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Lower Task Persistence In Smokers with Schizophrenia as Compared to Non-Psychiatric Control Smokers

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Abstract

One contributing factor to difficulty in quitting smoking may be task persistence, which can be viewed as a behavioral manifestation of distress tolerance, and describes the act of persisting in a difficult or effortful task. Task persistence was assessed in smokers with schizophrenia and schizoaffective disorder (SZ/SA; N=71) and non-psychiatric controls (N=78) before a quit attempt. These data support the hypothesis that smokers with SZ/SA display less task persistence than do non-psychiatric controls when persistence is measured via mirror tracing and a 2-item persistence measure. Lower persistence may partially explain the reduced smoking cessation successes of smokers with SZ/SA as compared to the general population.

These data also replicate findings regarding relationships between histories of ability to quit smoking and task persistence and expand them to a new population of smokers. The absence of a diagnostic status by length of previous abstinence interaction suggests that the contribution of task persistence to smoking cessation is similar for smokers with and without schizophrenia. Future studies should evaluate the ability of task persistence to predict abstinence from cigarettes *prospectively* among smokers with schizophrenia.

Keywords

task persistence; distress tolerance; cigarette; tobacco; smoking cessation

Tobacco use is the leading preventable cause of death in the United States - responsible for 443,000 U.S. deaths each year (Centers for Disease Control; CDC, 2008). Approximately 40% of smokers in the U.S. try to quit each year (CDC, 2008), however few use recommended methods and most relapse within the first eight days (Fiore et al., 2008). With such high rates of relapse, it is imperative that we identify contributing factors.

The need to find predictors of tobacco dependence treatment success may be especially great in smokers with schizophrenia. In comparison to the general population, individuals with

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schizophrenia are more likely to be current smokers (CDC, 2008; NIDA, 1999) and demonstrate altered cigarette puffing resulting in greater nicotine intake per cigarette (Olinicy, Young, & Freedman, 1997; Williams, et al., 2005; Tidey, Rohsenow, Kaplan, & Swift, 2005). They are less likely to quit smoking (Lasser, et al., 2000) and, even among those motivated to quit, appear to have lower quit rates in randomized trials (Williams & Hughes, 2003).

Task Persistence (and its sister concept, distress tolerance) may contribute to success in quitting smoking. Task persistence may be thought of as a behavioral manifestation of distress tolerance, and describes the act of persisting in a difficult or effortful task. Smoking cessation and maintenance of abstinence requires persistence in a wide range of behaviors to tolerate unpleasant withdrawal symptoms, frustrating cravings, and other challenges associated with quitting smoking. In theory, smokers higher in task persistence should be more successful at smoking cessation.

Several studies support this theory. For example, non-smokers showed greater persistence on an anagram task (Quinn et al., 1996) and a mirror tracing task (Quinn et al., 1996) than did non-smokers. Additionally, non-smoking adolescents had significantly higher persistence scores on a 2-item self-report measure than did adolescent current smokers (Steinberg et al., 2007). Among adolescent smokers, higher scores were detected for those planning to quit smoking as compared to those with no plans to quit (Steinberg, et al., 2007).

Persistence scores also differentiated between those with a history of abstinence as compared to those unable to quit. For example, current smokers with histories of at least 3-months abstinence persisted longer on breath-holding, a stressful paced auditory serial addition task, and inhaled carbon dioxide-enriched air as compared to those unable to remain abstinent for at least 3-months (Brown et al., 2002). In contrast, in a small sample of 22 smokers, Zvolensky et al (2001) were unable to detect significant differences in breath-holding endurance between smokers with and without histories of week-long quit attempts.

The purpose of this study is to test the hypotheses that 1) Smokers with schizophrenia will display reduced task persistence as compared to non-psychiatric control smokers and 2) The established relationship between task persistence and past quit-attempts in non-psychiatric samples will also hold for smokers with schizophrenia.

Method

Participants

A total of 203 smokers were recruited from New Jersey state funded tobacco dependence treatment clinics called "QuitCenters" through clinician referrals or responses to recruitment flyers. Of those, 149 ultimately met all inclusion criteria and were enrolled. Reasons for exclusion included: a) Failed diagnostic screen as per the criteria described below (15 with bipolar disorder, 2 with current major depressive disorder, 1 current anxiety disorder), b) Already passed quit date or already using smoking cessation medications (16 participants), c) Participant changed mind about participating (11 participants), d) Smoked fewer than 10 cigarettes per day (10 participants), e) Did not have a goal to quit smoking in the next several weeks (7 participants), f) Transportation issues (5 participants), g) Lost contact between screening and baseline appointment (4 participants), and h) Mini Mental Status Exam < 24 (1 participant).

Of the remaining 149 cigarette smokers seeking tobacco dependence treatment, 71 had schizophrenia or schizoaffective disorder (SZ/SA) and 78 were non-psychiatric control smokers (Control). Though it took approximately twice as long to recruit smokers with SZ/

SA as Control smokers, we were able to recruit smokers with SZ/SA from the QuitCenters at sufficient numbers because our research group conducted other studies focusing on this population and referred them to QuitCenters if they expressed interest in quitting. We confirmed all diagnoses of schizophrenia or schizoaffective disorder with the Structured Clinical Interview for the DSM-IV (SCID; Spitzer, Williams, Gibbon, & First, 1985). Control smokers were also screened to ensure they did not have any other psychotic disorders, a current major depressive episode, or a current or past manic episode using the SCID-IV (Spitzer, et al., 1985). Inclusion criteria for all subjects included age ≥ 18 , meeting DSM-IV diagnostic criteria for schizophrenia or schizoaffective disorder (for the SZ/SA group), were willing to adhere to the study protocol, were able to give informed consent (Folstein Mini Mental Status Examination (Folstein, Folstein, & McHugh, 1975) score > 23), and were stable on their current antipsychotic medication for one month, if appropriate. Subjects were excluded if they smoked fewer than 10 cigarettes a day, were currently using any FDA approved smoking cessation medications, or if they had made a previous quit attempt within the past 3 months (to ensure that this was a new quit attempt, rather than a continuation of a recent, failed attempt)

Measures

Mirror Tracing Persistence Task (MTPT)—This procedure has been shown to increase participants' frustration and stress (e.g., Kasrowicz, Manuck, Malkoff, & Krantz, 1990; Allen, Matthews, & Sherman, 1997) and was used in two previous studies of smoking and persistence (i.e., Quinn, et al, 1996; Brandon et al., 2003) and prospectively predicted smoking cessation in the Brandon et al. (2003) study. Participants traced 8 geometric figures by hand while only viewing their hand indirectly through a mirror. Participants were instructed that they could proceed to the next figure if they completed the figure or if they felt unable to complete it. Experimenters told participants to proceed to the next figure if they were still tracing after five minutes. Scores were determined by calculating the mean number of seconds spent on incomplete figures.

Breath Holding Task (Hajek et al., 1987)—Participants were asked to hold their breath for as long as they could safely do so. Hajek et al. (1987) found breath-holding endurance to prospectively predict abstinence while Brown et al. (2002) found breath-holding endurance to be related to retrospective quitting behaviors.

Smoking History Questionnaire—This questionnaire contained 9 questions on smoking history, tobacco related diseases, and quit attempts made over the participants' lifetime.

Fagerstrom Test for Nicotine Dependence (FTND)—A widely used, self-report measure of physical dependence on cigarettes (Heatherton, Kozlowski, Frecker, & Fagerstrom, 1991). Dependence scores can range from a low of 0 to a high of 10.

Change Questionnaire (Miller, Moyers, & Amrhein, 2005)—This 12-item, theory-driven measure is rated on a 10 point scale - with higher ratings indicating higher motivation to change.

The Temperament and Character Inventory – Persistence Scale (TCI-9-P; Cloninger, et al., 1994)—The full TCI-9 is a 240-item, true-false, self-report questionnaire that measures seven dimensions of personality, including the original three Tridimensional Personality Questionnaire scales. The TCI-9 also includes a fourth temperament dimension, "Persistence," which was the focus of this study. Only the 8-item

Persistence scale was used in this study. Total scores could range from 0 (low persistence) to 8 (high persistence).

Two-Item Persistence Measure (Steinberg et al., 2007)—Two items from the Tridimensional Personality Questionnaire (TPQ; Cloninger, 1987) with a modified response format (i.e., True/False to 4-choice) appeared to be consistent with task persistence (Steinberg et al., 2007). These items were shown to differentiate between smoking and non-smoking adolescents and between adolescent smokers with and without plans to quit smoking (Steinberg et al., 2007). Total scores could range from 0 for low persistence to 8 for high persistence.

Procedure

After providing written informed consent, participants completed assessment measures within two weeks of their target quit date. Participants were paid \$30 compensation for their time and then continued with treatment as usual at one of two New Jersey state-funded “QuitCenters” – smoking cessation clinics providing comprehensive, evidence-based (Fiore et al., 2008; Foulds, et al., 2006) treatment from a staff of trained tobacco treatment specialists. All participants received individual counseling and were encouraged to utilize at least one of the seven FDA approved smoking cessation medications.

Results

We evaluated demographic differences between diagnostic groups (SZ/SA vs. Control) using independent samples t-tests for continuous variables and chi-square tests for dichotomous variables. We did not detect differences between groups on age, racial categories, or attainment of high school diploma or GED ($p > .05$). Chi square analyses detected significant differences between groups with respect to gender, $\chi^2(1) = 4.77, p = .029$, employment, $\chi^2(1) = 8.25, p = .004$, and receipt of public financial assistance, $\chi^2(1) = 18.86, p < .001$. Control smokers were more likely to be women. Control smokers were less likely to be unemployed or receiving public assistance than were those with SZ/SA - though there were very high rates of unemployment (76% for controls and 93% for those with SZ/SA) and receipt of public assistance (68% for controls and 96% for those with SZ/SA) in both groups.

We then evaluated the relationship between persistence and the demographic variables previously found to be related to diagnostic category (i.e., gender, employment, and receipt of public financial assistance). Independent samples t-tests indicated that males persisted in breath-holding significantly longer than females, $t(147) = 2.83, p = .005$, and females scored significantly higher than males on the 2-item Persistence Measure, $t(147) = -2.11, p = 0.036$ though mirror tracing and the TCIP were unrelated to gender ($p > .05$). Those receiving public assistance persisted for significantly less time on the mirror tracing task, $t(147) = 2.92, p = .004$, and scored significantly higher on the 2-item persistence scale, $t(147) = -2.06, p = 0.041$, than those not receiving public assistance. Those who were unemployed displayed a trend towards reduced persistence on the mirror tracing task as compared to those who were employed, $t(148) = 1.97, p = .053$. No other persistence measures were related to public assistance or employment.

We also evaluated differences in tobacco use between diagnostic categories (SZ/SA vs. control smokers). There were no differences between groups ($p > .05$) on number of serious quit attempts, length of longest cigarette abstinence, cigarettes smoked per day, or motivation to quit (though a statistical trend was found for motivation to quit favoring the Control group). Those with SZ/SA were, however, significantly more nicotine dependent

based on the Fagerstrom Test for Nicotine Dependence (FTND; Heatherton et al., 1991), $t(147) = -2.13, p = .035$.

Differences in Persistence between SZ/SA and Control Smokers

We evaluated the relationship between the dependent variable, “persistence” and the independent variable, “diagnostic category” in four separate analyses of covariance (ANCOVA) for each of four persistence variables (i.e., mirror-tracing persistence, 2-item self-report persistence measure, Temperament and Characteristics Inventory – Persistence Scale (TCI-P), and breath-holding persistence). Covariates included FTND score, gender, and receipt of public assistance because these variables were significantly related to diagnostic category and persistence variables. The models included a gender X diagnostic category interaction term, but not a public assistance X diagnostic category interaction term because the latter would have too few participants in the cell reflecting those with SZ/SA but not receiving public assistance ($n = 3$). We applied a Bonferroni correction to all analyses.

Non-psychiatric control smokers demonstrated significantly greater persistence on the mirror tracing task, $F(1,148) = 9.62, p = .002$, and on the two-item Persistence Measure, $F(1,148) = 5.22, p = .023$ than did smokers with SZ/SA. We did not detect significant differences between groups for persistence as measured by the TCI-P, $F(1,148) = .98, p = 0.32$, or for breath-holding persistence, $F(1,148) = .75, p = 0.39$. We did not detect significant gender X disorder interactions for any of the persistence variables (all $p > .05$).

Persistence and Previous Quitting History

We also evaluated the relationship between persistence and past history of ability to maintain sustained abstinence from cigarettes. We conducted several 2 (Control vs. SZ/SA) X 2 (abstinence vs. no abstinence) analyses of variance. Abstinence intervals were retrospective and included four dichotomous items: at least 48-hours, at least one-week, at least one-month, and at least one-year of abstinence. The four persistence variables were: Mirror-tracing persistence, Two-item self-report persistence, Temperament and Characteristics Inventory – Persistence Scale, and Breath-holding persistence.

We found significantly greater mirror tracing persistence among participants reporting histories of abstinence for at least one-week, $F(1,148) = 3.98, p = .048$, and at least one-year, $F(1,148) = 6.03, p = .02$, as compared to those unable to maintain abstinence for those time periods. We also detected statistical trends indicating greater mirror tracing persistence among participants reporting histories of abstinence for at least 48-hours, $F(1,147) = 3.59, p = .06$, and at least 30-days, $F(1,148) = 3.69, p = .057$, as compared to those unable to maintain abstinence for those time periods. We were unable to detect a significant relationship between persistence and prior greatest length of abstinence at any time period (i.e., 48-hours, one-week, one-month, or one-year) when persistence was measured by breath-holding, or by scores on the TCI-P or two-item Persistence Measure (all $p > .05$). The interaction term was non-significant for all measures of persistence for all for abstinence durations ($p > .05$).

Discussion

This manuscript describes the first study to examine task persistence in smokers with schizophrenia or schizoaffective disorder. These data support the hypothesis that smokers with schizophrenia display less task persistence than do non-psychiatric control smokers when persistence is measured via two of the four persistence measures used (mirror tracing and 2-item Persistence Measure, but not breath-holding or 9-item TCI-P). Of the measures used in this study, mirror tracing may be most suited as an assessment when comparing

smokers with SZ/SA and smokers without psychiatric illness because persistence on the mirror tracing task is not reliant on cognitive ability (as in a paper/pencil measures) or physical health status (as in breath-holding). Breath-holding has been used in multiple persistence studies (Hajek et al., 1987; Hajek, 1991; Zvolensky et al., 2001; Abrantes et al., 2008; Brown et al., 2009), and the discordance between mirror tracing and breath-holding results is somewhat surprising. While we statistically controlled for the effects of gender in the model, the gender differences between diagnostic categories may have made detection of differences between diagnostic groups difficult. Males held their breath for significantly longer than did females, and chi-square analyses revealed significant differences in proportions of males and females among the smokers with SZ/SA (56% male) and non-psychiatric control smokers (39% male).

The finding that non-psychiatric control smokers display greater persistence than smokers with SZ/SA may contribute one piece of the puzzle for why smokers with schizophrenia have more difficulty quitting smoking than do smokers in the general population (Williams & Hughes, 2003). Several research groups have demonstrated a relationship between persistence and ability to quit when examined retrospectively (Quinn et al., 1996; Steinberg et al., 2007; Brown et al., 2002) and when examined prospectively (Brandon et al., 2003; Brown et al., 2009; Hajek et al., 1987). If task persistence is related to ability to quit smoking, and is lower in smokers with schizophrenia than in non-psychiatric control smokers, then this construct may help to partially explain the greater difficulty experienced by smokers with schizophrenia trying to quit.

It is not known how task persistence maps onto the neuropsychiatric aspects of schizophrenia, which are broad and include deficits in memory, executive function, and motor performance. Persons with schizophrenia, however, perform poorly on tasks that require sustained attention or vigilance with observed deficits in working memory (Tamminga, Thaker, & Medoff, 2002). Working memory, in turn, permits task-relevant information to be briefly retained, and is also linked to success in quitting smoking and may offer clues to task persistence (Moss, Sacco, Allen, Weinberger, Vessicchio, & George, 2009).

These data also replicate previous findings regarding the relationship between retrospectively assessed ability to quit smoking and task persistence (Quinn et al., 1996; Steinberg et al., 2007; Brown et al., 2002) and expand them to a new population of smokers (i.e., those with SZ/SA). We found that smokers who were able to quit in the past for at least 48-hours, one-week, one-month, and one-year were significantly more persistent on the mirror tracing task than were those who were unable to maintain those levels of abstinence (though the 48-hour and one-month time-periods were only statistical trends ($p = .06$ and $p = .057$ respectively)). No other measures of persistence were related to abstinence. Although persistence was related to ability to quit in the past in this sample of smokers with and without schizophrenia, there was no statistically significant interaction between diagnostic category and abstinence. This suggests that the role of task persistence on cessation outcome appears to be equivalent in both populations of smokers. Limitations of this study include a relatively small sample size (less than 80 participants representing each of two diagnostic categories) and the use of measures not yet formally validated in smokers with SZ/SA populations. These limitations could have hindered our ability to detect significant relationships between variables if they existed. The sample is also limited in that it includes only smokers with SZ/SA so findings cannot necessarily be generalized to the full SZ/SA population at large (e.g., non-smokers with SZ/SA). Additionally, because we wanted to minimize differences between diagnostic groups, the non-psychiatric controls were from a lower than average socioeconomic status and their data may be less generalizable to the general population, though not substantially different than the population of non-psychiatric

smokers – a large proportion of whom are from a low socioeconomic status (Hagman, Delnevo, Hrywna, & Williams, 2008). All participants (with SZ/SA and Controls) were also seeking treatment for smoking cessation which may be related to differences in task persistence as compared to other smokers not wishing to quit, or even to smokers wishing to quit on their own. Given that task persistence may actually be higher in smokers wishing to quit (Steinberg et al., 2007), the restricted range of persistence scales in this motivated sample was likely to have made it more difficult to detect differences between groups.

Despite these limitations, the evaluation of persistence and history of ability to maintain abstinence adds to the literature because of the inclusion of smokers with SZ/SA. It will also be important to evaluate the ability of task persistence to predict ability to abstain from cigarettes *prospectively* among smokers with schizophrenia. The largest potential clinical implication for these data is that if individuals with SZ/SA have reduced task persistence when compared to non-psychiatric controls, efforts should be made to either increase task persistence for tolerating or coping with the challenges associated with smoking cessation, or reducing the magnitude of those challenges, so that less task persistence is required. The latter might be accomplished through approaches such as pharmacotherapy to reduce the severity of nicotine withdrawal symptoms or exposure therapy to reduce the frequency and severity of cue-elicited cravings. Increasing smokers' level of task persistence may be more difficult, but potential approaches include general effort training (Eisenberger & Rhoades, 2001), cognitive behavioral therapy (Beck, Wright, Newman, & Liese, 1993), or specific training in persisting in abstinence-related behaviors (see Brandon, Vidrine, & Litvin, 2007). Alternatively, it has been suggested that individuals low in the related construct of distress tolerance would benefit from Acceptance and Commitment Therapy (Hayes, Strosahl, & Wilson, 1999) that teaches smokers to accept and tolerate abstinence-related stressors rather than struggling to alleviate them (see Brown, Lejuez, Kahler, Strong, & Zvolensky, 2005). All these approaches have the potential to benefit smokers, but may be particularly needed for smokers with SZ/SA.

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Table 1

Participant Characteristics

	Schizophrenia (n=71)				Control (n=78)				<i>t</i> (148)
	<i>M</i>	<i>SD</i>	%		<i>M</i>	<i>SD</i>	%	$\chi^2(1)$	
Serious Quit Attempts	2.89	2.41			2.64	2.91			-0.56
Cigarettes Per Day	18.79	9.0			18.51	9.36			-0.19
FTND	5.57	1.97			5.37	1.86			-2.13*
Longest tobacco abstinence (days)	13442	31693			9719.50	27042			-0.77
Motivation to Quit	108.38	16.16			112.85	9.16			1.97 ^a
Age	42.74	9.91			45.37	11.78			1.46
Female Gender				43.66			61.54		4.77*
African American				53.52			58.97		0.45
Caucasian				29.58			33.33		0.24
At least High School				70.42			76.92		0.81
Diploma/GED				92.96			75.64		8.25*
Unemployed				95.77			67.95		18.86**
Receiving public assistance									

Note:

* $p < .05$,** $p < .001$,^a $df = 130$

Table 2
 Non-Psychiatric Controls Score Higher on Task Persistence than Smokers with Schizophrenia

	Schizophrenia (n=71)		Control (n=78)		<i>F</i> (1,149)
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	
Mirror Tracing (in secs)	61.08	57.38	100.34	73.23	9.62*
Breath-holding (in secs)	33.23	18.08	36.51	16.84	0.98
2-item self-report	6.61	1.43	6.95	1.23	5.22*
TCl-Persistence	4.15	1.50	4.32	1.18	0.75

Note:

* $p < .05$,

** $p < .001$