



Short Communication

Associations between self-control and dimensions of nicotine dependence: A preliminary report

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HIGHLIGHTS

- ▶ Self-control has been linked to overall nicotine dependence in those who smoke.
- ▶ Associations between self-control and dimensions of nicotine dependence are unclear.
- ▶ We examined the correlation between self-control and several facets of dependence.
- ▶ Self-control negatively correlated with smoking driven by craving and withdrawal.
- ▶ Self-control positively correlated with the consistency of smoking patterns.

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ABSTRACT

Self-control plays an important role in several health-related behaviors, including cigarette smoking. There is some evidence that individual differences in self-control are negatively associated with overall levels of nicotine dependence but, to our knowledge, finer-grained relationships between these constructs have not been explored. This is an important knowledge gap, as nicotine dependence is thought to be composed of separate dimensions that motivate smoking behavior in relatively unique ways. The goal of this preliminary study was to begin to characterize the potentially nuanced associations between self-control and facets of nicotine dependence using data pooled from two previous studies ($n = 282$). Specifically, we examined the correlation between self-control and the following dimensions of nicotine dependence: compulsion to smoke due to craving and desire to avoid withdrawal symptoms; preference for smoking over other reinforcers; reduced sensitivity to the effects of smoking; consistency of smoking patterns; and smoking behavior that is rigid and immutable. In line with prior research, self-control was negatively correlated with overall levels of dependence. As predicted, however, self-control was differentially associated with distinct dimensions of nicotine dependence. Specifically, self-control was negatively correlated with the compulsion to smoke due to craving and desire to avoid withdrawal symptoms but positively correlated with the consistency of smoking patterns. Given the potential conceptual and clinical importance of such effects, additional research investigating the role(s) that individual differences in self-control play in addiction to cigarettes would be useful.

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1. Introduction

Self-control, or the capacity to alter one's own responses in the service of goals and standards (Duckworth & Kern, 2011), plays an important role in several health-related behaviors, including the use of cigarettes (de Ridder, Lensvelt-Mulders, Finkenauer, Stok, & Baumeister, 2012). For instance, relative to those with low self-control, children with high self-control are much less likely to smoke cigarettes during adulthood (Moffitt et al., 2011; Welch & Poulton, 2009). Furthermore, research suggests that individual differences in self-control influence the mechanisms underlying cigarette

use among those who smoke. Specifically, recent findings indicate that smokers who are effective at inhibiting prepotent responses and forgoing immediate rewards in favor of larger delayed rewards (and thus who presumably have greater self-control) are less nicotine dependent overall than smokers who have difficulty regulating behavior and resisting temptation (Billieux et al., 2010; Sweitzer, Donny, Dierker, Flory, & Manuck, 2008).

While it appears that individual differences in self-control are negatively associated with global nicotine dependence, to our knowledge, more nuanced relations between these constructs have not been explored. This is an important knowledge gap, as nicotine dependence is thought to be composed of several distinct facets that motivate smoking behavior in unique ways (Piasecki, Piper, & Baker, 2010; Shiffman, Waters, & Hickcox, 2004; West, 2009). One

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instrument designed to assess separate dimensions of nicotine dependence is the Nicotine Dependence Syndrome Scale (NDSS; Shiffman et al., 2004). Specifically, the NDSS measures five core aspects of tobacco addiction: 1) compulsion to smoke due to craving and desire to avoid withdrawal symptoms (*Drive*); 2) preference for smoking over other reinforcers (*Priority*); 3) reduced sensitivity to the effects of nicotine/smoking (*Tolerance*); 4) consistency/regularity of smoking patterns (*Continuity*); and 5) smoking behavior that is rigid and insensitive to contextual factors (*Stereotypy*). Self-control may be more strongly related to some of these dimensions relative to others. In particular, given its importance for overriding strong but undesirable impulses (Muraven & Baumeister, 2000), it seems especially likely that self-control is inversely related to the degree to which smokers experience cravings to smoke.

In addition to regulating impulses, it recently has been proposed that self-control is critical for establishing stable patterns of behavior (de Ridder et al., 2012). This novel perspective emerged from a meta-analysis revealing that self-control is more strongly associated with behaviors that are relatively automatic than with behaviors that are effortful or demanding. The development of highly regular and inflexible smoking patterns is thought to be a core feature of cigarette addiction (Tiffany, 1990). To the extent that self-control facilitates the acquisition of habits, it follows that individual differences in self-control actually may be *positively* related to the automatization of smoking behavior.

The aim of this preliminary study was to examine associations between self-control and facets of nicotine dependence in cigarette smoking adults. Consistent with previous research, we predicted that self-control would correlate negatively with overall dependence. We hypothesized, however, that self-control would relate differentially to conceptually distinct dimensions of dependence. Specifically, we predicted that self-control would correlate negatively with the degree to which smoking is driven by cravings but positively with the consistency and rigidity of smoking patterns.

2. Method

2.1. Participants

Participants ($n = 282$) were drawn from two prior studies. Study 1 (Wilson, Sayette, & Fiez, 2012) examined the effects of motivational status and smoking opportunity on neural responses to a smoking cue and included male and females and smokers who were and who were not motivated to quit smoking. Study 2 (Wilson, Sayette, & Fiez, in press) examined the neural mechanisms associated with cognitive strategies for coping with exposure to a cigarette cue and included male smokers who were motivated to quit smoking. For both studies, participants had to report smoking an average of 15–40 cigarettes per day for the past 24 months. Table 1 reports demographic characteristics of the individual and combined samples.

2.2. Materials

2.2.1. NDSS

The NDSS consists of 19 statements related to smoking habits (e.g., “I smoke consistently and regularly throughout the day.”), with

participants rating each item according to how well it describes them using a 6-point scale anchored by 1 (“Not at all true”) and 6 (“Extremely true”) (Shiffman et al., 2004). As described in the introduction, the NDSS is designed to assess five theoretically-derived dimensions of dependence. The NDSS also yields a summary measure of dependence (NDSS-Total; 14 items). The subscales of the NDSS have demonstrated adequate internal consistency ($\alpha = .55-.76$), as has the summary score ($\alpha = .84$) (Shiffman et al., 2004). Scores on the NDSS also have been found to correlate with other measures of dependence, predict cessation-related outcomes, and discriminate dependent from regular, but non-dependent, smokers (Shiffman & Sayette, 2005; Shiffman et al., 2004). The NDSS was scored using the regression-based algorithms described by Shiffman et al. (2004), with higher scores indicating a higher level of dependence ($M = 0$, $SD = 1$ in the normative sample).

2.2.2. Self-Control Scale (SCS)

The SCS consists of 36 self-descriptive items (e.g., “I have a hard time breaking bad habits”) rated on 5-point scale anchored by 1 (“Not at all like me”) and 5 (“Very much like me”) (Tangney, Baumeister, & Boone, 2004). The SCS has demonstrated high internal consistency ($\alpha = .89$) and scores on the measure have been found to correlate with a variety of behaviors thought to require self-control (e.g., regulation of eating behavior; Tangney et al., 2004). A total score indexing self-control was obtained by summing all 36 responses (the possible score ranged from 36 to 180). Higher scores on the SCS indicate higher self-control.

2.3. Procedure

Participants deemed eligible based upon a telephone screening were scheduled for an initial baseline session. They were instructed to smoke ad libitum prior to the session. Upon arrival, participants provided an exhaled carbon monoxide (CO) sample in order to verify smoking status ($CO > 10$ ppm). Participants then completed a battery of questionnaires (including the NDSS and SCS) and behavioral working memory tasks. Data from these additional questionnaires and tasks are not a focus of the present study. For Study 2, participants also were trained to use cognitive coping strategies after completing questionnaires and memory tasks. A subset of participants completed a functional magnetic resonance imaging experiment held on a separate day (reported in Wilson et al., in press).

2.4. Statistical analysis

In order to assess the association self-control and overall nicotine dependence, we calculated the Pearson product-moment correlation between total scores on the SCS and NDSS. Additionally, to test the hypothesis that self-control is associated differentially with distinct facets of dependence, we evaluated the correlation between scores on the SCS and scores on each NDSS subscale. The Bonferroni adjustment was used to control for possible inflation of Type I error rate as a result of the number of correlations performed, yielding a corrected alpha of $p < .008$ ($.05/6$).

3. Results

The mean score on the SCS was 114.40 ($SD = 19.82$). Means and standard deviation for scores on the NDSS and correlations between scores on the SCS and NDSS are presented in Table 2. (All correlations that are identified as significant remain so when controlling for the other subscales of the NDSS and for age and smoking rate. For simplicity, only the zero-order correlations are reported.) As predicted, self-control was negatively correlated with overall nicotine dependence (i.e., NDSS total score). As hypothesized, however, self-control was differentially associated with subscales of the NDSS

Table 1
Sample characteristics.

	Full sample ($n = 282$)	Study 1 ($n = 177$)	Study 2 ($n = 105$)
Percent male	71	53	100
Mean age (SD)	31.7 (8.2)	30.2 (7.6)	34.2 (8.6)
Mean years of formal education (SD)	12.5 (2.1)	12.6 (2.2)	12.5 (1.9)
Mean cigarettes/day (SD)	20.3 (5.3)	20.1 (5.1)	20.6 (5.5)

Table 2

Means and standard deviations for NDSS scores and correlations between NDSS scores and scores on the SCS.

	<i>M</i>	<i>SD</i>	Correlation with SCS	<i>p</i> value
NDSS-Total	.23	.90	-.25	<.001*
NDSS-Drive	.17	1.03	-.28	<.001*
NDSS-Priority	-.04	1.06	-.19	.001*
NDSS-Tolerance	-.26	1.01	-.04	.55
NDSS-Continuity	-.22	.98	.21	<.001*
NDSS-Stereotypy	.32	.92	.15	.01

Note. NDSS = Nicotine Dependence Syndrome Scale. SCS = Self-control Scale.

* Statistically significant after Bonferroni-adjustment (corrected alpha of $p < .008$).

assaying distinct facets of dependence. Specifically, self-control correlated negatively with the NDSS subscale capturing compulsive smoking driven by craving and the desire to avoid withdrawal symptoms (NDSS-Drive). In contrast, self-control correlated positively with the development of highly consistent smoking patterns (NDSS-Continuity) and the rigidity and immutability of smoking behavior (NDSS-Stereotypy), although the association with *Stereotypy* did not remain significant after the Bonferroni adjustment was applied. Finally, we found that self-control correlated negatively with the preference for smoking over alternative sources of reinforcement (NDSS-Priority), a dimension for which we did not have a priori predictions.

4. Discussion

Self-control was negatively correlated with overall nicotine dependence, which is in line with results from previous research examining the association between total dependence and the ability to inhibit responses (Billieux et al., 2010) and decline tempting but suboptimal rewards (Sweitzer et al., 2008). Our findings extend this research by demonstrating that the relationship between self-control and cigarette addiction is complex, varying according to the domain of dependence being considered. Specifically, self-control was negatively related to the experience of cravings to smoke but positively linked to the consistency of behavioral smoking patterns.

Our results suggest that craving may play less of role in maintaining smoking behavior for those with high, relative to low, self-control. One possibility is that smokers with comparatively high self-control may structure their cigarette use in ways that reduce the likelihood of experiencing craving. In other words, high self-control might facilitate the development of patterns of smoking that allow one to avoid circumstances that give rise to craving, a notion that is consistent with recent developments concerning the connection between self-control and the regulation of behavior (de Ridder et al., 2012; Hofmann, Baumeister, Forster, & Vohs, 2012). In support of this view, we found that self-control was positively correlated with the regularity of smoking behavior. Research examining self-control in relation to smoking habits and the frequency of craving episodes (e.g., using ecological momentary assessment methods) would be informative. Similarly, it also would be interesting to examine the extent to which within-individual changes in the capacity for self-control, such as short-term reductions in the ability to exert self-control due to fatigue (Muraven & Baumeister, 2000) and long-term improvements in self-control ability due to practice (Muraven, 2010), are associated with subsequent changes in patterns of smoking and urge.

Taken together, our findings indicate that self-control may modulate the automatization of smoking, or the extent to which cigarette use is habitual and relatively insensitive to situational factors such as craving states. As noted in the introduction, the development of a rigid smoking repertoire is thought to be one of the hallmarks of addiction. According to one prominent model (Tiffany, 1990), the consistent practice of drug-seeking and drug-taking behaviors causes components of these actions to take on the properties of an automatic

process. Of note, Tiffany's cognitive framework also holds that drug craving occurs when automatized drug use behavior is prompted but impeded in some manner. From this perspective, a positive association between self-control and smoking automaticity may have important – and somewhat paradoxical – clinical implications. Namely, to the extent that smokers with high self-control are more effective at establishing craving–minimizing smoking habits than those with low self-control during uninterrupted cigarette use, they consequently may be more prone to experiencing craving when smoking routines are interrupted, such as during a quit attempt (though the former may be better equipped than the latter to regulate craving when it does occur; e.g., see Berkman, Falk, & Lieberman, 2011). Research exploring this possibility would be informative.

A limitation of the current study is that self-control and nicotine dependence were assessed via self-report. It would be useful to examine associations between nonverbal measures of these constructs in future research. Additionally, research exploring how dimensions of dependence relate to constructs that appear to overlap conceptually with self-control, such as distress tolerance (Brown, Lejuez, Kahler, & Strong, 2002) and task persistence (Brandon et al., 2003), is warranted.

In conclusions, findings from this preliminary study suggest that self-control is related to dimensions of nicotine dependence in ways that may have significant conceptual and clinical implications. Specifically, elevated self-control appears to be associated with smoking behavior that is driven by habit more so than craving, and vice versa. Additional research exploring the links between self-control and nicotine dependence ultimately may prove useful for individually-tailoring smoking cessation interventions based upon personality characteristics (e.g., emphasizing the management of craving and the establishment of non-smoking habits for smokers with low and high levels of self-control, respectively). Given the enormous costs and high relapse rates associated with cigarette smoking (Piasecki, 2006), even a modest improvement in treatment effectiveness gained through such approaches would have substantial public health benefits.

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Contributors

SJW designed the study and wrote the protocol. RRM conducted literature searches and provided summaries of previous research studies. SJW conducted the statistical analysis and wrote the first draft of the manuscript. Both authors contributed to and have approved the final manuscript.

Conflict of interest

The authors declare that they have no conflicts of interest.

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