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Impulsive dispositions and alcohol: what we know, how we know it, and where to go from here

Angela K. Stevens*†, Brittany E. Blanchard† and Andrew K. Littlefield

Abstract

Background: Relations between impulsigenic traits and alcohol-related outcomes have been the focus of much research, yet precise relations remain elusive. Historically, research used broadband conceptualizations of impulsivity, which yielded inconclusive findings. Attempts to ameliorate this problem led to more work on narrowband assessments of impulsivity. Despite that several narrowband self-report measures exist, few demonstrate adequate psychometric properties. Given the limits of self-report, researchers have also utilized laboratory-based measures of impulsive dispositions; however, this seems to have contributed more uncertainty to the literature.

Review: We review commonly used self-report and laboratory-based measures of narrowband impulsivity, as well as assessments of alcohol-related constructs (e.g., consumption and consequences). We discuss remaining issues in impulsivity and alcohol assessment, which limit understanding of how impulsigenic traits influence alcohol-related behaviors. Cutting-edge conceptualizations and assessment of state-level impulsivity are also discussed.

Conclusions: More work is necessary to further this area of research, including establishing consistent nomenclature and a cohesive conceptualization of impulsigenic traits as they relate to alcohol use and alcohol use disorders.

Keywords: Impulsivity, Alcohol, Alcohol use disorder, Assessment, Self-report, Laboratory-based tasks

Background

Impulsigenic traits are transdiagnostic, as "impulsivity" is a symptom criterion for several psychological disorders in the *Diagnostic and Statistical Manual of Mental Disorders*, Fifth Edition (*DSM*-5), including borderline personality disorder and attention-deficit/hyperactivity disorder [1]. In addition to being included in specific criteria sets for some disorders, impulsivity-like traits are thought to be etiologically relevant to several disorders, including substance use disorders. Indeed, some of the most robust personality predictors of alcohol use and related problems are impulsigenic traits [2–4] (see Littlefield & Sher [5] for more details). A multitude of definitions and assessments of "impulsivity" have been used in the literature to link these traits to several alcohol-related constructs (e.g., various indices of alcohol use, problems, and disordered drinking). The purpose of this article is to review and synthesize conceptualizations and assessments of impulsivity and alcohol-related constructs. Strengths and limitations of relevant literatures are summarized. Further, relations between impulsigenic traits and problematic alcohol use among adults are reviewed in the context of the conceptual, methodological, and analytical limitations of the extant literature. Finally, suggestions for future research are provided.

Conceptualization and assessment of impulsivity

Impulsigenic traits have garnered significant attention in the literature given their relevance to psychopathology (see Berg, Latzman, Bliwise, & Lilienfeld [6] and Sharma, Markon, Clark [7]). Although impulsivity may be an etiologically important construct contributing to pathological alcohol use (and other psychological conditions), research progress remains somewhat hampered by

* Correspondence: angela.stevens@ttu.edu
†Equal contributors
Department of Psychological Sciences Texas Tech University, MS 2051 Psychological Sciences Building, Rm. 404, Lubbock, Texas 79409-2051, USA

inconsistencies in conceptualizations of impulsivity. Broadband impulsivity has historically been ill-defined, which has contributed to a muddled literature (see Evenden [8] and Cyders [9]). In fact, Block [10] describes a critical flaw of impulsivity assessment (i.e., using broadband, heterogeneous measures) using the "jingle" (i.e., two constructs with similar labels are distinctly different) and "jangle" (i.e., two constructs with different labels are equivalent constructs) fallacies. Initially, "impulsivity" was measured as part of comprehensive personality assessments (e.g., constraint subscale of Tellegen's three-factor model, psychoticism subscale of Eysenck and Eysenck's three-factor model, impulsive-sensation seeking subscale of Zuckerman's alternative five-factor model [11–13]). Later, behavioral tasks (e.g., continuous performance tasks) purported to assess "impulsivity" became more common. As a result, the existing literature is riddled with various references to "impulsivity" though multiple assessments and definitions have been used to define a number of theoretically discrete constructs (see Evenden [8]). Further, given recent calls to assess homogenous constructs [14], some consider the term "impulsivity" to be inaccurate ([4]; see Cyders [9]), and recent research has emphasized a "splitting" (rather than "lumping") approach to assessment (e.g., Blanchard et al. [15]). In addition to an enhanced focus on types of impulsivity, there has also been an increased interest in designing measures to distinguish trait- and state-level impulsivity (e.g., Tomko et al., [16]), which adds an exciting intricacy to this enigmatic literature.

Self-report assessment of impulsive dispositions

Although there are a multitude of self-report assessments that purport to assess various types of impulsivity (e.g., see Sharma, Kohl, Morgan, & Clark [17]; the discussion of Reise, Moore, Sabb, Brown, & London [18]), we focus on two of the most widely used scales: the Barrett Impulsiveness Scale (BIS-11) [19] and the UPPS-P Impulsive Behavior Scale [20]. The BIS-11 is comprised of three domains (i.e., motor, nonplanning, and attentional impulsivity) with six facets each. Despite that a strength of this assessment is measurement of impulsivity-like traits, researchers often report a total score when using the BIS-11, which assumes impulsivity to be a unidimensional construct (see Stanford et al. [21]). Although frequently used, rigorous psychometric assessment of the BIS-11 is limited; however, recent research suggests suboptimal fit for the unidimensional, bifactor, six correlated-factors, and second-order factors models (see Reise, et al. [18]). Further, in a large adult sample, internal consistency was poor-to-acceptable (α = .59-.74) for the three domains and unacceptable-to-acceptable for the six facets (α = .27-.72) [21]. Test re-test reliabilities at one-month were also substandard across domains (r = .61-.72) and facets (r = .23-.74).

Derived from the five-factor model of personality [22, 23], another commonly-used measure of impulsivity-like facets is the UPPS-P [20]. The UPPS-P measures the following five narrowband impulsivity-like traits: 1) sensation seeking, or the tendency to engage in new and thrilling experiences, 2) lack of planning, or the tendency to act without thinking, 3) lack of perseverance, or the inability to focus attention on a difficult or boring task, 4) positive urgency, or the tendency to act rashly under extreme positive mood, and 5) negative urgency, or the tendency to act rashly under extreme negative mood. The UPPS-P consistently demonstrates strong psychometric properties, including acceptable-to-excellent internal consistency (e.g., .83 to .94 across subscales among college students) [22] and high test-retest reliabilities in a nonclinical emerging adult sample (e.g., .81 to .93 across subscales) [24]. Further, tests of measurement invariance indicate the UPPS-P is invariant across Hispanic and non-Hispanic students [25]. Although additional work is warranted, evidence also indicates the UPPS-P may be invariant across gender [26]. As a result, the UPPS-P has received endorsement from the National Institutes of Health's (NIH) PhenX Toolkit [27] as the recommended self-report measure of impulsigenic traits.

Unlike the BIS-11, researchers tend to report facet-level scores of the UPPS-P (rather than an overall score), which utilizes the multidimensionality of this scale and is likely a more accurate reflection of impulsigenic trait structure, more broadly. Illustrating this issue, using principal components analysis, BIS subscales loaded onto multiple narrowband UPPS facets, indicating BIS subscales may represent heterogenous constructs and/or items (see Whiteside & Lynam [23]).

Although there are distinct differences among traditional conceptualizations of impulsivity (as noted above), these models of assessment are similar in that impulsivity is conceptualized as a comparatively stable trait. Indeed, this trait conceptualization provides information regarding individuals' predispositions for impulsigenic behavior, though clinically relevant information is missing. More specifically, trait impulsivity assessments do not identify *when* an impulsive behavior will occur – or state impulsivity (see Tomko et al. [16]).

Most recently, Tomko et al. [16] developed a self-report measure of momentary impulsivity (i.e., Momentary Impulsivity Scale [MIS]), which is the first self-report measure of state-like impulsivity. Prior to the development of the MIS, state impulsivity has been ostensibly examined via laboratory-based behavioral tasks, as these tasks provide "behavioral snap shots" of how individuals

would respond in a particular situation (see Cyders & Coskunpinar [28], p. 967). In this growing area of research, the introduction of the MIS offers the field a more viable option for rigorous psychometric research, compared to laboratory-based tasks, to improve our ability to accurately assess state-level impulsivity. The between- and within-person one-factor structure of the MIS exhibited good fit to the data, and the scale demonstrated high between-person reliability (or rank ordering of individuals remained stable across time) and moderate within-person reliability, which provided evidence for its state-like properties [16]. Further, Tomko et al. [16] also provided preliminary evidence for content validity of the MIS, as it significantly correlated with three of the four UPPS facets (i.e., urgency, lack of planning, and lack of perseverance) and the three BIS subscales and total score in the overall sample. In addition to using the MIS, other approaches to examine within-person impulsivity over time include the use of psychometrically-validated trait measures of impulsivity (e.g., the UPPS; [23] with EMA [29]).

Assessment of impulsive dispositions via laboratory-based behavioral tasks

Although self-reported assessments of impulsivity have multiple strengths (e.g., relative ease of administration; detailed psychometric evaluations of some scales), there are also notable limitations to self-report measures (e.g., social desirability bias, face validity; see Northrup [30] for self-report limitations and additional discussion in *Strengths and Limitations of Impulsive Disposition Assessment* below). In part to address these limitations, laboratory-based tasks remain popular behavioral indices of impulsivity. Similar to the self-report assessment literature, research examining laboratory-based behavioral tasks of impulsigenic traits is complicated by the existence of numerous tasks purported to assess distinct facets of impulsivity (e.g., response inhibition vs. delay discounting; see Cyders & Coskunpinar [28] and see Dick et al. [31]). Laboratory-based tasks often assess multiple forms of "impulsivity," including behavioral undercontrol and attentional processes (see Hamilton et al. [32, 33]). For example, response inhibition tasks, such as the Go-Stop paradigm (see Dougherty, Mathias, Marsh, & Jagar [34]), require inhibition of motor responses when signaled by the changing of a stimulus. Similarly, the Immediate and Delayed Memory tasks (IMT/DMT) assess rapid response impulsivity [35]. Another behavioral task is the continuous performance task [36], which assesses response inhibition, as well as initiation and attention. Further, another attentional indicator of "impulsivity" is distortions in time perception (e.g., Time Paradigm) [34]. Another distinct, though important construct, often assessed behaviorally (c.f., Monetary Choice Questionnaire [MCQ]) [37], is delay discounting, or the preference for smaller, more immediate rewards (e.g., Two Choice Impulsivity Paradigm [TCIP], Single Key Impulsivity Paradigm [SKIP]) [34]. Efforts to examine psychometric properties of laboratory-based behavioral tasks (e.g., test-retest reliability) suggest variability in reliability across task types. For example, in a sample of healthy adults assessed on average approximately nine days apart, test-retest reliability varied across tasks: inattention (including CPT omission errors; r = .38-.42), impulsive action (as measured by the stop signal task, Go/NoGo task, and CPT commission errors; r = .65-.73), and impulsive choice (including delay discounting; r = .76-.89) [24]. See Fillmore and Weafer [38] for an overview of laboratory-based behavioral tasks, including strengths and limitations of several behavioral tasks.

Relations between self-report and laboratory-based tasks

Efforts to bridge the gap between the self-report and laboratory task literature have utilized advanced statistical approaches (e.g., meta-analytic, structural equation modeling) to conceptualize the latent structure of impulsivity, and often include the UPPS framework. For example, Sharma et al. [7] used a meta-analytic approach to capture the structure of impulsivity. These findings indicated "impulsivity" consists of four distinct impulsigenic traits (i.e., the four traits assessed by the UPPS) and four behavioral/cognitive impulsivity-related constructs (i.e., inattention, inhibition, impulsive decision-making, and shifting). Similarly, MacKillop et al. [39] used a combination of self-report (i.e., BIS-11, UPPS-P, MCQ) and laboratory-based tasks (i.e., Go/NoGo Task, Conner's CPT) to assess a proposed latent structure of impulsivity comprised of three distinct domains: impulsive choice (i.e., inability to delay monetary gratification), impulsive action (i.e., response inhibition failure), and impulsive personality traits (e.g., attention, nonplanning, lack of perseverance). Although sensation seeking was tested, it did not load onto the impulsive personality domain (i.e., $\lambda < .2$). With sensation seeking removed, they achieved adequate fit for the three-factor model; however, this solution largely reflected method effects (e.g., all of the self-reported assessments, including the various facets of the UPPS, loaded onto the same "impulsive personality" trait). Consistent with these findings, in a meta-analysis by Cyders and Coskupinar [28], the mean sample-size weighted effect size between behavioral tasks and UPPS-P self-report was small (r = .10). More specifically, lack of perseverance, lack of planning, and negative urgency were associated with failure to inhibit prepotent response (r = .10, r = .11, and r = .11, respectively). Lack of planning was also linked to delay discounting (r = .13) and distortions in response time (r = .10), whereas sensation seeking was only related to delay discounting (r = .06). In a separate study, negative urgency was correlated with shorter delay latency on

the TCIP (r = -.29), and sensation seeking was linked to distortions in elapsed time (r = -.23) [40]; notably, in another study [41], the magnitude of the correlation between negative urgency and TCIP was higher than the correlation (r = .14) between self-report delay discounting (as assessed by the MCQ [37] and laboratory-based delay discounting (as assessed by the TCIP) [34]. Evidence also suggests that BIS-11 domains and facets were uncorrelated with IMT, DMT, GoStop, TCIP, and SKIP (see Stanford et al. [21]). These findings suggest that prepotent response inhibition failure corresponds most consistently with self-reported impulsigenic traits; however, it is evident that self-report and laboratory-assessed impulsivity appear to assess distinct constructs with little shared variance (see Cyders & Coskunpinar [28]).

Strengths and limitations of impulsive disposition assessment

Self-report assessments

Broadly, strengths of self-report assessment include their cost-effectiveness, efficiency, ease of dissemination, and face validity. That said, there are notable limitations to self-report, including face validity (e.g., participants may not be motivated to respond in a honest manner; see Cyders & Coskunpinar [28] for more details). More specific to "impulsivity," Reise et al. [18] noted multiple issues with the BIS-11, including the following: "(a) low or near-zero correlations of some items with others; (b) highly redundant content of numerous item pairs; (c) items with salient cross-loadings in multidimensional solutions; and ultimately; (d) poor fit to confirmatory models"; moreover, they conclude, "use of the BIS-11 total score as reflecting individual differences on a common dimension of impulsivity presents challenges in interpretation" (p. 631).

Even among the "gold standard" of self-report assessment, some are reconsidering the utility of splitting urgency (i.e., combining positive and negative urgency to reflect an overall affective urgency; [42–44] to combat potential redundancy or suppressor effects in multivariate models. As a recent recommendation notes,

> It is important to appreciate that the two urgency traits correlate highly with each other, with correlation values ranging from .46 (Cyders and Smith, 2007) to .69 (Settles et al., 2014). For that reason, when the two traits do not predict differently (which may be the case in the prediction of problem drinking or drug use), it may be wise to combine them and use the overall urgency trait. (Smith & Cyders, [45], p. S7).

Further, though there is some initial evidence of measurement invariance of the UPPS-P across gender [26], additional work could examine the impact of assumptions regarding indicator scaling (i.e., specifying items as continuous versus categorical). Beyond psychometric issues, others have criticized the UPPS impulsivity framework on theoretical grounds (see Gullo, Loxton, & Dawe [46]). Clearly, a consensus on the conceptualization of impulsigenic traits has not been reached, even among developers of the scale (e.g., [42–44, 47]).

Another approach to impulsivity assessment is the "lumping" of various subscales to create idiosyncratic, heterogeneous assessments of "impulsivity." This approach can lead to both psychometric and interpretational concerns. Demonstrating this issue, previous work examining "behavioral undercontrol" utilized subscales from multiple assessments, which may or may not reflect aspects of impulsive behavior (i.e., the Novelty Seeking scale of the Tridimensional Personality Questionnaire [TPQ] [48], the Psychoticism subscale of the Eysenck Personality Questionnaire-Revised [EPQ-R] [12], and the reverse-scored Lie subscale of the EPQ-R) [49]. Approaches which lump multiple measures may yield different substantive findings, limit comparability across studies, and impede and meta-analytic endeavors.

Laboratory-based behavioral tasks

Laboratory-based tasks are thought to address some of the limitations of self-reported assessments. Indeed, these methods are purported to measure individuals' behaviors, as opposed to how individuals think they would respond in a given situation (see Cyders & Coskunpinar [28]). However, one primary concern of behavioral tasks is the limited ecological validity and the use of different tasks (as well as inherently different conceptualizations) to measure similar constructs, which precludes researchers from making accurate comparisons across studies (see King Patock-Peckham, Dager, Thimm, & Gates [50] and see Sharma et al. [7]).

For example, given laboratory tasks are capturing a specific behavior within a discrete period, it is argued these tasks are more reflective of state-level (as opposed to trait-level) impulsivity [28, 40]. Despite this, evidence suggests moderate-to-high test-retest reliability for a number of these tasks, suggesting more trait-like, rather than state-like, qualities (see Weafer et al. [24]). Laboratory-based assessments also have different parameters that can be altered by researchers, and these are often not made explicit in research using such assessments. For instance, researchers can change the percentage of stop trials on the Stop-Signal Reaction Time Task (SSRT), which can impact correlations with self-report measure of impulsigenic traits ([51–53]; see Sharma et al., [7]). Moreover, the tasks purported to measure the same dimensions of "impulsivity" (e.g., inhibition) demonstrate weak-to-nonexistent correlations (see Rey-

Mermet et al. [54]). For other limitations of using laboratory-based tasks to measure individual differences, see Hedge, Powell, and Sumner [55].

Moreover, although impulsivity assessment using multi-trait, multi-method (MTMM) approaches have been executed (e.g., Smith et al. [4]; MacKillop et al. [39]), more work is needed. Specifically, in Smith et al. [4], self-report assessments of the UPPS-P were compared to orally-administered assessments of the same scale. One major reason to utilize a MTMM approach is to reduce method variance (e.g., self-report assessments may show overlap due to response bias related to social desirability); however, the use of orally-administered UPPS-P items do not quell the limitations of self-administered self-report items (e.g., response bias). Indeed, this approach may increase bias due to social desirability pressures [56]. Thus, this type of work may not reflect a true MTMM approach in the traditional sense [57]. More traditional MTMM approaches have been used (i.e., include self-report and laboratory tasks) [39]. However, as noted previously, these findings should be interpreted with caution, as it appears some solutions reflect method variance (i.e., in MacKillop et al. [39] all self-reported impulsivity measures loaded onto the same factor despite the notion that these measures purportedly assess multiple, distinct constructs) rather than the identification of latent constructs. Without understanding and appropriately modeling the true latent structure of impulsive dispositions, we can continue to expect inconsistent, and, at times, puzzling findings.

Conceptualization and assessment of alcohol-related outcomes

As with impulsivity, establishing consistent operational definitions and terminology for alcohol-related outcomes is crucial if one seeks to understand the "impulsivity-alcohol" relation. Much debate remains regarding the classification of consumption, alcohol-related problems, and AUDs. For example, under the previous classification system, alcohol abuse and alcohol dependence were differentiated, though this distinction has been replaced by alcohol use disorder in the *DSM-5* [1]. Although this change includes many improvements (e.g., removing of legal issues, addition of craving) [58] and may improve diagnostic validity and reliability by reducing diagnostic imposters (see Lane & Sher [59]), the new criteria are not without limitations. Specific issues remaining include treatment of symptoms as equivalent despite varying degrees of severity (e.g., tolerance versus withdrawal; [60]), disregard for symptom patterns [59], and use of consequences in establishing diagnoses (see Martin, Chung, Kirisci, & Langenbucher [60]). Additionally, emerging work based on Item Response Theory (IRT) indicates substantial variability in the difficulties (closely related to base rates) of AUD symptoms as a function of the instrument used for assessment (see Lane, Steinley, & Sher [61]), which creates challenges for work focused on linking impulsivity-like traits with specific symptoms of AUD.

Assessment of alcohol use and alcohol-related consequences

It is important to note that though the assessment of consumption is not currently included as criteria for an AUD (though this has been considered, e.g., Hasin et al. [58]), alcohol consumption is necessary to meet criteria for AUD. To assess consumption, researchers and clinicians have several self-report measures from which they can choose, though other indices are now available (e.g., biomarkers; see *Summary and Future Directions*). For example, many use quantity-frequency (Q-F) items, which typically assess various indices of consumption (e.g., daily quantity, quantity of greatest consumption, average frequency, frequency of binging) over a specified amount of time. These measures can then be used to create Q-F scores [62, 63] or items can be used individually as separate outcome measures. More standardized forms include the Timeline Followback Procedure (TLFB), which has evidence for acceptable psychometric properties [62, 64] and the Daily Drinking Questionnaire-Revised (DDQ-R) adapted from the original DDQ [65]. For example, the DDQ-R asks individuals to estimate the number of standard drinks consumed in a typical week from the past month. There are also various indices of "risky drinking." For example, to quantify so-called binge drinking, the National Institute of Alcohol Abuse and Alcoholism's (NIAAA) conceptualization, defined as 4+ drinks in a two-hour period (5+ for males), is increasingly becoming the accepted definition. Despite this improvement, several terms are used seemingly interchangeably in the literature, (e.g., problematic drinking, excessive drinking, heavy episodic drinking), which exacerbates conceptualization and assessment issues.

Dozens of assessments of alcohol-related consequences exist, and commonly used measures include screeners like the Alcohol Use Disorder Identification Test (AUDIT) [66]. The AUDIT (which also includes assessments of alcohol use) exhibits good-to-excellent internal consistency reliability, with Cronbach's alphas ranging from .77 to .94 across a variety of samples (e.g., primary care patients, college students; Allen, Litten, Fertig, & Babor [67]; see de Meneses-Gaya et al. [68] for a review of psychometric properties). More comprehensive measures of consequences, such as the Young Adult Alcohol Consequences Questionnaire (YAACQ) [69], the Young Adult Alcohol Problems Screening Test (YAAPST) [70], and the Rutgers Alcohol Problem Index (RAPI; see Neal, Corbin, & Fromme, 2006 for an

improved version [71, 72]), also have evidence for acceptable psychometric properties. These measures typically assess a range of problems, including physical, intrapersonal, social, and occupational consequences. Although many of these measures include *DSM*-5 AUD criteria [1], limitations remain, including limitations inherent to self-report, as well as more alcohol-specific issues [59]. Additional issues remain in analytic approaches. For example, many researchers use a summed-score approach to consequences, which does not consider that some consequences (e.g., withdrawal) are more severe than others (e.g., hangover). Moreover, many researchers often adjust for alcohol consumption when assessing consequences as an outcome, which may create interpretational issues and result in unnecessarily adjusting relevant variance in the dependent variable [73, 74]. In sum, a consensus regarding how to define, assess, and analyze alcohol-related outcomes has yet to be reached.

Relations between impulsive dispositions and alcohol-related outcomes

Despite the limitations regarding conceptualization and assessments of the constructs of interest, a myriad of research has examined the relations between "impulsivity" and alcohol outcomes. In most research, the methods previously reviewed (i.e., self-report and lab-based tasks of impulsivity, self-reported alcohol outcomes) are typically used to assess impulsivity-alcohol relations. However, another area of importance are alcohol-challenge studies in which individuals consume alcohol and then perform laboratory-based behavioral tasks of impulsivity. Although outside of the scope of this review, see Littlefield, Stevens, and Sher [75] for a review of developmental processes of "impulsivity" and alcohol (e.g., "maturing out") [76], as well as other etiological models of alcohol involvement.

Self-reported impulsive dispositions and alcohol

Regarding self-report assessment of impulsigenic traits, the BIS-11 total score is associated with alcohol consumption and use status [77, 78], as well as related problems [79–81], including early-onset AUD symptomatology [82, 83]. For example, in one study examining past-month drinking among college students, the BIS-11 total was positively associated with drinks per drinking occasion (r = .21) and length of drinking occasion (r = .14); at the subscale level, motor (r = .22) and cognitive subscales (r = .18) were associated with drinks per occasion, and cognitive was related to length of occasion (r = .16). Nonplanning was not associated with any index of alcohol consumption [84]. When examining UPPS-P facet-level relations and alcohol constructs, more work has been done relative to the BIS. For example, meta-analytic approaches examining mean effect sizes (ES) indicate sensation seeking is robustly associated with increased drinking frequency (*ES* = .22) and binge drinking (*ES* = .36), whereas lack of planning tends to be associated with increased drinking frequency (*ES* = .21), and alcohol-related problems (*ES* = .26) [85]. Lack of perseverance is linked to increased drinking quantity (*ES* = .32) and frequency (.28), and may be associated with drinking onset, whereas negative urgency is often associated with drinking frequency (*ES* = .22), alcohol-related problems (*ES* = .34), and AUD symptomatology (*ES* = .38) [85]. Although less work has been done with positive urgency, existing findings indicated relations with alcohol-related problems (r = .34; see Coskunpinar, Dir, & Cyders [85] for a meta-analysis and see Littlefield et al. [75] for a review). Further, self-reports of state-level impulsivity and it relations to alcohol-related outcomes remains in its nascent stages; however, using ecological momentary assessment (EMA), impulsivity (as assessed by the MIS) was positively associated with alcohol use at the momentary level (i.e., on a particular occasion) and at the daily level [86].

Laboratory-based tasks and alcohol-related constructs

Typically, effect sizes for relations between laboratory tasks of impulsigenic traits and alcohol outcomes are small. In a recent meta-analysis, weighted relations of laboratory tasks and self-reported alcohol use, broadly, were small-to-medium (Go/No Go Task r = .18; [SSRT] r = .17; hypothetical delay discounting r = .09), except for the Iowa Gambling Task (reflecting inhibitory dyscontrol; r = .41) and the Stroop Color-Word Test (reflecting inattention; r = .41) [7]. Likewise, women who reported early-onset drinking (<18 years) compared to late-onset (>21 years) made more commissions errors on the IMT and DMT [40]. Age at first drink was also significantly negatively correlated with more impulsive responding on the DMT among women [87]. However, Rubio et al. [81] used the Continuous Performance Test (CPT) to assess commission errors, which is analogous to the IMT (see Dougherty, Bjork, Marsh, & Moeller [88]), and found no significant difference in commission errors between non-dependent, heavy drinkers (as defined by the researchers) and control participants. Using a laboratory-based hypothetical choice task, Kollins [89] examined delay discounting in a sample of college students. Earlier onset of alcohol use was associated with a preference for smaller, immediate hypothetical rewards [89]. Delay discounting was also strongly linked to "passing out" from alcohol consumption (r = .73) [89]. Combining self-report and laboratory-based tasks (i.e., an MTMM approach), MacKillop et al. [39] used a multivariate structural equation model and demonstrated differential relations across impulsivity-like trait and AUDIT scores. Specifically, impulsive choice, impulsive personality traits, and sensation seeking latent variables

were significantly positively predictive of AUDIT scores, whereas the construct of impulsive action was unrelated (correlations not provided).

Alcohol challenge studies and impulsive dispositions

Alcohol challenge studies are another approach to examine the impulsivity-alcohol relation. In these studies, experimentally controlled alcohol use is typically treated as the independent variable to determine its influence on behavioral task performance. These studies eliminate some limitations inherent to self-report methods and may yield more causal inferences.

For example, in some alcohol administration studies, individuals who consumed alcohol tended to discount smaller, more immediate hypothetical rewards at lower rates than sober individuals [90]. This is contrary to later findings by Dougherty, Marsh-Richard, Hatzis, Nouvion, and Mathias [91] who investigated the dose-dependent effects of alcohol on three laboratory-based impulsivity tasks (IMT, GoStop, and SKIP). Their results suggested a dose-dependent relation for commission errors on the IMT across time, whereas performance on the GoStop (a measure of response inhibition), but not the SKIP (a measure of delay discounting). Indeed, individuals responded more impulsively on the GoStop task across all time points (i.e., 0.25-hour, 1-hour, and 2-hour), regardless of dose. Alcohol consumption resulted in more delay discounting at the one- and two-hour time points, regardless of dose, on the SKIP. In sum, it appears the studies of impulsivity-alcohol relations yield equivocal findings, which may vary as a function of the task used (see Weafer & Fillmore [92] for a review).

Summary and future directions

Although notable methodological advances have been made in the area of impulsivity and alcohol research (e.g., sophisticated frameworks of impulsigenic personality traits, advanced statistical approaches, psychometrically-supported state-level measures, alcohol-challenge studies, MTMM designs), much work is needed to elucidate relations between impulsive dispositions and alcohol-related outcomes. Research aiming to establish a conceptual model of impulsivity that integrates self-report and laboratory-based constructs is worthy of attention, as this would advance the field by increasing interpretability of findings and facilitating comparability across studies. The studies reviewed represent a necessary and important first step in this process. We now provide some notable limitations, as well as potential solutions and associated future directions we hope will advance the understanding of the impulsive disposition-alcohol relation.

One concern is the possibility that self-report and laboratory-based tasks are conceptually distinct constructs. More specifically, it is arguable that laboratory tasks are a measure of "ability" as opposed to a "response style," and modest correlations are typical for ability vs. response style measures (see Sharma et al. [7]). If this is the case, one logical conclusion is that "the two methodologies assess different phenomena entirely – a large-scale version of the jingle phenomena – such that it is a fruitless effort to pursue any integration of these literatures" (Sharma et al. [7], p. 388). Thus, a unifying conceptualization of impulsigenic traits is needed.

We agree with Cyders [9], who asserts that if researchers continue to use the term "impulsivity" to refer to several related, but distinct constructs "we will continue to muddy the water, mask existing effects, misunderstand existing research, and fail to move forward past the question of *Is impulsivity related to psychopathology and how?*" (p. 2). Plainly stated, we caution the reader from using the term "impulsivity."

Further, distinguishing between state- and trait-level impulsivity is an important consideration when examining alcohol use and related problems, as it is arguable that *when* an impulsive behavior occurs (i.e., state-level) is equally (or perhaps more) clinically relevant than *if* a person has the proclivity for impulsive behavior (i.e., trait-level). Assessment of state-level impulsivity is a burgeoning area of research, and future directions including examination of the MIS factor structure (outside of its original sample), convergent and discriminant validity using laboratory-based tasks (i.e., an MTMM approach), as well as investigating its criterion validity (e.g., alcohol consumption, risky behavior).

One obstacle we continue to face as we attempt to bridge the gap between self-report and laboratory-based findings is the confounding impact of method variance. Indeed, previous attempts to examine self-report and laboratory-based impulsivity measures simultaneously resulted in method components, aptly named by Meda et al. [93]. Current research attempting to construct a comprehensive conceptual model of impulsivity [39] may be confounded by method effects. Therefore, future directions include creating and/or refining laboratory-based and self-report assessments of distinct impulsigenic constructs (e.g., sensation seeking, urgency, impulsive decision-making) to be able to utilize a true MTMM approach [57]. It may also be beneficial to utilize more nuanced classifications of impulsive dispositions measured by laboratory tasks (e.g., separating impulsive decision making, motor impulsivity, and cognitive impulsivity; [94]). Additionally, measuring domain-specific impulsivity may have clinical and practical utility (e.g., the Domain-Specific Risk-Taking Scale [DOSPERT], which include areas like safety/health,

recreational, and social decisions; [95]). This domain-specific approach may also be helpful in designing laboratory-based tasks to correspond to self-report measures of specific impulsive dispositions.

Further, we believe some considerations may be useful for future research utilizing existing measures. For example, when using the UPPS-P, items should be modeled as ordinal, as a 4-point Likert-type response scale for individual items does not reflect a continuous variable. Additionally, although work examining latent structures of impulsive traits use advanced methods and multi-method approaches, exploratory factor analyses (EFAs) are conducted using suboptimal methods (e.g., principal components analysis; Sharma et al., [17]), or are not conducted prior to confirmatory factor analyses [39]). For example, although the motor subscale of the BIS-11 was modeled as an impulsive personality trait, this may be a self-report measure of impulsive action [39], which may have been evidenced by appropriate exploratory models. Moreover, replication studies are needed to confirm purported conceptual models of impulsivity.

In line with current trends in impulsivity assessment, incorporating EMA designs when assessing alcohol use and associated variables (e.g., consequences, motives, and protective behavioral strategies) will also serve to further research on the impulsive trait-alcohol link (see Trull & Ebner-Priemer [96]). To utilize benefits of an MTMM approach, alcohol research endeavors can also use transdermal alcohol monitoring (e.g., Secure Continuous Remote Alcohol Monitor [SCRAM]) [97], which would also be a great improvement over tradition self-report methods. Clinically, just-in-time adaptive interventions [98] may benefit from inclusion of state-level impulsivity in algorithms for delivering interventions. Going forward, it will also be necessary for clinicians and researchers to use consistent and psychometrically-supported definitions and assessments of alcohol consumption and AUDs, as well as impulsive dispositions. To evaluate these measures and better understand relations between impulsigenic traits and alcohol-related outcomes, cognitive interviewing and observational data may be useful (see Durbin & Hicks [99]).

Conclusions

Although multiple associations have been identified between various types of impulsive dispositions and alcohol-related outcomes, advancements in conceptualization, assessment, and methodology are necessary before a clearer understanding of these relations can be obtained. Research efforts have made great strides toward examining these complex relations, though much more is needed to discern the role of impulsigenic traits on alcohol use and related outcomes to better inform prevention and treatment of alcohol use problems and disorders. Nevertheless, with advances in statistical analytic procedures, this is a particularly exciting area of study, as researchers may now be able to better understand within-person relations of impulsivity and problematic alcohol use (see Lievens [100] for a recent review discussing personality-situation interplay and assessment approaches to broaden the range of methodological techniques in personality research). As discussed, we suggest that a unifying conceptualization, consistent nomenclature, state- and trait-level assessment, and EMA designs may be particularly useful in elucidating precise relations between impulsive dispositions and alcohol.

Abbreviations

AUD: Alcohol use disorder; AUDIT: Alcohol use disorder identification test; BIS-11: Barrett impulsiveness scale – 11th revision; CPT: Continuous performance test; DMT: Delayed memory test; DOSPERT: Domain-specific risk-taking scale; DSM-5: Diagnostic and statistical manual of mental disorders, 5th edition; EFA: Exploratory factor analyses; EMA: Ecological momentary assessment; EPQ-R: Eysenck personality questionnaire-revised; IMT: Immediate memory test; MCQ: Monetary choice questionnaire; MIS: Momentary impulsivity scale; MPQ: Multidimensional personality questionnaire; MTMM: Multi-trait-multimethod; SCRAM: Secure continuous remote alcohol monitor; SKIP: Single key impulsivity paradigm; SSRT: Stop-signal reaction time task; TCIP: Two choice impulsivity paradigm; TPQ: Tridimensional personality questionnaire

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AKS, AKL, and BEB performed the literature review and outlined the manuscript. AKS and BEB wrote the initial version of the manuscript, which was edited by AKL, who also made substantial writing contributions. All authors read and approved the final manuscript.

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