



Short Communication

Stability and change in multi-method measures of impulsivity across residential addictions treatment



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HIGHLIGHTS

- Within-person change in impulsivity across substance abuse treatment was assessed.
- Negative urgency and lack of planning decreased over the course of treatment.
- Behaviorally-assessed inhibitory control improved over the course of treatment.
- First study to show change in UPPS impulsivity across substance abuse treatment
- Findings have implications for clinical assessment and treatment.

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ABSTRACT

Introduction: Although the relations between constructs related to impulsivity and substance use disorders (SUDs) are well established, recent research suggests that changes in impulsivity may be an important mechanism in the recovery process. However, this evidence is primarily based on studies that have examined the relation between changes in impulsivity and substance involvement across the span of several years using self-report measures; thus, it is unclear if these changes are linked across shorter time intervals or extend to behavioral methods of assessment. **Methods:** Using prospective data from 43 participants (mean age = 35.06; 60% female) enrolled in residential substance abuse treatment, the extent to which seven facets of impulsivity (i.e., questionnaire-assessed delay discounting, lack of perseverance, lack of planning, negative urgency, positive urgency, sensation seeking, and behaviorally-assessed inhibitory control) changed across approximately 4 weeks of treatment was examined. **Results:** Dependent group t-tests suggested significant reductions in negative urgency and lack of planning, and significant improvements in inhibitory control. **Conclusions:** Findings indicate that specific impulsivity facets show change across relatively short time frames and suggest nonspecific effects of residential treatment on levels of impulsivity. These results inform the functional relation between facets of impulsivity and substance involvement and have implications for assessment and treatment approaches for SUDs.

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1. Introduction

It is well established that impulsivity-related constructs (as measured by both self-report and behavioral measures; see Cyders & Coskunpinar, 2011) are linked to substance use disorders (SUDs; see

Littlefield & Sher, in press, for a detailed review). More recently, research in non-clinical samples suggests that individuals who demonstrate the sharpest reductions in impulsivity across time tend to show the steepest declines in substance use and related problems (e.g., King, Fleming, Monahan, & Catalano, 2011; Littlefield, Sher, & Wood, 2009). Evidence also suggests that participation in addiction treatment programs predicts declines in impulsivity (Blonigen, Timko, Moos, & Moos, 2009) and that impulsivity change mediates the association between treatment duration and reductions in alcohol-related problems (at least among younger individuals; Blonigen, Timko, Finney, Moos, & Moos, 2011). Thus, a potential mechanism of change

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for SUD interventions may be reductions in impulsivity (see Blonigen, Timko, & Moos, 2013).

However, the extent to which these traits change over shorter intervals that are common in treatment settings (e.g., over the course of a month) is less clear. Prior work suggests that delay discounting is stable among individuals who receive general SUD treatment (Aklin, Tull, Kahler, & Lejuez, 2009; Bickel, Yi, Landes, Hill, & Baxter, 2011; Takahashi, Furukawa, Miyakawa, Maesato, & Higuchi, 2007; Wilde, Bechara, Sabbe, Hulstijn, & Dom, 2013; though see Landes, Christensen, & Bickel, 2012) and that general self-reported impulsivity also remains stable across treatment (Aklin et al., 2009).

Although the aforementioned studies suggest that impulsivity is stable across shorter time intervals associated with treatment, these studies have focused primarily on the rate of delay discounting or have used broad-band, rather than narrow-band, measures of self-reported impulsivity. Other behavioral measures of impulsivity, such as stop-signal tasks, have also been developed and linked to substance use outcomes (see Fillmore & Weafer, 2013; Lejuez et al., 2010, for reviews). Such tasks require individuals to rapidly respond to a “go-signal” and to inhibit responses to a “stop-signal” (see Logan, 1985; Logan & Cowan, 1984). Longer stop-signal reaction times (SSRT) are thought to reflect weaker inhibitory control over behavior (see Logan, 1994) and have been linked to substance use (e.g., Fillmore & Rush, 2002; Li, Milivojevic, Kemp, Hong, & Sinha, 2006; Rubio et al., 2008; see Fillmore & Weafer, for more details). However, the extent to which SSRT may change over the course of treatment is less understood.

As reviewed elsewhere (see Littlefield & Sher, in press; Littlefield, Stevens, & Sher, 2014), specific impulsivity-related facets assessed via self-report relate to distinct substance use outcomes in both non-clinical and clinical samples. For example, a recent meta-analysis (Coskunpinar, Dir, & Cyders, 2013) suggests that alcohol dependence was most highly related to negative urgency (acting rashly when distressed) and lack of planning. Thus, it could be specific facets of impulsivity, such as negative urgency and lack of planning, and may more strongly track with treatment progression compared to other impulsivity facets.

In sum, reductions in certain facets of impulsivity may be an important treatment mechanism for individuals with SUDs, though examinations of within-person changes in facets of impulsivity across shorter time frames common in treatment settings are lacking. In this exploratory study, we used multiple methods to examine whether significant within-person changes in several facets of impulsivity (i.e., questionnaire-assessed delay discounting, lack of perseverance, lack of planning, negative urgency, positive urgency, sensation seeking, and behaviorally-assessed inhibitory control) could be detected across approximately four weeks of residential addiction treatment. We hypothesized that behaviorally-assessed inhibitory control, lack of planning, and negative urgency may show significant within-person changes across treatment, given that behaviorally-assessed measures may be more sensitive to detect changes compared to self-report “trait” measures and that lack of planning and negative urgency appear to show relatively strong relations to alcohol dependence.

2. Materials and methods

2.1. Participants

Participants ($n = 43$) were recruited from a 6-week residential SUD treatment facility located within a rural Southeastern US community. Clients participated in 12-step groups and met regularly with a treatment coordinator. After completing the intake protocol for the treatment facility and any necessary detoxification procedures, potential participants were approached to participate in the study. All participants were reimbursed for their time.

2.2. Measures

Forty-three participants (60% female, 84% Caucasian, average age = 35) completed both baseline and follow-up assessments of the primary study measures (detailed below). Participants also completed basic demographic information and were assessed for past-year DSM-IV diagnosis using the Mini-International Neuropsychiatric Interview (M.I.N.I.; Sheehan et al., 1998). Regarding past-year SUDs for study participants, 57% met the criteria for an alcohol use disorder (dependence and/or abuse), 28% for an amphetamine use disorder, 49% for a cannabis use disorder, 33% for cocaine use disorder, 47% for an opioid use disorder, 40% for a sedative use disorder, and 14% for a hallucinogen use disorder; 65% of the participants met the criteria for two or more SUDs.

2.2.1. Delay discounting

Delay discounting was assessed using the 27-item Monetary-Choice Questionnaire (MCQ; Kirby, Petry, & Bickel, 1999). For each item, the participant chooses between a smaller, immediate monetary reward and a larger, delayed monetary reward. The measure is scored by calculating where the respondent's answers place him/her amid reference discounting curves, where placement among steeper curves indicates higher levels of impulsivity. Analyses used the average discounting curve (k) across small, medium, and large delayed awards (see Kirby et al., 1999, for more details).

2.2.2. Impulsivity

Lack of perseverance, lack of planning, negative urgency, positive urgency (the tendency to act rashly in the presence of extreme positive affect), and sensation seeking was assessed using the 59-item UPPS-P impulsivity scale (Lynam, Smith, Whiteside, & Cyders, 2006). Response options ranged from strongly agree to strongly disagree for each item. Coefficient alpha exceeded .80 for all scales.

2.2.3. Inhibitory control

Behavioral inhibitory control was assessed using the STOP-IT (Verbruggen, Logan, & Stevens, 2008), a computer-administered stop-signal task. Briefly, the stop-signal procedure consists of a visually based primary task, followed 25% of the time by an auditory-based stop signal. STOP-IT includes a practice phase of 32 trials followed by an experimental phase of three blocks of 64 trials (total). SSRT (calculated in the corresponding ANALYZE-IT software; see Verbruggen et al., 2008) was used to measure inhibitory control.

3. Results

On average, baseline and follow-up assessments of the impulsivity facets occurred 28.21 days apart ($SD = 3.60$, range 20–35). Dependent group t -tests were conducted for each of the seven facets of impulsivity. SSRT are not considered valid for participants whose rates of successful inhibitions differ significantly from 50% (see Verbruggen et al., 2008) and thus these participants ($n = 10$) were excluded from analyses involving SSRT.

As shown in Table 1, negative urgency, lack of planning, and inhibitory control exhibited significant within-person reductions across treatment. Effect sizes (corrected for dependence between two means using equation 8 from Morris & DeShon, 2002) for these changes ranged from 0.32 to 0.82, suggesting small-medium effect sizes (Cohen, 1988). Changes in delay discounting, lack of perseverance, positive urgency, and sensation seeking reflected very small effect sizes and were not statistically significant (see Table 1).

4. Discussion

Emerging research suggests that reductions in impulsivity may be a potential mechanism of change for individuals with SUDs, though the

Table 1Dependent *t*-tests and effect sizes for change in impulsivity facets across treatment.

Impulsivity facet	Baseline <i>M</i> (SD)	Follow-up <i>M</i> (SD)	Pre–post correlation	<i>df</i>	<i>t</i>	<i>p</i>	Effect size
MCQ delay discounting	.03 (.04)	.04 (.06)	.56	42	−1.01	0.32	−0.16
UPPS-P lack of perseverance	20.70 (6.27)	20.12 (6.27)	.54	42	0.59	0.56	0.09
UPPS-P lack of planning	25.49 (7.91)	23.63 (7.91)	.73	42	2.10	0.04	0.32
UPPS-P negative urgency	35.16 (9.58)	31.21 (9.47)	.47	42	2.65	0.01	0.40
UPPS-P positive urgency	31.95 (11.98)	30.70 (11.97)	.62	42	0.79	0.43	0.12
UPPS-P sensation seeking	32.79 (9.96)	32.91 (10.15)	.71	42	−0.10	0.92	−0.02
STOP-IT inhibitory control	246.35 (62.79)	213.29 (48.27)	.18	32	2.64	0.01	0.47

Note. Effect sizes were calculated using equation eight from Morris and DeShon (2002). The degrees of freedom are lower for inhibitory control given 10 participants with invalid stop-signal reaction times were excluded from analysis. MCQ = monetary choice questionnaire (Kirby et al., 1999). UPPS-P = UPPS-P impulsivity scale (Lynam et al., 2006). STOP-IT = STOP-IT computer-administered stop-signal task (Verbruggen et al., 2008). With the exception of inhibitory control, all pre–post correlations were statistically significant, $p < .01$.

majority of these studies have examined such changes across considerably longer time frames than is common in many treatment settings and have relied on broad-band, mono-method approaches to assessing impulsivity. Using a more fine grained, multi-method approach, the current results suggest that several facets of impulsivity showed significant reductions across approximately four weeks of treatment, whereas other facets exhibited stability across treatment.

More specifically, behaviorally-assessed inhibitory control exhibited significant reductions across treatment. As noted by several researchers (e.g., de Wit, 2009; Lejuez et al., 2010), poorer performance on behavioral tasks among problematic substance users could reflect a static relationship between impulsivity and SUDs (e.g., individuals predisposed for impulsivity are heightened risk to develop SUDs) or a more dynamic relationship (e.g., impulsive functioning both influences and is influenced by substance use). Consistent with prior research from the existing literature (see Fillmore & Weafer, 2013; King, Patock-Peckham, Dager, Thimm, & Gates, 2014, for recent reviews), evidence from the current study suggests a dynamic relation between SUDs/substance use and inhibitory control indexed by a go–stop task.

The significant within-person reductions in negative urgency, and to a lesser extent lack of planning, are consistent with the larger literature suggesting that certain personality traits may undergo changes over the course of treatment. Barnes (1979) first distinguished between “pre-alcoholic” personality traits and clinical alcoholic personality traits (see Littlefield & Sher, in press, for more details). More recently, there is increasing recognition that treatments aimed at impacting psychopathology can influence personality traits generally (and vice versa; see Barlow, Sauer-Zavala, Carl, Bullis, & Ellard, 2014; Conrod, Castellanos-Ryan, & Strang, 2010; Magidson, Roberts, Collado-Rodriguez, & Lejuez, 2014), with several studies documenting significant changes in neuroticism/emotional stability as a function of treatment (e.g., Brown, 2007; Fruyt et al., 2006; Sutherland, 1997; Tang et al., 2009). Indeed, some have noted that impulsivity may be directly influenced by existing treatment approaches for SUDs (e.g., 12-step programs) given that these interventions seek to enhance self-efficacy, coping skills, and target deficits in self-regulation (see Blonigen et al., 2013, 2009, for more details). However, to our knowledge, this is the first study to document that negative urgency and lack of planning show significant change across treatment and over a relatively brief time frame. Overall, the findings from the current study suggest that certain facets of impulsivity appear to be malleable and clinical assessments and interventions may benefit by considering client’s levels of impulsivity across treatment.

Delay discounting rate, lack of perseverance, positive urgency, and sensation seeking were stable across treatment. The results for delay discounting are consistent with prior studies (i.e., Aklin et al., 2009; Bickel et al., 2011; Takahashi et al., 2007; Wilde et al., 2013). Sensation seeking and lack of perseverance show smaller magnitude relations with alcohol dependence (Coskunpinar et al., 2013) compared to negative urgency and lack of planning and these scales contain items that ostensibly may not track with sustained sobriety and treatment for SUDs (e.g., “I would enjoy water skiing” for sensation seeking). Thus,

stability in these constructs across treatment is not surprising. It is more difficult to evaluate the stability of positive urgency, given few studies have examined the relation between this construct and clinically-relevant SUDs outcomes (see Coskunpinar et al., 2013, for more details).

There are several notable limitations of the current study that suggest potential aims for future research. First, though numerous behavioral measures of impulsivity have been linked to substance use (see Fillmore & Weafer, 2013; Lejuez et al., 2010), the current study only included one measure (a go–stop task); future research examining change in impulsivity across treatment could incorporate other behavioral measures of impulsivity. Second, though repeated measure designs have examined changes in behavioral measures of impulsivity across shorter time intervals than examined here (e.g., over an hour; Miller & Fillmore, 2014), the findings involving SSRT should be interpreted cautiously given potential concerns regarding practice effects on behavioral tasks. Third, this study lacked a “control group” (i.e., individuals similar to the participants in the current study but who did not receive treatment/maintain sobriety). Although it is very doubtful that the UPPS measures (that are typically considered as “trait” measures of impulsivity) would demonstrate significant within-person changes across such a brief timeframe in a control sample and other research in this area also lacked a control group (i.e., Aklin et al., 2009; Takahashi et al., 2007; Wilde et al., 2013), future studies could compare differential change in impulsivity as a function of treatment as well as treatment type. Fourth, overall within-person changes in impulsivity were examined in the current data; subsequent work could examine if person variables (e.g., treatment history, substance of choice) impact potential individual differences in impulsivity change across treatment. Fifth, treatment outcome data and further follow-up measures of impulsivity were not obtained for this somewhat small sample; subsequent research could examine, within a larger sample, whether changes in impulsivity are maintained at later time points and if individual differences in change in impulsivity impact treatment outcomes (e.g., likelihood of relapse).

Conflict of interest

The authors declare that there are no conflicts of interest.

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