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A prospective study of persistence in the prediction of smoking cessation outcome: results from a randomized clinical trial

David Kalman[1], **Randall Hoskinson**[2], **Usha Sambamoorthi**[1], and **Arthur J. Garvey**[3]

[1]University of Massachusetts School of Medicine, 55 Lake Avenue North, Worcester MA 01655 USA

[2]Rhode Island Hospital, 593 Eddy Street Providence, RI 02903 USA

[3]Harvard School of Dental Medicine, 188 Longwood Avenue, Boston, MA 02115 USA

Abstract

Research has had mixed success in identifying pretreatment variables which can be used to guide treatment and enhance outcome. A critical first step in the process is to identify variables that reliably predict outcome. Some recent studies, largely retrospective, have found mixed evidence on the relationship between task persistence and smoking outcome measures. In the present study, we use data from a randomized clinical trial (N=241) to prospectively investigate the ability of persistence to predict outcome. Findings from multivariate analyses did not support our hypotheses: persistence did not predict outcome. We discuss these findings in relation to previous studies by focusing on theoretical and measurement issues related to the study of persistence in smoking cessation research. We conclude by recommending directions for future research, including conceptual clarification of the relationship between persistence and theoretically related constructs and investigations of variables that may moderate relationships between these constructs and cessation outcome.

Keywords

tobacco; smoking; nicotine dependence; randomized clinical trial

1. Introduction

Researchers have recently investigated the influence of task persistence in the relapse process following a quit smoking attempt (see review by Brown, Lejuez, Kahler, Strong & Zvolensky, 2005). These investigators theorized that smokers who relapse soon after their quit day may do so because of low task persistence in the face of nicotine-induced withdrawal distress. If smokers with low task persistence are especially vulnerable to relapse, then these smokers may benefit from treatments that are developed to target this risk factor (Brown et al., 2009a; Hickman, Stromme, Lippman, 1998).

Corresponding Author: David Kalman Psychology Service (116B) ENRM VAMC Bedford, MA 01730 Tel. (781) 687-3019, Fax (781) 687-2169 david.kalman@.va.gov.

David Kalman conducted work on this project while at the Boston University School of Medicine.
Randall Hoskinson conducted work on this project while at the Harvard School of Dental Medicine.

Work on this project was performed at the Harvard School of Dental Medicine.

Three prospective studies investigating task persistence with laboratory measures have been conducted to date with participants who planned to quit smoking. In their study of a small sample of unaided smokers followed for 28 days after their quit day, Brown et al. (2004) found that task persistence on physical stressors (but not a psychological stressor) was significantly associated with reduced risk of lapsing. Brown et al. (2009b) investigated the ability of a prequit measure of persistence to predict outcome in 81 smokers planning to quit without assistance. Again, physical challenge tasks requiring persistence but not a psychological challenge task predicted smoking cessation outcome. During the baseline assessment in a clinical trial, Brandon et al. (2003) used two laboratory tasks to assess task persistence with 144 participants prior to their quit day. In multivariate analyses, they found that persistence on one of two psychological challenge tasks (mirror tracing but not anagram puzzles) predicted who maintained continuous abstinence and a trend was found for time to relapse.

We believe that further study of the persistence construct is needed before conclusions about its utility as a treatment outcome predictor and, ultimately, the focus of treatment interventions can be confidently drawn. As already noted, three prospective studies to date (including one small study with a short follow up) have investigated the predictive ability of this construct. All but one study used laboratory tasks to assess persistence. As Steinberg et al. (2007) argue, a brief self-report measure of persistence, if its predictive validity for smoking cessation can be demonstrated, may be more practical to administer in a clinic setting than a behavioral measure.

The purpose of the present study is to prospectively investigate the role of a self-report measure of persistence in predicting outcome in smokers from a community sample enrolled in a clinical trial. Consistent with prior research and theory, we hypothesized that persistence would predict early cessation outcome (i.e., smoking status within the first twenty-four hours of a quit attempt). We also examined the relationship of persistence to time to first lapse and to seven-day point prevalence at three-month follow up.

2. Methods

2.1. Participants

The present study is based on data collected from 241 participants recruited for a treatment study for tobacco dependence. The purpose of the larger study was to test the hypothesis that cessation efficacy can be enhanced by increasing the frequency of counseling during the first two postquit weeks (i.e., when risk of relapse is greatest). All participants smoked a minimum of 5 cigarettes per day (CPD), were motivated to quit, and were in good health. Medical exclusion criteria included uncontrolled hypertension, cardiovascular disease or symptoms and insulin-dependent diabetes. Psychiatric exclusion criteria included: history of schizophrenia, current severe depression (past 3 months), unstable bipolar disorder, alcohol or drug dependence (past 12 months), and/or hospitalization for psychiatric reasons in the past 12 months. Institutional review board approval was obtained from the Harvard Medical School/ Harvard School of Dental Medicine Committee on Human Studies and the Boston University Institutional Review Board. All participants gave written consent.

2.2. Treatment Procedures

Participants were randomly assigned to receive either standard or “front-loaded” counseling. Participants in both conditions received two prequit and twelve postquit individual counseling sessions. However, participants assigned to standard counseling treatment received two of the twelve sessions in the first two post quit weeks, whereas, participants assigned to frontloaded treatment received six of the twelve counseling sessions in the first two weeks following their quit day. All participants received nicotine transdermal patches for 12 weeks.

2.3. Measures

Persistence—Persistence was assessed using the Persistence Scale of the Temperament and Character Inventory (TCI; Cloninger, Przybeck, Svrakic & Wetzel, 1994). This is an eight-item scale with a Cronbach alpha of 0.72 in our sample. Examples of scale items are, "I am usually so determined that I continue to work long after other people have given up" and "I usually push myself harder than most people do because I want to do as well as I possibly can."

Additional Questionnaires—At the baseline visit, the questionnaire included demographic variables, quitting and smoking history, and current tobacco use. The Fagerstrom Test of Nicotine Dependence (FTND; Hetherington, Kozlowski, Frecker & Fagerstrom, 1991) was included in the baseline questionnaire to measure nicotine dependence. The negative affect scale of the Positive and Negative Affect Scales (PANAS-NA; Watson, Clark & Tellegen, 1988) was used to measure affect.

Carbon Monoxide (CO)—CO was used as a measure of tobacco exposure. We analyzed participant breath samples using a Vitalograph BreathCO (Lenexa, Kansas) instrument. Ambient CO levels were recorded and subtracted from expired CO values for each participant.

2.4. Data Analysis

Data analyses were conducted using SAS software (version 9.1.3). The effect of persistence on outcome was examined in nested models using multivariate analyses. Three sets of analyses were conducted corresponding to three outcome variables (cessation status 24 hours after a quit attempt, time to first lapse, cessation status at three months postquit). Logistic regression and Cox proportional hazards regression were used to examine our hypotheses. Demographic variables (age, gender, race and marital status) were entered in step one of each analysis; the FTND was entered in step 2; the PANAS-NA was entered in step 3; treatment condition (patch vs. placebo patch) was entered in step 4; and the variable persistence was entered in step 5. Following the method by Rosner (2000), we determined that the power to detect a difference between means was greater than 80% for all of our analyses (2-sided alpha, $\overset{p}{<} < .05$). These power analyses were based on the ability to detect a difference of half a standard deviation between means.

3. Results

3.1. Baseline characteristics and overall outcomes

The mean age of participants was 47.6 (*SD* = 11.5), 48% were male, 72% were white, and 38% were married. Participants smoked 18.1 cigarettes per day (CPD) (*SD* = 7.9) and the mean FTND score of the sample was 5.0 (*SD* = 2.3). The mean values for persistence was 2.47 (*SD* = 0.59). Twenty-five percent of participants lapsed within 24 hours, the mean time to first lapse was 31.4 days (median = 10.5 days), and 38.5% were abstinent from smoking at the three-month follow up assessment.

3.2. Does persistence predict smoking cessation outcome?

We conducted nested multiple logistic regressions to test the association between persistence and 24-hour outcome (see Table 1). In step one of the analyses, only the variable, marital status, was significant: married participants were more likely to be abstinent. In step two, there was a trend for FTND: lower scores predicted smoking abstinence. The additional variables entered in steps 3-5 were not significant.

Multiple logistic regressions were used to predict the 3-month post-quit outcome (see Table 2). These regressions showed a trend for nicotine dependence to predict outcome: lower scores

predicted smoking abstinence. None of the variables in the other steps were significant. In the final model, none of the variables were significant in predicting 3-month post-quit outcome.

Finally, Cox proportional hazards regressions were conducted for time to first lapse. Only the variable, nicotine dependence, predicted smoking relapse, i.e., grater nicotine dependence predicted less time to smoking relapse ($x^2 = 3.71$, hazard ratio = 1.07 [1.00 – 1.14], p = .05). In the final model, nicotine dependence remained significant.

We also refined our persistence measure by including only those items that correlated most highly with each other; the strongest inter-correlations were found for four items. Results of these analyses were consistent with those obtained with the full scale, however.

4. Discussion

In this prospective study, we were unable to find support for our hypothesis: persistence did not predict smoking cessation outcome. Thus, we were unable to replicate findings from previous studies (e.g., Brandon et al., 2003). One potentially important difference among studies concerns the approach to measuring persistence. Unlike the behavioral measure of persistence in studies cited above (e.g., Brandon et al., 2003), our self-report measure of persistence does not impose a stressor on subjects as an analogue to the stress of quitting smoking. As Brown et al. (2005) argue, as a predictor of smoking cessation outcome, persistence may be especially important to assess in the presence of a stressor. In their formulation, smokers who relapse soon after their quit day often do so because they have low distress tolerance, i.e., they have great difficulty tolerating the stress of nicotine withdrawal symptoms (see also Baker, Piper, McCarthy, Majeski & Fiore, 2004). Brown and colleagues also theorized that these smokers would show impaired task persistence, a construct they conceptualized as a behavioral marker of low distress tolerance. Accordingly, they suggest task persistence is best assessed under conditions of distress.

Hickman et al. (1998) reported the results of a study investigating whether task persistence can be taught. In their study, which was based on learned industriousness theory (Eisenberger, 1992), participants who were exposed to high-effort tasks demonstrated greater persistence when presented with a different task than a group exposed to low-effort tasks or a control group. The use of behavioral techniques to enhance persistence follows from the principles of learning theory, i.e., that behavior is shaped through the application of reinforcement contingencies. By contrast, Brown et al. (2005) argue that persistence can be taught with psychotherapeutic techniques that are designed to enhance distress tolerance. These techniques, which are drawn from Acceptance and Commitment Therapy, are described in Brown et al. (2009a) together with modestly promising results of a pilot test ($n = 16$) of their application with smokers who had never been quit for longer than 72 hours following a quit attempt in the previous 10 years (see also Hayes, Strosahl & Wilson, 1999). While no participant was smoking abstinent at the 26-week follow up, five participants (31.25%) were smoking abstinence at the end-of-treatment (4-weeks postquit day) and four (25%) were still abstinent at the eight-week follow up.

The present study has important strengths, including its prospective design, the use of a sample of community-based smokers, and its sample size. Limitations include lack of a laboratory stressor and lack of follow-up measures of persistence. Follow-up measures of persistence immediately after a quit attempt should be included in future studies to investigate the effect of quitting on persistence and whether persistence in the post quit period predicts outcome. Future research should also consider factors that may moderate the relationship between distress tolerance and persistence under demanding conditions such as that involved in quitting smoking. For example, the self-control strength theory and research suggests that the degree to which an outcome is desired and the perceived likelihood of success can moderate this

relationship (Muraven & Slessareva, 2009). The identification of individual difference variables will lead to the creation of a richer theory.

More work is also needed to better understand the relationship between distress tolerance and persistence. As noted earlier, Brown et al. (2005) conceptualize persistence as a behavioral marker of distress tolerance. However, distress tolerance is linked to the hypothalamus-pituitary-adrenal axis (Sapolosky, Romero & Munck, 2000), whereas, recent research suggests that persistence is linked to areas in the lateral orbital and medial prefrontal cortex and the ventral striatum (Gusnard et al., 2003). These findings suggest that distress tolerance is more emotionally based and persistence is more cognitively based. In summary, the findings of the present study suggest that persistence is best measured under conditions of task demand in studies of predictors of and individual differences in smoking cessation outcome.

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Table 1

Adjusted Odds Ratios and 95% Confidence Levels for Logistic Regression on Smoking Status 24 Hours after a Quit Attempt

Variable	Chi Square	AOR (95% CI)	p
Step 1			
Age	0.26	1.01 (0.98, 1.03)	.61
Gender	2.05	0.64 (0.35, 1.18)	.15
Race	0.05	1.08 (0.53, 2.21)	.82
Marital Status	4.20	0.50 (0.26, 0.97)	.04
Step 2			
Nicotine Dependence (FTND)	3.56	1.14 (0.99, 1.30)	.06
Step 3			
Negative Affect (PANAS)	0.00	1.00 (0.62, 1.62)	1.00
Step 4			
Treatment condition	0.25	0.86 (0.47, 1.57)	.62
Step 5			
Persistence (TPQ-P)	0.66	1.24 (0.74, 2.10)	.42

AOR = Odds Ratio; CI = Confidence Interval; p = probability; FTND = Fagerstrom Test for Nicotine Dependence; CPD = cigarettes per day; PANAS = Positive and Negative Affect Scale; TPQ-P = Temperament and Personality Questionnaire (Persistence Scale).

Table 2

Adjusted Odds Ratios and 95% Confidence Intervals for Logistic Regression on 7-day Point Prevalence at 3 Months Postquit Day

Variable	Chi Square	AOR (95% CI)	p
Step 1			
Age	0.05	1.00 (0.98, 1.03)	.82
Gender	2.43	1.54 (0.89, 2.66)	.12
Race	1.41	1.47 (0.78, 2.78)	.23
Marital	0.92	1.31 (0.75, 2.29)	.34
Step 2			
Nicotine Dependence (FTND)	3.15	0.90 (0.80, 1.01)	.07
Step 3			
Negative Affect (PANAS)	0.75	0.81 (0.51, 1.30)	.39
Step 4			
Treatment condition	2.62	1.55 (0.91, 2.65)	.11
Step 5			
Persistence (TPQ-P)	1.27	1.31 (0.82, 2.08)	.26

AOR = Odds Ratio; CI = Confidence Interval; p = probability; FTND = Fagerstrom Test for Nicotine Dependence; CPD = cigarettes per day; PANAS = Positive and Negative Affect Scale; TPQ-P = Temperament and Personality Questionnaire (Persistence Scale).