27	—	—	—	.19
Ideal laboratory-based task							
Inattention	—	.23	—	.30	.30	—	—
Inhibitory dyscontrol	—	—	—	—	—	—	.11
Impulsive decision-making	—	—	.36	—	—	—	—
Set-shifting	.42	—	—	—	—	.49	—
Intermeasurement *r*	.24	.15	.01	.01	.01	−.08	.01
Multiple ***R***	.52	.36	.45	.38	.63	.52	**.22**
R^2 increment							
Task, personality entered first	.12	.03	.13	.09	.09	.23	.01
Personality, task entered first	.09	.08	.07	.05	.30	.03	.04
Averaged personality factors	.22	.25	.16	.12	.39	.17	.12
Averaged behavioral factors	.36	.19	.15	.17	.13	.42	.11
Multiple *R*	.42	.31	.22	.21	.41	.45	.16
R^2 increment							
Task, personality entered first	.13	.04	.02	.03	.02	.18	.01
Personality, task entered first	.05	.06	.03	.01	.15	.03	.01

Note. In the bottom half of the table (joint predictive power using average personality and behavioral task values), the intermeasurement $r = .02$, based on the grand mean in Table 6. Higher intermeasurement correlations (e.g., as might be achieved with improved laboratory-task psychometric properties) would reduce incremental predictive power. The dashes indicate insufficient data. N/NE = Neuroticism/Negative Emotionality.

Fiske, 1959). Thus, the use of multiple assessment strategies increases confidence that the findings arise from the hypothesized construct(s) and, similarly, that both measurement strategies have some validity in assessing the construct(s). The general lack of relations between self-report scales and laboratory behavioral tasks of impulsivity has raised concerns, as both—at least initially—were intended to measure similar trait-like phenomena, and yet our meta-analytic results confirm the generally low relations found between self-report and behavioral tasks to assess impulsivity. That is, the strongest correlation between any pair of self-report scales and behavioral tasks is .41 (WCST Perseveration errors and I_7 Venturesomeness); the strongest average correlation of any task with scales representing a self-report impulsigenic factor is .31 (Stop-Signal task with Conscientiousness/Will vs. Resourcelessness), the strongest correlation of any scale averaged across multiple tasks is |.10| (UPPS Lack of Perseverence, DII Functional Impulsivity, and EPQ Neuroticism); and the highest correlation of any task with all impulsigenic trait scales averaged together is .14 (Circle Tracing). Thus, method variance accounts for a maximum of 17% of the variance between self-report scales and tasks and on average considerably less.

However, the lack of relation has the potential advantage that—precisely because the two measurement approaches do not share method variance—any consistent relations that these measures show to a third set of variables, such as daily-life behaviors, are likely due to true, unique variance in each type of measure. Our meta-analytic review indeed demonstrated that both self-report measures of impulsigenic traits and laboratory behavioral tasks are related to deviant and nondeviant impulsive daily-life behaviors, and the possibility that these relations represent primarily shared method variance between the predictors has been ruled out. Together, therefore, these data indicate that each assessment strategy is tapping unique variance in daily-life behavior that the other is not. Moderate correlations—all in the .22 to .29 range—were found between a range of externalizing behaviors and both impulsigenic trait and behavioral-task factors, specifically, for Disinhibition (vs. Constraint) and Neuroticism/Negative Urgency, and for Inattention, Impulsive Decision-Making, and Set-Shifting (the last represented only by WCST Perseveration). For specific externalizing indices, average correlations ranged as high as .55 for the self-report factors (Delinquency with DvC), as high as .30 for behavioral-task factors when multiple indices were available (Cigarette use with Impulsive Decision-Making) and up to .49 (WCST Perseveration with Gambling) for single behavioral tasks. It must be acknowledged that the available data are sparse, with many correlations derived from few studies; nonetheless, these findings are encouraging.

Whether this variance can be characterized by the term impulsivity in both cases remains a concern, however, because it seems unwise to use the same term for unrelated phenomena. Thus, we return to the issue of whether addressing methodological problems could reveal relations across these two types of measures sufficient to justify calling them both assessments of impulsivity. Our factor-analytic results indicate that specific behavioral patterns across tasks can be discerned, but it is possible that laboratory behavioral tasks, because of their focus on specific behaviors, each measure only one small aspect of a trait-like phenomenon, much like a single item of a self-report scale. If so, each single aspect would reflect only a fraction of a broader target construct, and it would be unreasonable to expect any one such task to assess what is captured by multi-item, and thus broader, more comprehensive self-report measures (Gwin, 1998; Mitchell, 1999). If this is the case, factor-scores-based tasks could be expected to show stronger correlations with self-report measures than would single, specific-task scores. The few studies reporting factor analyses of several behavioral tasks, therefore, represent preliminary stages of establishing the commonalities and specificities among and across tasks and of creating multitask behavioral indices that are much more likely to be related to symptomatology, self-reported impulsivity, and, indeed, any outcome measures or correlates of interest.

As an example of this method, relating laboratory-task impulsivity to psychopathology, Avila et al. (2004) extracted two factors from 13 behavioral tasks and examined their relations with ADHD and oppositional defiant disorder (ODD) symptomatology. They found that a factor resembling a combination of our inattention and inhibition factors related .29 and .03, respectively, with ADHD and ODD symptoms, whereas a second factor resembling a combination of our Impulsive Decision-Making and Shifting factors correlated with these disorders' symptoms .14 and .22, respectively, suggesting a convergent-discriminant pattern across the two task-based factors and the two types of symptoms. The strongest correlate of the individual tests with both types of symptoms was the Continuous Performance Task (*r*s = .38 and .33). Although these are stronger convergent correlations, they are quite similar, and the pattern of convergent-discriminant validity found using the factor-based scores provides more differential information about the participants' psychopathology, thus showing promise for this approach.

On the other hand—and again like single items—it is becoming clear that more than one dimension of impulsive behavior is being tapped by many of these laboratory tasks (e.g., Cyders & Coskunpinar, 2011, 2012; Lane et al., 2003; and recall the task-impurity problem raised by Miyake & Friedman, 2012). Without the benefit of multiple items, which aggregate true variance and cancel out error or any other nontargeted variance, it is impossible to know what underlying or latent constructs are combined in a given behavioral task. Further, laboratory impulsive-behavior tasks appear to be differentially sensitive to the underlying impairments they are intended to measure, just as various self-report items are stronger or weaker indicators of trait constructs. However, there currently is no consensus regarding which measures possess the greatest discriminating power for which deficits (Frazier et al., 2004; Halperin et al., 1991; Olley, Malhi, & Sachdev, 2007; Zaparniuk & Taylor, 1997). Given this scenario—that is, assuming that the lack of correspondence between self-report and laboratory-task assessed impulsivity to date has a basis in inadequate measurement—if the laboratory task(s) chosen for a particular study is/are not well-suited to capture the particular phenomenon under investigation, then the correlation between the study's laboratory task(s) and self-report measure(s)would be small, but not necessarily because of poor congruence between the theoretical constructs.

We were able to locate only one study that examined relations between behavioral indices based on multiple tasks and self-report measures of impulsivity, but it provides an excellent illustration of the significant benefit that aggregating measures could have on our understanding of these phenomena. Stuart and Holtzworth-Munroe (2005) examined the relation between a behavioral index composed of the Circle Tracing, Differential Reinforcement of Low Rate Responding and Time Production tasks, and a self-report impulsivity index composed of I_7 Impulsivity and the BIS-10 Nonplanning, Cognitive, and Motor subscales, after dropping a fourth measure (similar to the IGT) that correlated most weakly with both the self-report measures (*r*s = −.04 to .12) and the other behavioral tasks (*r*s = .02 to .15). The average correlation among the other behavioral tasks was .17, and the correlation of the two composites was .38. This was higher than the correlations between any pair of individual self-report scales and behavioral tasks in their study, which ranged from .09 to .30 and averaged .21, as well as higher than all but two correlations in our meta-analytic results in Table 6. Thus, even with a "weak" signal (as indexed by the average .17 correlation among the behavioral tasks), aggregating across tasks accrued considerable advantage in relating the behavioral indices to self-reported impulsivity.

Note that .17 is within the suggested range of item intercorrelations when constructing a multi-item scale (Clark & Watson, 1995) and that using all three measures together as a single index is comparable to using a three-item scale with an alpha of .38. To achieve an alpha coefficient of .80—an often-used cutoff for self-report scales—would require a behavioral task battery of 20 tasks, whereas alphas of .50, .60, and .70, would require batteries of 4, 7, and 11 tasks, respectively. Thus, these results indicate that with sufficient resources to assess large samples using broad batteries of neuropsychological tests to create more reliable multitask and multiscale factors, it is possible to obtain a level of relation between these two types of measures that would warrant the claim that both types of measures assess related, but likely still distinct, aspects of impulsive behavior.

General Discussion

Assuming that such methodological problems can be solved, we are brought back to our initial question of whether we should be seeking a theory of impulsivity or seeking to explain the diversity of impulsive behaviors; that is, whether (and if so, how) we can conceptualize impulsivity as a unitary characteristic or whether, instead, we need to differentiate among distinct psychological differences in impulses and the behaviors they lead to. However, assuming that such methodological problems can be solved also raises a third possibility: That we can develop an integrated model that accounts for both the commonalities among and differences between seemingly diverse types of impulsive behavior. We explore this possibility for the remainder of the article.

To begin, we note that the results presented here parallel those in other areas, such as neuroscience, where theoretically related measures all seem to be related to a common set of neural systems but may invoke those systems in different ways. Meta-analyses and other studies, for example, have suggested that impulsigenic personality traits, as well as performance on decision-risk tasks, are related to medial and dorsolateral prefrontal cortex, striatum, and insula, either functionally or structurally (e.g., Gregory et al., 2012; Mohr, Biele, & Heekeren, 2010; Treadway et al., 2012; Yang & Raine, 2009). However, different subsystems are evoked differentially depending on task characteristics, such as whether a decision involves emotionally salient risk, and whether outcomes are positive or negative, involve large versus small amounts of uncertainty, or (do not) require persistent effort. To illustrate, echoing data presented in Study 1 that indicated that measures of certain impulsigenic traits reflect affective traits as well, Mohr et al. (2010) meta-analytically summarized neural decision-making research by demarcating between emotional and cognitive risk. They argued that the former is important when risk related to potential gains or losses is being assessed, whereas the latter is important when risk related to outcome uncertainty, independent of valence, is being assessed. The two processes involve different neural systems—the former involving more insular activation, the latter more medial prefrontal cortex activation—that are activated under different conditions.

In the same way, rating-scale measures and laboratory tasks may act as indicators of different features of the same psychological systems or overlapping components of a common network. Rating-scale measures, for example, may more strongly reflect stable, long-term, "macro-level" patterns of responses involving emotionally salient stimuli and risks that are difficult to assess in the laboratory (e.g., those involving large losses of income, damage to significant relationships, or persistent effort over the course of months or years). Existing laboratory tasks, in contrast, may assess processes that are less affectively laden and occur on a more fine-grained "microlevel" timescale. Conducting research, including measure development that clarifies the nature of both types of processes, is an important future goal.

Another possibility, given the evidence from our Study 1 regarding the affect-driven nature of some impulsigenic traits, is that self-report measures tap underlying emotional/motivational mechanisms related to these daily-life behaviors, whereas the laboratory behavioral tasks may assess cognitive aspects, and these two processes interact to influence one's behavior. Baskin-Sommers et al. (2012) presented preliminary evidence along these lines. They assessed selective attention processes in individuals classified as externalizing by their scores on the MPQ Constraint (CON) and NEM scales. Baskin-Sommers et al. found that when externalizing individuals were primed to attend to goal-relevant information that aligned with their priorities, they were more responsive to the information, suggesting that they could (or were willing to) go against their typical impulsive cognitive style when given the motivational/emotional incentive to do so. In contrast, when presented with information that ran counter to their priorities they showed diminished ability—or willingness—to redirect their attention.

These data suggest that the typically low correlations between impulsigenic traits and laboratory tasks assessing attention may occur because these processes function independently but, depending on the circumstance, interact to influence behavior. Further, there is evidence from adolescents that impulsigenic traits may result from similar predispositions that interact with executive control processes in different ways to result in either early or later initiation of externalizing behaviors (Romer et al., 2011). However, to date there has been no systematic integration of these two literatures to demonstrate how impulsigenic traits and laboratory behavioral tasks may incrementally predict daily-life behaviors. Together with the possibility of improving the measurement of laboratory-task impulsivity, research jointly studying these two "sources" of impulsive behavior appears promising.

DeYoung (2010) has taken an interesting step toward a unified model of impulsivity by first defining it as "the tendency to act on immediate urges, either before . . . or despite consideration of negative consequences" (p. 487). Somewhat paradoxically, the high level of abstraction of this definition renders is in some ways as broad and imprecise as our natural language term; yet, that very abstractness also may allow for both a conceptual unification of impulsivity under a single broad umbrella and an explanation of the diversity of impulsive behaviors underneath this umbrella, based in individuals' distinct personality traits and associated urges, as well as cognitive styles and abilities.

DeYoung (2010) further proposes serotonin as a key substrate of all impulsivity-related traits, particularly those comprising the "alpha"/stability dimension (i.e., Neuroticism, Agreeableness, and Conscientiousness, the latter two of which typically combine at the three-factor level of the personality trait hierarchy to form our DvC factor), based on its function of modulating both "bottom-up" impulses originating in the hypothalamic and brain stem systems (Gray & McNaughton, 2000) and (the lack of) top-down restraint originating in the dorsolateral prefrontal cortex (Carver & Harmon-Jones, 2009).[4] Note that this description parallels Bechara's (2005) depiction of addiction as an imbalance in just these two systems.

Individuals differ genetically in their serotonin functioning (e.g., Hariri, 2006), which suggests that their stimulus–response and inhibition systems may have a characteristic, basal strength—based at least in part on their serotonin functioning—that is unconnected to any particular stimulus type (recall that this is highly similar to Tellegen's (1985) speculation on the nature of individual differences in DvC). At the same time, an important aspect of other personality traits is that they differentially focus individuals on distinct stimuli. For example, for individuals high or low in Extraversion, socially relevant stimuli are particularly salient, either to be approached or avoided, respectively, whereas for individuals with midlevel Extraversion social stimuli have no particularly strong valence. In contrast, the higher an individual's Neuroticism, the more salient aversive or threatening stimuli become. Thus, individuals who are similar in their "tendency to act on immediate urges" (which biologically may mean that their serotonin functioning and associated stimulus–response and inhibition systems have similar basal strengths) nevertheless could react differentially to the same environmental stimuli because of differences in their dominant personality traits.

Conversely, individuals with similar levels of Extraversion (or other personality traits) but whose serotonin-function-related stimulus–response and inhibition systems had different basal strengths would differ in the degree and nature of "impulsive" (in the case of Extraversion, sensation-seeking) behavior they exhibited. This is no doubt oversimplified. Indeed, Krakowski (2003) indicated that serotonergic dysfunction effects differ depending not only on "the individual's impulse control and emotional regulation" (p. 294; a statement that itself indicates that one cannot equate serotonin function with impulse control per se) but also by the social context. Nonetheless, it provides a starting point for closer investigation of how similar levels of serotonergic activity, other neurotransmitters

[4] DeYoung (2010) further postulated that dopamine is involved in the regulation of impulsive behavior related to Extraversion (i.e., strong approach) and, to a lesser extent, Openness but acknowledged that relations of this neurotransmitter to impulsive behavior are likely more complex. We do not address them further here.

such as dopamine, or various personality traits may find different expressions in overt behavior, because the behavioral manifestations of each are dependent on the others.

Thus far, this conceptual analysis concerns only the personality-trait part of the puzzle. We have yet to integrate the cognitive piece that is reflected in laboratory tasks of impulsive behavior. From a personality perspective, serotonergic systems appear to reflect the two ends of the DvC/C personality dimension, the most affect free of the impulsigenic traits, whereas from a laboratory-task perspective they seem to align most closely with impulsive-decision-making (i.e., delay-discounting) tasks and inhibition (e.g., G/NG) tasks. Thus, it would be tempting to conclude that there are—or should be—associations between them, but we know from existing research that we must resist following this sirens' call.

Rather, we must follow the data and consider more closely the nature of the cognitive factors that are tapped by laboratory tasks and how these factors relate to daily-life impulsive behaviors independently of personality. For example, picking up on Krakowski's (2003) notion that impulse control and emotional regulation are not synonymous with serotonin function, and given the links of the inhibition and impulsive decision-making factors that emerged in our analysis of impulsive-behavior laboratory tasks with executive function and intelligence, respectively, we may postulate, minimally, four quasi-independent factors that interact to affect the likelihood that individuals will engage, for example, in aggressive acts or substance abuse: (a) an individual's levels of impulsigenic personality traits (e.g., particularly low Agreeableness in the case of aggression and low DvC [and possibly high Openness] in the case of substance abuse); (b) genetically determined serotonin function modulating an individual's "generic impulsivity," both the bottom-up tendency to act on stimuli and the top-down regulation of such tendencies; as well as cognitively mediated (c) inhibition (i.e., ability to restrain a prepotent response) and (d) impulsive decision making (i.e., inability to delay gratification).

This model of impulsive behaviors thus implies, for example, that (a) a person with relatively low serotonin would tend to have strong urges and less restraint. (b) The specific nature of the urges experience would vary depending on the individual's personality (e.g., strong approach to signals of reward in the context of high Extraversion vs. strong urges to physical violence in the context of low Agreeableness, and each of these moderated by other traits). That whether the urges would actually be enacted—that is, whether aggressive behavior or approach to the attractive stimuli would occur—would be further moderated by (c) the individual's level of cognitive inhibition (i.e., the ability to consider the negative consequences of the act); (d) the cognitive ability to delay gratification, which might be more relevant in the case of the attractive stimulus than the potentially violent situation (i.e., all four factors might not be relevant in all situations); and, following Krakowski (2003), even (e) the social context. Again, this model is clearly highly speculative, but it does provide a framework for going beyond a simplistic view of impulsivity as a single construct or even as a set of personality traits. Rather, it views impulsivity as an emergent property of multiple systems interacting in a social context.

Conclusion

Everyday English language implies that impulsivity is a unitary construct. However, an analysis of self-report measures commonly used to assess impulsivity argues for four distinct impulsigenic traits: Sensation Seeking, related to E/PE; Negative Urgency, related to N/NE; lack of Planning, related to DvC/C; and lack of Perseverence, related to C/WvR. Similarly, laboratory behavioral tasks, developed by neuropsychological researchers to examine "behavioral" or "cognitive" impulsivity, appear to tap four distinct constructs. We have labeled these Inattention, Inhibition, Impulsive Decision-Making, and Shifting, to capture the behavioral tendencies assessed by each factor, consistent with the factors' similarity to those obtained and so labeled in previous analyses of these tasks.

A meta-analytic correlation matrix of relations between the self-report scales commonly used to measure impulsigenic traits and laboratory impulsive-behavior tasks highlights the general lack of relations between these two measurement strategies. However, in this article we offer methodological and theoretical reasons for this phenomenon and suggest that the former may be rectified by applying classic psychometric principles to laboratory-task measures. We also suggest that the lack of shared method variance between laboratory behavioral tasks and self-report scales be considered a strength. We see the lack of shared method variance as a prime opportunity to adopt a "multiple-regression approach" to the prediction of impulsive daily-life behaviors, with which both types of impulsive behavior correlate moderately strongly.

Due to the paucity of data, we were not able to use meta-analytic regression or structural equation modeling to test the hypothesis that these two types of constructs would predict daily-life behaviors jointly much more strongly than either type of measure alone. A "simulation" of such a study, based on the mean values of our meta-analysis relating daily-life behaviors to self-reported traits and laboratory tasks, respectively, indicated promise for such an approach, but more rigorous methods are needed to evaluate this conjecture fully. We now need studies that carefully select a battery of multiple self-report and laboratory task measures of impulsigenic traits, to improve the psychometric properties of laboratory-task measures and investigate their joint relations with daily-life behaviors.

Such an approach would allow for more rigorous comparisons between different models of how behavioral tasks and self-report are structurally organized and relate to one another and daily functioning. The results presented here are consistent with prior research and provide a broad sense of how these measures are organized and relate to outcomes but were limited in the range and detail of models that can be compared. Future studies utilizing a range of self-report and behavioral tasks would afford opportunities to more carefully test different accounts of what self-report and behavioral indicators are measuring, using confirmatory methods that could not be employed here due to a lack of studies. These more confirmatory methods would allow one to model more carefully effects of measurement error in the particular subsets of variables considered and to specify in greater detail what is shared and what is unique about the different types of measures and why (e.g., to parse differences between method and trait variance). These confirmatory methods also would allow more rigorous comparisons between different accounts of the data. For example, if more formal model comparison methodology were used, it may be that other structural accounts of self-report and performance measures, and their relations, would be found to explain empirical observations better. The models we present here were estimated and evaluated in a relatively exploratory fashion, and we were unable to compare such models to other competing accounts as might be done in future research carefully addressing the questions raised here. However, we believe that such a future research agenda would support the conclusions drawn here and demonstrate directly the hypothesized incremental validity of these two types of variables in predicting important life outcomes.

As stated earlier, individuals, their families and communities, and society at large all experience the consequences of impulsive behavior. Looking at the behavioral consequences outlined in Table 7 alone, one can begin to quantify their associated cost. In strictly financial terms, the National Institute of Drug Abuse (2008) estimates the societal cost of substance abuse and dependence as $181 billion per year for illegal drugs, $185 billion per year for alcohol and $193 billion per year for tobacco. The World Health Organization reported "estimates of the cost of violence in the United States of America reach 3.3% of the gross domestic product" (Waters et al., 2004, p. x). Nor are these costs restricted to the behavior of adults; a report by the president of the Illinois State Bar Association, for example, gave the cost of incarcerating a single juvenile offender as $85,000 a year (Hassakis, 2011). Similarly, the estimated societal cost over the lifetime of a pathological or problem gambler is between $40 and $58 billion, with these costs arising from bankruptcy, lost revenue, divorce, and treatment, among other things (Grinols, 2004; National Opinion Research Center, 1999). Finally, it is perhaps more difficult to quantify the societal costs of risky sexual behavior, but the Centers for Diseases Control (CDC) estimated the annual cost of sexually transmitted diseases alone at $17 billion (CDC, 2012).

Our review indicates that these behaviors, with their associated costs, do not arise from impulsigenic traits alone; nor are they based simply in poor impulse control, from a cognitive perspective. However, it can be argued that these traits and cognitive (dis)abilities are risk factors for these behaviors, and investigating more deeply the links between these behaviors and both personality and cognitive factors is an important first step on a long road to developing more effective treatment and prevention programs. The research presented above offers compelling evidence for those measurement strategies best suited for use in combination to determine individuals' level of these traits and (dis)abilities and offers a framework for considering their interactions. Future research must now build on this foundation.

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* References marked with an asterisk indicate studies included in the meta-analysis.

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Correction to Sharma, Markon, and Clark (2013)

In the article "Toward a Theory of Distinct Types of "Impulsive" Behaviors: A Meta-Analysis of Self-Report and Behavioral Measures" by Leigh Sharma, Kristian E. Markon, and Lee Anna Clark (*Psychological Bulletin,* Advance online publication. October 7, 2013. doi: 10.1037/a0034418), the citation for Dougherty et al. (2009) in Table 4 was incorrectly listed as Dougherty et al. (2007). In addition, the second mention of Dougherty within the text of the article was incorrectly listed as Dougherty et al. (2007).

All versions of this article have been corrected.

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