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An Abbreviated Impulsiveness Scale Constructed Through Confirmatory Factor Analysis of the Barratt Impulsiveness Scale Version 11

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ABSTRACT

Impulsiveness is a personality trait that reflects an urge to act spontaneously without thinking or planning ahead for the consequences of your actions. High impulsiveness is characteristic of various problematic behaviors including attention deficit disorder, hyperactivity, excessive gambling, risk-taking, drug use, and alcoholism. Researchers studying attention and self-control often assess impulsiveness using personality questionnaires, notably the common Barratt Impulsiveness Scale version 11 (BIS-11; last revised in 1995). Advances in techniques for producing personality questionnaires over the last 20 years prompted us to revise and improve the BIS-11. We sought to make the revised scale shorter—so that it would be quicker to administer—and better matched to current behaviors. We analyzed responses from 1,549 adults who took the BIS-11 questionnaire. Using a statistical technique called factor analysis, we eliminated 17 questions that did a poor job of measuring the 3 major types of impulsiveness identified by the scale: inattention, spontaneous action, and lack of planning. We constructed our ABbreviated Impulsiveness Scale (ABIS) using the remaining 13 questions. We showed that the ABIS performed well when administered to additional groups of 657 and 285 adults. Finally, we showed expected relationships between the ABIS and other personality measurements related to impulsiveness, and we showed that the ABIS can help predict alcohol consumption. We present the ABIS as a useful and efficient tool for researchers interested in measuring impulsive personality.

SCIENTIFIC ABSTRACT

Impulsiveness is a personality construct characterized by the urge to act spontaneously and without reflecting on consequences. It is commonly measured using the Barratt Impulsiveness Scale version 11 (BIS-11), which has remained a prevalent scale despite inconsistent replication of its original factor structure. Here, we applied exploratory factor analysis (EFA) to data from a large adult sample (N = 1,549) and confirmatory factor analysis (CFA) to data from two replication samples (N = 657; N = 285) to reexamine the factor structure of impulsiveness as measured by the BIS-11. We sought to improve scale efficiency, score reliability, and inferential validity by eliminating questionable items and factors. Factors reflecting need for cognition (three items) and domain-specific financial impulsiveness (three items) were removed to increase scale specificity. Three poorly measured factors reflecting restlessness (two items), perseverance (two items), and cognitive instability (two items) were removed, and five items poorly explained by the remaining factors (R^2 from .02 to .26) were also removed. From this final model, we derived the ABbreviated Impulsiveness Scale (ABIS). The ABIS measures attentional (five items, α = .72), motor (four items, α = .75), and nonplanning (four items, α = .75) impulsiveness. Model fit for the ABIS was superior to fit for the canonical BIS-11 in every sample tested. In addition, the ABIS predicted alcohol consumption in a separate study of impulsive behavior (r = .44, $p < .05$). By removing unreliable items and poorly measured factors, we produced an efficient, internally consistent, and generalizable scale measuring attentional, motor, and nonplanning impulsiveness. The ABIS can be used as a brief alternative to the BIS-11 or as a model for reanalyzing previously collected BIS-11 questionnaire responses.

Keywords: impulsiveness, impulsivity, Barratt Impulsiveness Scale, BIS-11, factor analysis
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Impulsiveness is a personality trait characterized by the urge to act spontaneously without reflecting on an action and its consequences. Trait impulsiveness influences several important psychological processes and behaviors, including self-regulation (Baumeister, 2002; Neal & Carey, 2005), risk-taking (Kahn, Kaplowitz, Goodman, & Emans, 2002; Stanford, Greve, Boudreaux, Mathias, & Brumbelow, 1996), and decision-making (Ainslie, 1975; Bechara, Damasio, & Damasio, 2000; Huettel, Stowe, Gordon, Warner, & Platt, 2006). Impulsiveness is also an important component of several clinical conditions (American Psychiatric Association, 2000), including attention deficit hyperactivity disorder (ADHD; Malloy-Diniz, Fuentes, Leite, Correa, & Bechara, 2007; Moeller, Barratt, Dougherty, Schmitz, & Swann, 2001), borderline personality disorder (Critchfield, Levy, & Clarkin, 2004; Ferraz et al., 2009), alcohol and drug abuse (Kollins, 2003; Perry & Carroll, 2008), and impulse control disorders such as pathological gambling (Petry, 2001; Steel & Blaszczynski, 1998).

Impulsiveness is typically measured using self-report scales, which provide a relatively unobtrusive means of assessment across various clinical and research contexts. The most widely administered instrument for this purpose over the last 2 decades is likely the Barratt Impulsiveness Scale version 11 (BIS-11; Patton, Stanford, & Barratt, 1995), cited by over 2,300 sources since its formulation (Google Scholar, 2013). Consisting of 30 questions, the BIS-11 is thought to measure six related yet distinct impulsiveness factors that have been combined to form three more general subtraits: attentional impulsiveness ("inability to concentrate"), nonplanning impulsiveness ("lack of premeditation"), and motor impulsiveness ("action without thought").

This canonical three-factor structure of impulsiveness is based on a long tradition of work by Barratt and colleagues recognizing the multidimensional structure of impulsiveness while also seeking to distinguish impulsive traits from comorbid constructs, including anxiety, sensation-seeking, and risk-taking (Barratt, 1965; Barratt & Patton, 1983). Beginning with the BIS-10, Barratt and colleagues formalized their multidimensional hypothesis by developing a set of items to reflect three underlying impulsiveness constructs: motor, nonplanning, and cognitive (rapid decision) impulsiveness (Barratt, 1985). Subsequent studies supported the scale's multidimensional nature but led to the reconceptualization of cognitive impulsiveness as attentional impulsiveness (Luengo, Carrillo-De-La-Pena, & Otero, 1991; Patton et al., 1995). Thus, prior evidence consistently supports the multidimensional nature of BIS-11 impulsiveness; however, significant questions remain regarding the number and nature of influences underlying scale responses.

Although the BIS-11 continues to see frequent use in experimental and clinical contexts, attempts to replicate its canonical three-subtrait structure have generated inconsistent results. Studies examining BIS-11 items using exploratory (Haden & Shiva, 2008; von Diemen, Szobot, Kessler, & Pechansky, 2007) and confirmatory (Ireland & Archer, 2008; Ruiz, Skeem, Poythress, Douglas, & Lilienfeld, 2010; Someya et al., 2001) factor analyses raise important questions regarding the adequacy of the canonical BIS-11 factor structure. Some factors have proven unreliable, such as those reflecting cognitive instability (e.g., "I have racing thoughts") and perseverance (e.g., "I change residences") (Fossati, Barratt, Acquarini, & Ceglie, 2002; Fossati, Di Ceglie, Acquarini, & Barratt, 2001). Others, such as cognitive complexity (i.e., a preference for complex thought), seem to measure personality constructs distinct from core impulsiveness (Cacioppo & Petty, 1982). These inconsistencies may derive in part from analytical choices during the formulation of the BIS-11. In particular, the use of principal components analysis (Gorsuch, 1990), the failure to account for the ordinal nature of scale responses (Muthén, 1983; Wirth & Edwards, 2007), and the reliance on exploratory analysis without subsequent confirmatory replication (MacCallum, Roznowski, Mar, & Reith, 1994) represent substantial drawbacks to the original analytic approach. Finally, it is unclear which BIS-11 scales provide the most psychometrically sound measures of impulsiveness: the six-factor first-order scales, the canonical three-factor second-order scales, or the commonly (mis)used single-factor total score (Fossati et al., 2002; Stanford et al., 2009).

We sought to address these concerns by conducting a methodologically rigorous examination of the factor structure underlying the BIS-11 with the goal of producing an efficient and generalizable instrument for measuring impulsiveness. Attempts have been made to produce abbreviated scales using BIS-11 items—in part because a shorter scale would be valuable in clinical contexts and for survey research—but these studies either failed to test the adequacy of the underlying BIS-11 factor structure (Spinella, 2004) or sought only a unidimensional "total-score" impulsiveness measure (Steinberg, Sharp, Stanford, & Tharp, 2013). In addition, these studies failed to confirm data-driven models in separate replication samples, leaving their scale models vulnerable to capitalization on chance variation (MacCallum, Roznowski, & Necowitz, 1992).

In the study presented here, we applied exploratory and confirmatory factor analysis (EFA and CFA, respectively) to reexamine the structure of impulsiveness as measured by the BIS-11 and to produce an alternative scale, the ABbreviated Impulsiveness Scale (ABIS). Our analysis proceeded in three broad phases. First, we applied EFA to BIS-11 responses from a large, diverse sample to identify an underlying factor structure and eliminate invalid and unreliable factors and items. The resulting ABIS factor model confirmed the attentional, nonplanning, and motor impulsiveness subtraits proposed by Patton and colleagues (1995) for the BIS-11. Next, we applied CFA to test the generalizability of our ABIS factor model in two separate replication samples. The ABIS model proved more generalizable than the canonical BIS-11 model. Finally, we validated the ABIS scales through comparison to the BIS-11 as well as independent behavioral and personality measures related to impulsiveness. The ABIS provides an efficient, internally consistent, and generalizable alternative to the BIS-11 for measuring impulsiveness.

Methods

Analysis Procedure

Our study was designed to examine the associations among answers to personality survey questions (items) about impulsiveness and to improve upon an existing measure of impulsive personality based on these items (i.e., the BIS-11). We used the factor analytic techniques EFA and CFA to identify latent impulsive personality traits influencing people's answers to these items. Our study proceeded in eight stages, which are illustrated in Figure 1. In Stage I, we used CFA to test the ability of the canonical BIS-11 model to describe the patterns of item responses. This canonical model failed, leading us to Stage II, in which we used exploratory, data-driven techniques (parallel analysis and EFA) to construct an initial seven-factor model of impulsive personality. Next, in Stage III, we identified and took steps to eliminate three problematic factors that were unrelated to core impulsiveness. In Stage IV, we targeted individual questions for removal, eliminating idiosyncratic items that remained poorly explained after accounting for the

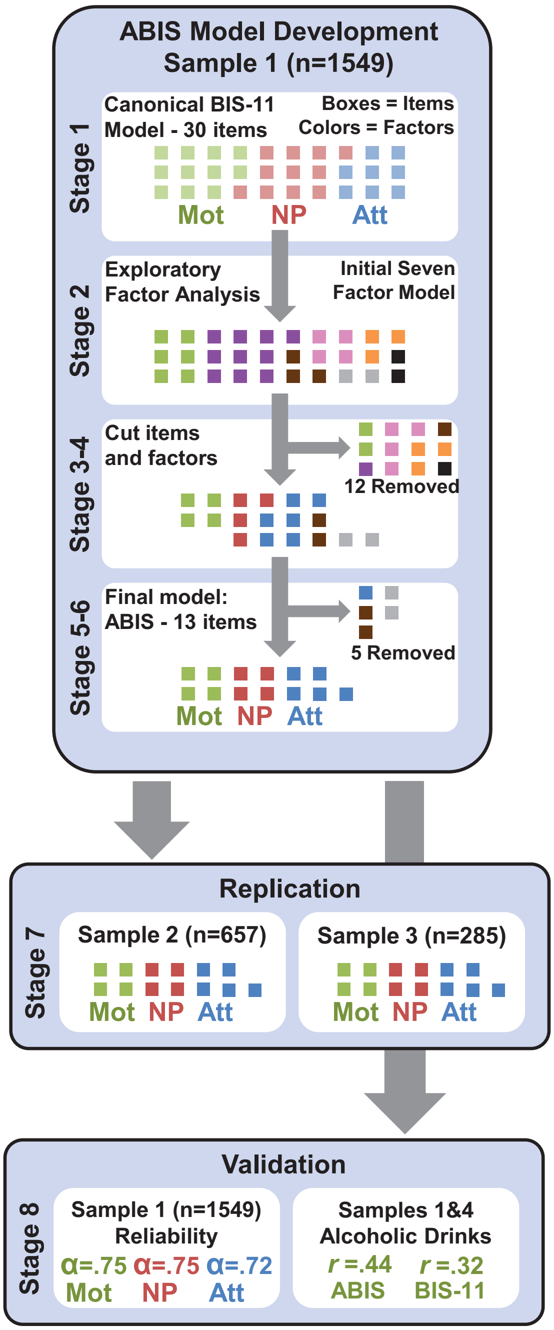

Figure 1. Flowchart of study analysis procedure. Small boxes represent individual scale items, with color representing separate factors. The ABIS model was developed through Stages I–VI using EFA and CFA (Sample 1), resulting in a three-factor, 13-item scale. The ABIS was replicated in Stage VII (Samples 2 and 3) and validated in Stage VIII (Samples 1 and 4). Mot = motor impulsiveness; NP = nonplanning impulsiveness; Att = attentional impulsiveness.

influence of identified factors. In Stage V, we eliminated additional factors that were poorly measured by the remaining set of items. In Stage VI, we finalized our factor model and simplified the structure of the exploratory model to fit the format of a confirmatory factor model. In Stage VII, we confirmed our final model in two additional independent samples. Finally, in Stage VIII, we validated the abbreviated scales derived from our model by relating them to personality and behavioral outcome variables reflecting impulsiveness.

Participants

Our primary sample comprised 1,549 adults from Durham, North Carolina, and surrounding communities (Sample 1). Participants were recruited via advertisements in community locations and on the campuses of Duke University and the University of North Carolina at Chapel Hill. Two replication samples comprised 657 adults from the Duke University community (Sample 2) and 285 adults recruited online (Sample 3) through Amazon's Mechanical Turk (http://www.MTurk.com). A final validation sample comprised 49 adults from the Durham and surrounding communities (Sample 4) recruited for a functional neuroimaging experiment examining impulsive decision-making. All participants provided informed consent under protocols approved by either the Duke University or Duke University Medical Center Institutional Review Boards.

Primary Study Measures

Our primary measures of interest included the following.

BIS-11. Responses to these 30 items measuring attentional, motor, and nonplanning impulsiveness (Patton et al., 1995) were our main measures of interest. Responses were indicated on a computer using a 4-point (5 points in Sample 3) scale: *rarely/never*, *occasionally*, *often*, *almost always/always*. Subjects from all four of our samples completed the BIS-11. Items from this scale were used to formulate the ABIS. The BIS-11 items are reproduced in Appendix 2 (Supplemental File B) and are publicly available at http://www.impulsivity.org/measurement/bis11.

Alcohol use questionnaire. Impulsiveness plays a key role in the initiation and maintenance of substance use and dependence (Dick et al., 2010). To examine alcohol use, we asked participants from Sample 4 to self-report the number of alcoholic beverages consumed on a typical day on which they drank and the average number of days per week alcohol was consumed. From the product of these quantities, we derived a measure of the average number of alcoholic drinks consumed per week.

Additional personality measures. We included additional measures to validate the ABIS. These included the Decision Making Styles Inventory Analytical and Intuitive scales (Nygren & White, 2002), the Need for Cognition and Faith in Intuition scales (Epstein, Pacini, Denes-Raj, & Heier, 1996), the Behavioral Inhibition System/Behavioral Activation System Scale (Carver & White, 1994), the Urgency, Premeditation, Perseverance, and Sensation Seeking impulsiveness scale (Whiteside, Lynam, Miller, & Reynolds, 2005), the Brief Sensation Seeking Scale (Hoyle, Stephenson, Palmgreen, Lorch, & Donohew, 2002), and the Impulsive Sensation Seeking Scale (Zuckerman, 2002).

Delay discounting—proportion impatient choice. Delay discounting, or the tendency to devalue (discount) delayed rewards, is a common behavioral measure of impulsive decision-making (Bickel, Odum, & Madden, 1999; Reynolds, Richards, Horn, & Karraker, 2004; Wittmann & Paulus, 2008). Participants from Sample 4 completed an experiment examining delay discounting in which they made 100 choices between two different options: a small monetary amount that could be received immediately and a larger amount ($5–$50) that could be received after a delay (1–8 weeks). We used the proportion of choices for which the participant chose the impatient (smaller but immediate reward) option as an individual difference measure of impulsive decision-making.

EFA and CFA

Model fit was evaluated using the comparative fit index (CFI; Bentler, 1990) and the root mean square error of approximation

(RMSEA; Steiger, 1990). These indices have been found to perform well with categorical data under our study conditions, including relatively large samples, four-item response scales, and categorical model estimation techniques (DiStefano, 2002; Edwards, Wirth, Houts, & Xi, 2012; Green, Akey, Fleming, Hershberger, & Marquis, 1997; Hutchinson & Olmos, 1998). We used CFI values of .95 and RMSEA values of .06 as cutoffs for good model fit (Hu & Bentler, 1999). RMSEA cutoffs of .08 and .10 indicated acceptable and marginal fit, respectively (MacCallum, Browne, & Sugawara, 1996). See the accompanying APA Publications and Communications Board Working Group on Journal Article Reporting Standards, 2008) and JARS-SEM (JARS-Structural Equation Modeling; Hoyle & Isherwood, 2013) questionnaires for methodological details regarding our factor analyses.

Results

Stage I: Attempting to Confirm the Canonical BIS-11 Factor Structure of Impulsive Personality

We first attempted to confirm the BIS-11 factor structure proposed by Patton et al. (1995). These authors identified six latent factors underlying responses to the 30 BIS-11 scale items. Theoretical motivations led them to aggregate the six factors into three second-order factors. We used CFA to test the suitability of these six- and three-factor solutions as well as a single-factor (unidimensional/total-score) solution. Each item was specified to load on a single factor on the basis of its assignment to the BIS-11 subscales (Patton et al., 1995). The magnitude of these loadings and the factor covariances were freely estimated from the data (corresponding to congeneric indicators, an oblique factor rotation, and strict simple structure). Model fit results appear in Table 1.

None of the models that were based on the canonical BIS-11 structure provided an acceptable explanation of the relationships between item responses. CFI values were especially poor for these models. Substantial exploratory modification was required to achieve conventionally acceptable model fit. On the basis of these results, we concluded that the item-factor relationships specified by the canonical BIS-11 model could not explain the patterns of responses in our sample.

Stage II: Exploring an Alternative Factor Structure of Impulsive Personality Using EFA

Given our failure to explain our data using CFA that was based on the canonical BIS-11 structure, we turned to EFA to derive an alternative, data-driven model of the factor structure underlying BIS-11 responses. Parallel analysis (Horn, 1965) using either permuted data or random normal data (Buja & Eyuboglu, 1992) indicated seven factors underlying our BIS-11 responses. EFA using the unrestricted factor model (Hoyle & Duvall, 2004; Jöreskog, Sörbom, Magidson, & Cooley, 1979) corroborated this estimate, demonstrating that a seven-factor solution was the simplest that achieved good fit (RMSEA = .05, CFI = .95). The model fit results of this initial EFA appear in Table 1 and served as the basis for constructing the abbreviated scale.

Our initial seven-factor EFA revealed several constructs that roughly correspond to subtraits identified in the original BIS-11 six-factor model, including self-control/planning, motor, perseverance, cognitive complexity, and cognitive instability factors. These initial EFA results also suggested several avenues by which the scale could be abbreviated without sacrificing inferential validity. Our revision proceeded as detailed in the next subsection, with the EFA reestimated at each stage after the removal of items.

Stage III: Eliminating Factors Unrelated to Core Impulsiveness

Our initial EFA revealed a factor similar to BIS-11 "cognitive complexity" and anchored by items 15, 18, and 29, which refer to a preference for complex thought. These items appeared to measure "need for cognition," a personality construct that is distinct from impulsiveness and that reflects an individual's desire for effortful cognitive activity (Cacioppo & Petty, 1982). We examined the correlation between responses on items from the cognitive complexity factor (with higher scores reflecting a stronger preference for complex thought) with responses on the Need for Cognition scale (Epstein et

Table 1
Factor Analysis Results and Fit Statistics

Stage	Type	Model description	χ^2	*df*	RMSEA	RMSEA Lower 90% CI	RMSEA Upper 90% CI	CFI	*N*
I	CFA	Patton et al. (1995) one factor (total score)	7,466.59	405	0.106	0.104	0.108	0.639	1,549
I	CFA	Patton et al. (1995) three factor (canonical model)	6,249.95	402	0.097	0.095	0.099	0.701	1,549
I	CFA	Patton et al. (1995) six factor (first order factors)	5,622.44	390	0.093	0.092	0.098	0.732	1,549
II	EFA	Seven factors, 30 items	1,145.29	246	0.049	0.046	0.051	0.954	1,549
III	EFA	Five factors, 25 items	984.49	185	0.053	0.050	0.056	0.949	1,549
IV	EFA	Five factors, 18 items	498.36	73	0.061	0.056	0.066	0.967	1,549
V	EFA	Three factors, 14 items	570.84	52	0.080	0.074	0.086	0.955	1,549
VI	CFA	Three factors, 14 items, simple structure	884.75	74	0.084	0.079	0.089	0.930	1,549
VI	CFA	Three factors, 13 items, simple structure	753.77	62	0.085	0.080	0.090	0.938	1,549
VI	CFA	Final model, three factors, 13 items, three error covariances	371.90	59	0.059	0.053	0.064	0.972	1,549
VII	CFA	Sample 2, replication of final model	262.44	59	0.072	0.064	0.081	0.968	657
VII	CFA	Sample 2, Patton et al. (1995) three factors (canonical model)	2,863.76	402	0.096	0.093	0.100	0.743	657
VII	CFA	Sample 3, replication of final model	166.04	59	0.080	0.066	0.094	0.971	285
VII	CFA	Sample 3, Patton et al. (1995) three factors (canonical model)	1,659.31	402	0.105	0.100	0.110	0.779	285

al., 1996) collected from a subset of 379 subjects. Items 15 (r = .68, 95% confidence interval [CI] [.62, .73]), 18 (r = .51, 95% CI [.43, .58]), and 29 (r = .42, 95% CI [.33, .50]) exhibited substantial correlation with the need for cognition total score whereas the weaker-loading items 12 (r = .34, 95% CI [.25, .43]) and 20 (r = .26, 95% CI [.16, .35]) showed moderate correlation. We chose to remove items 15, 18, and 29 on the basis of their strong relationship to need for cognition.

Our initial EFA also revealed a doublet factor consisting of items 11 and 28. These items, which refer to either "squirming" (11) or "restlessness" (28) at plays, the theater, or lectures, are redundant in concept and wording. This suggests that the "factor" they form may instead reflect a method effect unrelated to the underlying structure of impulsive personality (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). Consistent with this assessment, the polychoric (i.e., ordinal) correlation between items 11 and 28 (r = .73, 95% CI [.71, .75]) was among the largest between BIS-11 items. To eliminate this method factor, we chose to remove one of these two items on the basis of item R^2 values. These values, which express the proportion of variance for each item explained by the modeled factors, can be taken as an estimate of item reliability (Brown, 2006). Item 11 was removed because it proved less reliable than item 28 upon removal and reestimation (R^2 = .22 for 11 vs. .34 for 28).

We also identified a financial factor consisting of items 10, 22, and 25, each of which refers to impulsiveness in the context of spending or saving decisions. Financial factors have been identified in previous EFAs of BIS-11 responses (Fossati et al., 2001). Although this factor was stable and meaningful, it reflects shared variance related to impulsiveness within the particular domain of financial behavior as opposed to a broader trait relevant across domains. Supporting this interpretation, two of the three financial items also had substantial cross-loadings on the more domain-general planning (item 10, .37) and motor (item 22, .39) factors. We chose to eliminate this domain-specific financial factor by removing item 25, which possessed the highest loading on the financial factor (.77) and had no substantial loadings on other factors. Items 10 and 22 were retained at this stage.

In summary, our first round of item elimination evaluated three questionable factors from our initial seven-factor EFA solution, which led to the elimination of five items: three (15, 18, 29) reflecting the need for cognition, one redundant item (11) from a restlessness doublet, and one item (25) anchoring a domain-specific financial factor.

We reestimated our EFA using the 25 remaining indicators and found a five-factor solution to be most interpretable, as summarized in Table 1. This model revealed factors similar to the original BIS-11 first-order factors, save for the eliminated factor of "cognitive complexity."

Stage IV: Eliminating Unreliable Items

To identify additional items for removal, we examined the item reliability as indexed by R^2 values. Items with low reliability fell into one of three categories: items with a pejorative interpretation (e.g., "I can only think about one thing at a time"; 23, 27, 3), items with an unusual or narrow relevance (e.g., "I change hobbies"; 4, 24), or items with residual variance due to the eliminated financial factor (10, 22). When all remaining BIS-11 items were sorted in descending order by their R^2 values, we found a clear gap separating the low-reliability items mentioned above (R^2 values from .02 to .26) from the remaining items (R^2 values from .32 to .74). We chose to eliminate all seven of these low-reliability items. Stepwise elimination starting with the lowest reliability item did not substantively change the ordering of items by reliability. The elimination of these 7 items left 18 items. We reestimated our EFA using the 18 remaining items and found a five-factor solution to be most interpretable, as summarized in Table 1.

Stage V: Eliminating Poorly Measured Doublet Factors

Two of the factors in our five-factor, 18-item model were doublets, featuring strong loadings of only 2 items. These doublet factors reflected perseverance (items 16 and 21, "I change jobs" and "I change residences") and cognitive instability (items 6 and 26, "I have 'racing' thoughts" and "I often have extraneous thoughts when thinking"). The cognitive instability doublet factor also possessed moderate loadings (.32–.35) on three items (5, 9, 28), but each of these items had stronger loadings on an attention factor. To address the "local dependence" (Yen, 1993) reflected by these item pairs, we first attempted to eliminate single items from each factor. Removing either item 16 or 21 from the perseverance factor or item 6 or 26 from the cognitive instability factor left the remaining doublet item with low reliability ($<$.27); therefore, we excluded all four items. Removing the perseverance and cognitive instability doublet factors left a 14-item scale.

We reestimated our EFA using the 14 remaining items and found a three-factor solution to be most interpretable, as summarized in Table 1. These three factors reflected constructs similar to motor, nonplanning, and attentional impulsiveness, as conceptualized by Patton et al. (1995).

Stage VI: Confirming the Final Model Using CFA

We translated the results of our three-factor, 14 item EFA into a model reflecting simple structure such that each item loaded on only one factor while still allowing the factors themselves to covary. These results were promising, indicating marginal fit, as summarized in Table 1. Translation to simple structure resulted in one attention item with a low R^2 value (28, R^2 = .20), which we removed, leaving a final set of 13 items (Table 1).

After examining the model covariance matrix and modification indices (which quantify the expected change in model fit due to freeing individual fixed model parameters), three error covariances were introduced between model uniqueness terms to account for residual dependence between scale indicators. First, the error terms for items 17 and 19 were allowed to covary because their similar wording and proximity on the scale may have introduced additional methodological correlation. Likewise, error terms for items 12 and 20 were allowed to covary on the basis of their similar wordings. Finally, error terms for items 13 and 30 were allowed to covary. These two items share conceptual variation related to long-term planning and often emerged as a doublet separate from items 1 and 7 (which reflect more near-term planning) with higher-order EFA extractions. We believe that there is sufficient evidence to justify a planning factor including all four items, but we allowed for the error covariance between items 13 and 30 to account for the additional dependence between these items. Freeing these three parameters accounted for residual covariance without altering the general pattern and magnitude of item loadings, which remained large (.55–.82) and highly significant (p < .001) in all cases.

Results for our final model, including the three correlated uniqueness terms specified above, are represented in Figure 2. Model fit (Table 1) was good. The final model features five items measuring attentional impulsiveness (5, 8, 9, 12, and 20), four items measuring nonplanning impulsiveness (1, 7, 13, and 30), and four items measuring motor impulsiveness (2, 14, 17, and 19) for a total of 13 items, less than half of the length of the canonical BIS-11 scale. This reduction

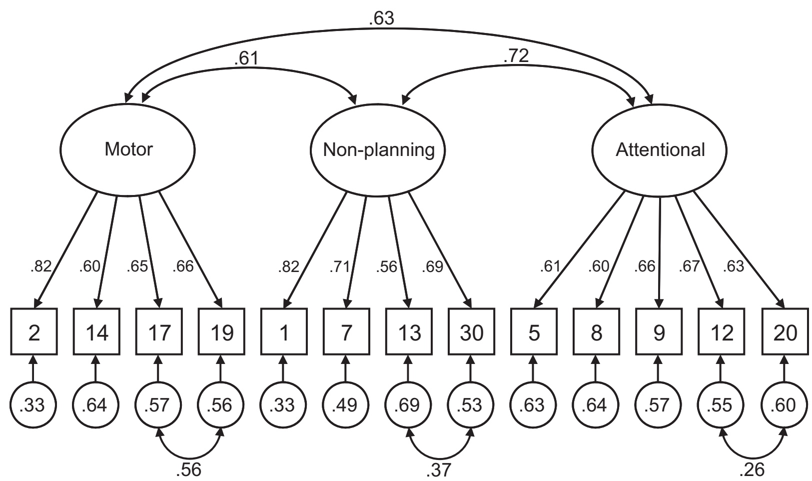

Figure 2. Path diagram illustrating the final ABIS model estimates from Sample 1. The 13 items of the ABIS (boxes, BIS-11 item numbering) measure correlated attentional (five items), motor (four items), and nonplanning (four items) latent factors (ellipses). Item error/uniquenesses are shown as circles; three error covariances (curved arrows between errors) were specified. Parameter estimates are standardized using the variances of the continuous latent variables as well as the variances of the outcome (i.e., Mplus StdYX). All parameters are significant at $p < .001$ across Samples 1–3.

was achieved by eliminating nonrelevant factors, doublet factors, and unreliable items.

Stage VII: Confirming Model Generalizability Through Replication Using CFA

We next sought to confirm the structural validity of our abbreviated scale using CFA in two additional samples. We replicated the model structure in an additional survey-based sample of 657 adults (Sample 2). CFA was performed on responses to relevant BIS-11 items, specifying the final model from Stage VI. All estimated model parameters, including the three error covariance terms specified, were highly significant ($p < .001$). Overall model fit in the replication sample was acceptable to good (Table 1). Model fit for the canonical three-factor Patton model was marginal to unacceptable in this sample (Table 1). Modification indices did not suggest any conceptually relevant alterations. The results of this analysis confirm the factor structure of our abbreviated scale, which produced acceptable replication fit values in an independent sample.

To reinforce the generalizability of our abbreviated scale model, we implemented a stringent test by using CFA to replicate the model structure in a diverse Internet sample of 285 individuals (Sample 3) who completed the BIS-11 using a five-point response scale. Analysis procedures were identical to those used previously. CFA was performed on BIS-11 item responses specifying the final model from Stage VI (including error covariances). Again, all estimated model parameters were highly significant ($p < .001$). Overall, model fit in this replication sample was acceptable/marginal to good (Table 1); the CFI value indicated good fit whereas the RMSEA value of .08 was equal to the cutoff value separating acceptable and marginal fit for this index. Model fit for the canonical BIS-11 three-factor structure was unacceptable in this sample (Table 1). Modification indices did not suggest any conceptually relevant alterations. The results of this analysis confirm the factor structure of our abbreviated scale, which produced acceptable replication fit values in a moderately sized Internet sample. The Internet sample we collected is quite diverse in terms of age, occupation, race, and geography, more so than most samples studied within personality psychology (Buhrmester, Kwang, & Gosling, 2011; Gosling, Vazire, Srivastava, & John, 2004). In addition, the model results generalized well to a 5-point response scale (although we recommend the continued use of a 4-point scale for the sake of continuity with previous research).

Replication of the abbreviated scale model in a local community and a broad Internet sample indicates the enhanced generalizability of the abbreviated measure. This is particularly clear in comparison to the performance of the canonical BIS-11 model, which showed inadequate fit in every sample we examined.

Stage VIII: Validating the Abbreviated Scale Using Measures of Personality and Behavior

On the basis of our model of BIS-11 responses refined and replicated in Stages I–VII, we present the ABIS, a 13-item scale measuring attentional (5 items), nonplanning (4 items), and motor (4 items) impulsiveness (Table 2). Scores on each subscale are computed by averaging responses on all relevant subscale items after accounting for reverse-scored items (see Appendix 1: Supplemental File A for scale administration and scoring instruction forms, which is available online). Properties of the ABIS scale scores in our factor analysis

Table 2
ABIS Scale Items

ABIS scale	Item number	Item text
Attention	5	I don't "pay attention."
	8	I am self-controlled.
	9	I concentrate easily.
	12	I am a careful thinker.
	20	I am a steady thinker.
Motor	2	I do things without thinking.
	14	I say things without thinking.
	17	I act "on impulse."
	19	I act on the spur of the moment.
Nonplanning	1	I plan tasks carefully.
	7	I plan trips well ahead of time.
	13	I plan for job security.
	30	I am future oriented.

Table 3
Descriptive Statistics for ABIS Scales in Factor Analysis Samples

Sample	Total				Females				Males			
	M	*SD*	α	*N*	*M*	*SD*	α	*N*	*M*	*SD*	α	*N*
Sample 1												
ABIS attention	2.05	0.47	0.72	1,549	2.07	0.47	0.74	939	2.04	0.46	0.68	608
ABIS motor	2.06	0.51	0.75	1,549	2.03*	0.50	0.75	939	2.10*	0.52	0.75	608
ABIS nonplanning	2.11	0.62	0.75	1,549	2.06*	0.61	0.75	939	2.19*	0.62	0.75	608
Sample 2												
ABIS attention	2.08	0.53	0.77	657	2.08	0.55	0.80	377	2.08	0.51	0.74	278
ABIS motor	1.94	0.56	0.81	657	1.89*	0.55	0.82	377	2.00*	0.56	0.80	278
ABIS nonplanning	2.14	0.63	0.71	657	2.06*	0.62	0.71	377	2.25*	0.63	0.71	278
Sample 3												
ABIS attention	2.25	0.70	0.77	285	2.15*	0.62	0.73	145	2.35*	0.76	0.79	140
ABIS motor	2.38	0.99	0.88	285	2.36	1.04	0.90	145	2.40	0.94	0.86	140
ABIS nonplanning	2.35	0.77	0.70	285	2.27	0.76	0.72	145	2.44	0.78	0.66	140

Note. Sample 3 items were measured from 1 to 5, rendering comparisons to Samples 1 and 2 uninformative. Summary statistics are shown for scale scores, which reflect the average of relevant scale items. Two individuals from Sample 2 reported neither male nor female gender.
* Gender difference $p < .05$.

samples are shown in Table 3. In particular, the internal consistency of the abbreviated scales, as indexed by coefficient α, is greater than that for the canonical BIS-11 subscales in all of our samples (BIS-11 α: attention = .71; motor = .64; nonplanning = .69). The ABIS values are also similar to or greater than those published for the BIS-11 subscales in another large sample (Stanford et al., 2009). Coefficient α is positively related to the number of scale items (Churchill Jr. & Peter, 1984; Voss, Stem Jr, & Fotopoulos, 2000), leading us to expect that abbreviated scale scores would exhibit lower reliability by this measure. The fact that α was actually greater for the shortened ABIS scale scores supports our contention that the ABIS more reliably measures the impulsive subtraits latent in the BIS-11 item set.

We next investigated the relationships among the ABIS scales, BIS-11 subscales, and relevant measures of personality and behavior. Table 4 depicts correlations between the ABIS and BIS-11 scales. The ABIS attention, motor, and nonplanning scales were strongly correlated with their corresponding BIS-11 subscales (*r*s from .71 to .77, 95% CIs ± .02). We also sought to validate the ABIS scales by relating them to a range of self-report and behavioral individual difference measures relevant to impulsiveness. These associations are depicted in Table 5. Despite the brevity of the ABIS scales, they produced correlations similar to those of the corresponding BIS-11 scales across various personality measures. Consistent with their enhanced internal consistency, there was a general tendency toward stronger correlation estimates using the ABIS scales. Exceptions tended to have clear explanations, such as the drop in correlation between ABIS nonplanning and need for cognition after the intentional removal of "cognitive complexity" items in Stage III of our analysis. The similar pattern of associations observed with the ABIS and BIS-11 scales supports the inferential validity of the ABIS scales when measuring motor, attentional, and nonplanning impulsiveness.

Previous research has suggested that impulsiveness is positively related to alcohol consumption in teenagers (Fossati et al., 2002) and adults (Granö, Virtanen, Vahtera, Elovainio, & Kivimäki, 2004), with small to moderate effect size ($r \sim .30$ using the BIS-11). We found that self-reported alcohol consumption in adults was related to ABIS motor impulsiveness ($r = .44$, $p < .05$, 95% CI [.17, .64]) and BIS-11 motor impulsiveness ($r = .32$, $p < .05$, 95% CI [.04 .55]). The difference between these correlations was nonsignificant ($p = .21$),

Table 4
Correlation of ABIS and BIS-11 Scales in Sample 1

	B11 Tot	att	mot	sc	cc	per	ci	ATT	MOT	NP	ABIS Att	ABIS Mot	ABIS NP	fin	nfc
BIS11-Total Score	—														
BIS11-attention	0.72	—													
BIS11-motor	0.71	0.31	—												
BIS11-self control	0.79	0.48	0.45	—											
BIS11-cognitive complexity	0.59	0.35	0.25	0.37	—										
BIS11-perseverance	0.55	0.22	0.30	0.37	0.23	—									
BIS11-cognitive instability	0.48	0.37	0.28	0.22	0.04	0.20	—								
BIS11-ATTENTION	0.75	0.90	0.36	0.45	0.28	0.25	0.73	—							
BIS11-MOTOR	0.79	0.34	0.91	0.52	0.29	0.68	0.31	0.39	—						
BIS11-NONPLANNING	0.84	0.51	0.44	0.87	0.78	0.37	0.17	0.45	0.50	—					
ABIS attention	0.76	0.78	0.35	0.72	0.43	0.28	0.28	0.71	0.39	0.71	—				
ABIS motor	0.71	0.38	0.79	0.59	0.21	0.30	0.32	0.43	0.75	0.51	0.43	—			
ABIS nonplanning	0.67	0.34	0.37	0.87	0.34	0.43	0.15	0.31	0.47	0.77	0.50	0.40	—		
Finance (removed)	0.59	0.27	0.61	0.40	0.45	0.26	0.21	0.29	0.59	0.51	0.35	0.33	0.36	—	
Need for cognition (removed)	0.50	0.38	0.15	0.23	0.78	0.13	0.30	0.42	0.18	0.57	0.39	0.19	0.15	0.17	—

Note. B11 Tot = BIS-11 total score; att = attention; mot = motor; sc = self control; cc = cognitive complexity; per = perseverance; ci = cognitive instability; NP = nonplanning; fin = finance; nfc = need for cognition. BIS-11 first-order scales are abbreviated in lowercase whereas second-order scales are abbreviated in upper case. All correlations significant at $p < .01$ (excepting BIS-11 cognitive complexity × cognitive instability).

Table 5
External Validity of ABIS Scales

Measure	Attention ABIS	Attention BIS-11	Motor ABIS	Motor BIS-11	Nonplanning ABIS	Nonplanning BIS-11	*N*
Decision-Making Styles Inventory—Analytical	−0.46[*a]	−0.26[*]	−0.44[*]	−0.39[*]	−0.51[*]	−0.52[*]	379
Decision-Making Styles Inventory—Intuitive	0.11[*]	0.07	0.33[*]	0.37[*]	0.16[*]	0.20[*]	379
Need for Cognition	−0.35[*a]	−0.26[*]	−0.12[*]	−0.12[*]	−.10[a]	−0.45[*]	379
Faith in Intuition	−0.02	0.05	0.18[*]	0.16[*]	−0.01	−0.01	379
Behavioral Approach System—Drive	−.02[a]	0.05	0.17[*]	0.16[*]	−0.11[*a]	−0.06	1,167
Behavioral Approach System—Fun-Seeking	0.23[*]	0.23[*]	0.50[†*]	0.43[*]	0.28[*a]	0.23[*]	1,167
Behavioral Approach System—Reward Responsiveness	−.04[a]	0.04	0.07[*]	0.05	−0.12[*a]	−0.07[*]	1,167
Behavioral Inhibition System	0.11[*]	0.13[*]	−0.08[*]	−0.12[*]	−0.13[*a]	0.01	1,167
UPPS—Premeditation	−0.38[*]	−0.18	−0.49[*]	−0.42[*]	−0.59[*]	−0.57[*]	49
UPPS—Urgency	0.21	0.27	0.42[*]	0.25	0.09	0.17	49
UPPS—Perseverance	−0.53[*]	−0.51[*]	−0.32[*]	−0.44[*]	−0.55[*]	−0.40[*]	49
UPPS—Sensation-Seeking	0.05	0.12	0.15	0.06	0.03	−0.16	49
Brief Sensation-Seeking Scale	0.15	0.17	0.30[*]	0.21	0.33[*]	0.21	49
Impulsive Sensation-Seeking	0.27	0.27	0.37[*]	0.33[*]	0.50[*a]	0.28	49
Average number of alcoholic drinks per week	0.06	0.10	0.44[*]	0.32[*]	0.20	0.31[*]	48
Delay Discounting—Proportion Impatient Choice	0.04	0.03	0.28	0.14	0.23	0.28	49

[a] Scale difference (ABIS vs. BIS-11, 2-tailed) $p < .05$.
[*] $p < .05$.

although this comparison was likely underpowered (Sample 4, $N = 48$). Definitive conclusions regarding the relative size of these effects across scales will require further analysis in larger samples, although the results for motor impulsiveness and alcohol consumption are consistent with the overall trend toward strengthened relationships when using the ABIS scales. There were no significant relationships with ABIS attentional or nonplanning impulsiveness in this sample ($r = .06$, 95% CI [–.23, .34] and $r = .20$, 95% CI [–.10, .45]).

We also examined the relationship between the ABIS scales and delay discounting, a laboratory-based measure of impulsive decision-making. Decisions reflecting delay discounting (willingness to accept a smaller reward that can be obtained sooner) are commonly described in terms of self-control and impulsiveness (Coutlee & Huettel, 2012; Madden & Bickel, 2010), although studies have not found a consistent relationship between delay-discounting behavior and self-reported impulsiveness (Reynolds, Ortengren, Richards, & de Wit, 2006; Stanford et al., 2009). Consistent with these latter findings, we failed to identify any significant relationship between impulsiveness (measured with either the ABIS or BIS-11) and individual differences in impatient decision-making in a delay-discounting task ($r = .04$ to .28, 95% CIs from −.24 to .52), although ABIS motor and BIS-11 nonplanning impulsiveness showed trend-level relationships ($p < .10$). Because statistical power was relatively low for this sample ($N = 49$), the extent of any relationship between impulsiveness and delay discounting remains unclear.

Discussion

We describe the creation of the ABIS, a brief scale that measures attentional, motor, and nonplanning impulsiveness with better than twice the efficiency of the BIS-11 while maintaining similar, if not better, score reliability. It is critical to note that we demonstrated through CFA in two independent replication samples that, in contrast with the BIS-11, the model underlying the ABIS generalizes to independent samples drawn from separate respondent populations. Finally, we show evidence that links impulsiveness measured by the ABIS to other relevant personality measures and alcohol consumption. These findings support the use of the ABIS in basic, clinical, and applied research as either a brief alternative to the BIS-11 or a model for reanalyzing previously collected BIS-11 questionnaire responses.

We initially set out to reevaluate the factor structure of the BIS-11 using large samples, modern factor analytic methods (exploratory and confirmatory), and replication in independent samples. Despite demonstrating poor model fit for the BIS-11's particular factor structure, our final model corroborates its general structure in that our attentional, motor, and nonplanning scales resemble the core impulsiveness subtraits identified by Patton et al. (1995). However, we argue that our systematic removal of extraneous factors and unreliable items allows the ABIS to measure these preserved core subtraits with enhanced efficiency and clarity.

The ABIS motor impulsiveness scale, anchored by items 2 and 19, “I do things without thinking” and “I act on the spur of the moment,” reflects spontaneous, reactive, and uninhibited action. ABIS motor impulsiveness relates strongly to BIS-11 first- and second-order motor impulsiveness and moderately to UPPS Urgent impulsiveness (tendency for uninhibited emotional acts), intuitive decision-making style, BAS Fun Seeking, and sensation-seeking. ABIS motor impulsiveness also showed a significant association with alcohol consumption, and that association was at least as large as that from the full BIS-11 using far fewer items.

The ABIS nonplanning impulsiveness scale, anchored by items 1 and 7, “I plan tasks carefully” and “I plan trips well ahead of time” (both reverse scored), reflects a tendency to forego premeditation, forethought, and preparation. It encompasses lack of planning for shorter-term, concrete aims, such as tasks and trips, as well as longer-term and more abstract aims, such as job security and the future more generally. It is strongly related to the BIS-11 second-order nonplanning and first-order self-control subscales as well as the UPPS premeditation scale. It also shows moderate relationships with an analytical decision-making style and sensation-seeking.

The ABIS attentional impulsiveness scale, anchored by items 12 and 9, “I am a careful thinker” and “I concentrate easily,” (both reverse scored), reflects inconsistency in controlling thought and focusing attention. ABIS attentional impulsiveness relates strongly to the BIS-11 first-order attention and self-control subscales as well as to UPPS perseverant impulsiveness (lack of focus and self-discipline). ABIS attention also showed moderate negative relationships with analytical decision-making style and need for cognition.

Our results indicate that the ABIS scales are best considered measures of separate but correlated components of impulsiveness. The scales show moderate intercorrelation (*r*s from .40 to .50, 95% CIs ± .04). Each scale taken alone is acceptably unidimensional after accounting for the specified correlated uniquenesses (Table 6). By contrast, a single-factor model, reflecting a total score computed by summing across all items, showed unacceptable fit, reflecting a lack of unidimensionality across all items (Table 6). Despite cautions from the scale authors (International Society for Research on Impulsivity, 2013), the BIS-11 subscales are commonly summed to produce a total scale, a practice which ours and others results fail to support (Ireland & Archer, 2008; Steinberg et al., 2013). We hope to avoid this misunderstanding with the ABIS scales and emphasize that ignoring the multidimensional nature of the ABIS or BIS-11 items undermines the validity of inferences made using those items. Inappropriate use of summary scores in such cases introduces additional measurement error (Fava & Velicer, 1996; Wood, Tataryn, & Gorsuch, 1996) and can distort the nature of the measured construct (Cattell, 1958). This can lead to problems identifying true relationships between impulsiveness traits and other constructs, particularly in cases in which those relationships differ among motor, attentional, and nonplanning impulsiveness. We reiterate that it is psychometrically inappropriate to combine the ABIS scales, and that they should not be summed or averaged to calculate a total score. (Note that, according to our analyses, this admonition also holds equally for the original BIS-11 subscales.)

Although evidence from our study clearly supports the multidimensionality of impulsiveness measured via BIS-11 items, we remain agnostic regarding the potential existence or nature of a "general impulsiveness" construct underlying attentional, motor, and nonplanning impulsiveness. The correlated-factors model we describe does not specifically address this question because this model is statistically equivalent to a first-order factor model with a single general (second-order) impulsiveness factor. Bifactor models (Holzinger & Swineford, 1937), in which items simultaneously load on a general factor and uncorrelated specific factors (e.g., attention, motor, nonplanning), suggest an alternative possible higher-order structure (Yung, Thissen, & McLeod, 1999). Our own findings (Table 6) and those of others (Steinberg et al., 2013) indicate that bifactor solutions that are based on the canonical BIS-11 model and items provide a poor fit overall, although including a general factor did improve models that were based on the full 30-item set. Applied specifically to the ABIS items, we found that a bifactor model produced fit somewhat inferior to our final three-factor model (Tables 1 and 6) with moderate to strong loadings on the general factor across all items (covariance terms were dropped to allow model estimation). Practical attempts to investigate specific impulsiveness traits in isolation should control for correlated impulsiveness constructs using standard methods (CFA/structural equation modeling, multiple and hierarchical regression) as opposed to more speculative bifactor models. However, more generally, questions regarding the higher-order structure of impulsiveness require further investigation and are likely to be informed by emerging bifactor modeling techniques, including exploratory bifactor analysis (Jennrich & Bentler, 2011; Muthén & Muthén, 2012).

To the best of our knowledge, our study reflects the first attempt to independently reexamine and abbreviate the BIS-11 using EFA and CFA methods in replication samples. The ABIS scales, which are the result of this analysis, are supported by findings from two previous studies that sought to produce reduced scales on the basis of BIS-11 items. Spinella (2004) produced a 15-item scale with three subscales by selecting the five items with the highest loadings on each factor from a three-factor orthogonal principal components analysis of BIS-11 data. This method, although straightforward to implement and useful for eliminating some of the weaker-loading and unreliable BIS-11 items, fails to identify the strong minor factors present in the data, such as the restlessness doublet removed in Stage III of our analysis. Unextracted minor or methodological factors can distort the nature of major factors and the patterns of item loadings (Wood et al., 1996). This may be the case for the Spinella attentional impulsiveness factor, which is dominated by the restlessness doublet. However, aside from the attention scale, the Spinella results show consistency with the ABIS scales, although our model tends to show modestly better fit values and replicability (Table 6).

Another study (Steinberg et al., 2013) used unidimensional item response theory models to produce an eight-item scale intended to replace the problematic BIS-11 total score measure. The authors initially applied a bifactor item response model that was based on the BIS-11 canonical three-factor model. As in our own analyses using EFA/CFA (Table 1) and a bifactor model (Table 6), they found that many of the BIS-11 items failed to load on the general impulsiveness factor and that many items were characterized by high correlations with only one or two other items, reflecting doublets or other minor factors (often because of methodological factors such as similarity of item wording). The authors subsequently switched to fitting unidimensional models with the goal of producing a revised BIS total score scale by eliminating items not clearly related to the general impulsiveness factor (resulted in an eight-item scale). Although the primary goal and factor analysis technique used in this study are distinct from our own, their results, which revealed problematic doublet factors and items poorly related to impulsiveness, are consistent with our own findings. In addition, the items they selected for their alternative BIS

Table 6
Alternative Model Analysis Results and Fit Statistics

Model description	χ^2	*df*	RMSEA	RMSEA Lower 90% CI	RMSEA Upper 90% CI	CFI	*N*
Sample 1, ABIS attention unidimensional model	19.63	4	0.050	0.029	0.073	0.994	1,549
Sample 1, ABIS motor unidimensional model	7.01	1	0.062	0.025	0.109	0.999	1,549
Sample 1, ABIS nonplanning unidimensional model	0.50	1	0.000	0.000	0.059	1.000	1,549
ABIS unidimensional model (12 × 20; 13 × 30; 17 × 19 covariances)	1,170.53	62	0.107	0.102	0.113	0.901	1,549
Steinberg et al. (2013) eight-item unidimensional model (5 × 9 covariance)	424.46	19	0.117	0.108	0.127	0.900	1,549
Spinella (2004) 15-item three-factor model	1,614.48	87	0.106	0.102	0.111	0.871	1,549
Sample 1, Patton et al. (1995) three-factor bifactor model	3,798.43	375	0.077	0.075	0.079	0.825	1,549
Sample 1, ABIS three-factor bifactor model (no covariances)	515.25	52	0.076	0.070	0.082	0.958	1,549

total-score scale represent a subset of the items that we independently selected for the three scales of the ABIS. Given this convergence of findings, we decided to test the unidimensionality of the Steinberg et al. (2013) scale items in our data. In contrast to their findings, but consistent with our own results that were based on the BIS-11 and ABIS models, we found that a unidimensional CFA model failed to acceptably fit the data (Table 6). In the case of the Steinberg et al. (2013) scale and the ABIS items, the patterns of covariation between scale items indicate the need for a more complex explanation of the data (e.g., multiple latent factors). In fact, some form of general impulsiveness may underlie responses to BIS-11 items. However, neither our own findings nor the findings of Steinberg et al. (2013), Spinella (2004), or Patton et al. (1995) provide sufficient evidence to justify measuring such a general impulsiveness factor using a total-score scale. Instead, the evidence supports the use of scales designed to measure separate impulsiveness subtraits, as with the ABIS attentional, motor, and nonplanning scales.

A limitation of our analyses and the resulting ABIS scales is that they measure a relatively focused set of impulsive traits. This results from our decisions to restrict our study to the 30 BIS-11 items and produce an abbreviated scale representing only the core factors reflected by those items. Thus, the ABIS is less comprehensive than measures drawn from a broader set of items, such as the UPPS impulsiveness scale (Whiteside et al., 2005). Our analyses led us to discard several peripheral factors reflecting financial impulsiveness, restlessness, and cognitive instability, among others. Although these constructs are poorly measured by the available set of BIS-11 items, they represent potentially interesting aspects of impulsive personality and behavior. For instance, impulsiveness in financial domains (e.g., "I buy things on impulse") predicted impatient economic decisions in a delay-discounting task ($r = .35$, $p < .05$, 95% CI [.08, .57]). Such minor factors hold promise as a possible basis for expanded or alternative scales measuring the broader set of impulsive traits reflected by the BIS-11 items.

We are optimistic that our findings will inform such a broader discussion and contribute to future attempts to revise the BIS scale. However, in the present, we argue that the ABIS scale scores provide the most efficient and reliable measures of core attentional, motor, and nonplanning impulsiveness currently available. The ABIS generalizes well to independent samples, especially compared with the BIS-11. However, an important direction for future research will be to examine the properties of the ABIS in high-impulsiveness populations such as substance abusers, ADHD patients, and prison inmates.

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