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## Predictors of relapse among smokers: Transtheoretical effort variables, demographics, and smoking severity

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### Abstract

The present longitudinal study investigates baseline assessments of static and dynamic variables, including demographic characteristics, smoking severity, and Transtheoretical Model of Behavior Change (TTM) effort variables (Decisional Balance (e.g. Pros and Cons), Situational Temptations, and Processes of Change) of relapse among individuals who were abstinent at 12-months. The study sample (N=521) was derived from an integrated dataset of four population-based smoking cessation interventions. Several key findings included: Participants who were aged 25–44 and 45–64 (OR = .43,  $p = .01$  and OR = .40,  $p = .01$ , respectively) compared to being aged 18–24 were less likely to relapse at follow-up. Participants in the control group were more than twice as likely to relapse (OR = 2.17,  $p = .00$ ) at follow-up compared to participants in the treatment group. Participants who reported higher Habit Strength scores were more likely to relapse (OR = 1.05,  $p = .02$ ). Participants who had higher scores of Reinforcement Management (OR = 1.05,  $p = .04$ ) and Self-Reevaluation (OR = 1.08,  $p = .01$ ) were more likely to relapse. Findings add to one assumption that relapsers tend to relapse not solely due to smoking addiction severity, but due to immediate precursor factors such as emotional distress. One approach would be to provide additional expert guidance on how smokers can manage stress effectively when they enroll in treatment at any stage of change.

### Keywords

smoking; relapse; maintenance; stage of change; transtheoretical model; processes of change; pros and cons; self-efficacy; temptations

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Smoking continues to be the leading cause of preventable disease, general morbidity, and mortality in the United States (CDC, 2010). Before becoming completely abstinent, most smokers make a number of quit attempts (between 4 and 14) (CDC, 2013; Kaida, Edwards, Fraser-Lee, Kunyk et al., 2004) making relapse a common factor within the behavior change process (e.g. DiClemente, 2006). Although relapse is prevalent, most smoking cessation interventions group relapsers with those who never quit in their final analyses. This ignores a potentially important subgroup from a public health perspective (Sun, Prochaska, Velicer & Laforge, 2007).

Utilizing a Transtheoretical Model of Behavior Change (TTM) framework provides a theoretical guide for examining how relapsers differ from individuals that never quit. The TTM is organized around individuals' Stage of Change, or their readiness to change a target behavior. Readiness to change a behavior (i.e. smoking cessation) is mediated by three core constructs or "effort" variables: Decisional Balance, Situational Temptations, and Processes of Change. Decisional Balance refers to an individual's perception of the importance of the Pros vs. the Cons of smoking. Situational Temptations assess how tempted people are to engage in smoking in specific situations. Processes of Change are the frequency with which an individual engages in ten specific cognitive and behavioral activities that have been shown to facilitate forward movement through the stages.

Significant predictors of successful cessation/abstinence have been found to include smoking addiction severity, age, education (Velicer, Redding, Sun, & Prochaska, 2007), and Stage of Change and TTM effort variables (e.g. Redding, Prochaska, Paiva, Rossi et al., 2011; Blissmer, Prochaska, Velicer, Redding et al., 2010). In order to better serve the full population of smokers, a more comprehensive understanding of static and dynamic variables that could differentiate those who relapse from those who stay quit could provide insights for improving tailored cessation interventions. As such, the present study aimed to determine which of the variables (demographic, smoking severity and TTM effort) could best predict relapse at 24 months among past smokers that were quit at 12 months.

## Methods

### Intervention

This study involved secondary data analysis on a combined dataset of four population-based studies (Prochaska et al., 2001; Prochaska et al., 2004; Prochaska et al., 2005; Velicer et al., 2004). All four studies used a common TTM-tailored expert system intervention that was printed and delivered to participants' homes. Participants also received stage-matched self-help manuals. Control groups received assessments only. Participants were assessed at 6 month intervals post-baseline through 30 months.

### Participants

The original four studies recruited only current smokers (in the pre-Action stages) at baseline. Since the intention of the present study is to examine relapse, participants in the Action/Maintenance stages at 12 months post-baseline (N=661) and who had complete data at 24-months post-baseline (N=521) were included. Participants who reported that they were

in any of the pre-Action stages (Precontemplation, Contemplation, or Preparation) at 24-months were classified as relapsers, and those who were in Action/Maintenance at 24-months were classified as maintainers.

## Measures

**Severity of Smoking**—Number of cigarettes smoked daily and time to first cigarette, two main parts of the Fagerstrom index that reflect the degree of addiction were assessed (Fagerstrom, Heaherton, & Kozlowski, 1990) in addition to previous longest quit attempt in months and number of quit attempts in the past year.

**Stage of Change**—An algorithm assessed a participant's readiness to quit smoking, with response options of 1= Precontemplation (not intending to quit smoking within the next six months), 2=Contemplation (intending to use the quit smoking within the next 6 months), 3= Preparation (intending to use the quit smoking within the next 30 days), 4= Action (quit smoking within the last six months), and 5=Maintenance (quit smoking more than six months ago) (Prochaska & DiClemente, 1992).

**Decisional Balance**—An 8-item decisional balance measure assessed the relative importance of various advantages (Pros) and disadvantages (Cons) in an individual's decision to smoke. Participants were asked to rate the importance of each item on a 5-point Likert scale, ranging from 1 = "Not At All Important" to 5 = "Extremely Important" (Velicer et al., 1985).

**Situational Temptation**—A 9-item measure assessed the intensity of urges to engage in smoking when faced with difficult situations. Psychometric analysis revealed a hierarchical structure with three first-order factors: Positive Social, Negative Affect, and Habit Addictive (Velicer et al., 1990). The higher the self-efficacy individuals have, the lower are their temptations. Participants rated their confidence to be able to quit smoking in the presence of temptations on a 5-point Likert scale ranging from 1= "Not At All Tempted" to 5="Extremely Tempted" (Velicer et al., 1990; DiClemente, 1986, 1981).

**Processes of Change**—This measure (Fava, Rossi, Velicer, & Prochaska, 1991) evaluates 10 processes using a five-point Likert scale of frequency of use in the past month (1 = *Never* to 5 = *Repeatedly*). Confirmatory factor analysis supported the 10-process measurement model (Prochaska, et al., 1988), with two higher order factors of five processes each labeled: experiential and behavioral.

## Results

Approximately half of the sample was female (58.7 %), with a mean age of 41.45 (SD = 13.45). The majority of the sample was White (95.9%) and married or living with a partner (65.9 %), and about half of the sample having some high school education or holding a high school diploma (52.4%). There were no significant differences between treatment and control groups on any of the demographic characteristics (i.e. gender, age, race, education, marital status). There was a significant difference between groups for time until first cigarette, with the treatment group having significantly more participants waiting more than

10 hours to smoke their first cigarette of the day (8.1%) than the control group (2.3%) ( $\chi^2(1) = 13.92, p < .01$ ). There was also a significant difference between groups for longest quit attempt, with the treatment group having significantly more participants with their longest quit attempt range between 36–72 months (17.5%) than the control group (6.3%) ( $\chi^2(1) = 19.68, p < .001$ ).

Crosstabs indicated that 35.0% of the control group (total N=300) participants relapsed, while 19.9% of the treatment group (total N=221) participants relapsed at follow-up. There was a statistically significant relationship between being in the treatment group and relapsing compared to maintaining at 24-months ( $\chi^2(1) = 14.19, p = .00$ ). Odds ratios for baseline demographic variables and severity of smoking variables, and TTM effort variables, are presented in Tables 1 and 2, respectively.

## Discussion

The primary goal and strength of this study was to explore static as well as dynamic variables as potential predictors of relapse within a multivariate and longitudinal study design. The majority of participants (71.4%) who quit at 12 months maintained at 24 months. As expected, being in a control group was a salient predictor of relapse. Only age was a predictor of relapse with participants aged 25–64 less likely to relapse than participants aged 18–24. Nationally, this period of human development (i.e., ages 18–24) has the highest rates of smoking, as well as intense psychological distress (CDC, 2012), and appears most likely to increase relapse risk even if we can encourage a quit attempt.

In line with previous findings (Velicer et al., 1990) the psychological aspects of smoking severity assessed by Habit Strength as well as the Total Situational Temptations predicted that those who scored higher were more likely to relapse at follow-up. Yet, there were no similar effects with the conventional ways of assessing smoking severity based on daily cigarette use and time until first cigarette. The discrepancy in findings between the two ways of measuring addiction severity indicate that a more comprehensive way of assessing addiction via immediate emotional and social factors, also termed as “process-situational,” an approach pioneered by Marlatt and Gordon (1985), may better capture mechanisms of relapse. Furthermore, this finding supports that relapsers tend to relapse not solely due to smoking addiction severity, but due to immediate precursor factors such as emotional distress (e.g. Shiffman & Waters, 2004).

Previous quit attempts suggest interesting patterns, with those who had been quit between 36–72 months in the past being less likely to relapse compared to those who had only been quit for a month. However, it was also observed that those who made 3–10 quit attempts in the past compared to none were more likely to relapse.

Based on the significance of the Total Situational Temptations score finding, positive social experiences related to smoking, in which a positive affective component (e.g. socializing) is present, also can instigate relapse (Velicer et al., 1990). Pros and Cons did not differentiate between relapsers and maintainers. Pros and cons are most important in preparing individuals to take action but not for maintaining that action.

Similar to what has been found in previous studies (Redding et al., 2011; Sun et al., 2007), Self-Reevaluation (SR) was a key process that differentiated relapsers from maintainers. Those studies have indicated that once individuals quit, they benefit from decreasing their reliance on SR and increasing their utilization of Behavioral Processes such as Helping Relationships for potential stress management and support, and Stimulus Control for alteration of environmental cues to maintain the cessation process. Typically, SR has been shown to be utilized as one is getting prepared to quit smoking. It is a process that allows an individual to realize that quitting smoking goes beyond just changing behavior but that it can be an important part of their identity.

PRIME Theory (West, 2006) proposes that establishing a “strong non-smoker” identity may be an important factor protecting against the situational temptation to smoke that could lead to relapse (Vangeli, Stapleton, & West, 2010). A preliminary study (Vangeli et al., 2010) found that identity became more established over time as a smoker and raised the question of whether the process of identity change from a smoker to a non-smoker might be expected to take longer among those with a more extensive smoking history. If that is, in fact, seen in replication studies, helping smokers toward a strong “non-smoker” identity through use of SR may be a useful goal in future tailored interventions to prevent relapse.

One other process, Reinforcement Management (RM) was a significant predictor of relapse. RM, a behavioral process, has been found to be utilized when taking action to quit (e.g., rewarding one’s self or being rewarded by others for making changes). Although practicing RM can encourage someone to quit, it may not be sufficient for maintenance as that process entails an omission of a behavior (e.g. not smoking) rather than the active participation in a new behavior.

This study had several limitations. Although sample characteristics were representative of the larger population-based clinical trial, homogeneity of race limits generalizability of findings. Second, the long recall period between baseline and prior years allows for potential recall bias about quit attempts and prior smoking behavior (Gilpin & Pierce, 1994). Additionally, relapsers were evaluated at one time point only. Looking at relapsers at multiple timepoints likely will add to the literature. It is also important to note that given that an odds ratio is reflective of a one unit increase in the dependent variable, dichotomization may have inflated classification (e.g. treatment vs. control group).

Our findings add to the literature that relapse may be much more of an affective and situational process among smokers. Studies suggest that nicotine craving, an intense desire to smoke, typically lasts around 5–12 minutes, and that cravings, as well as increases in smoking rate and nicotine intake are highly related to acute physical or psychological stress (e.g. al’Absi, Wittmers, Erickson, Hatsukami, & Crouse, 2003). The interaction between craving and stress is important to examine, since stress-induced craving states have been associated with relapse (Ng & Jeffery, 2003). As such, one approach would be to provide additional expert guidance on how smokers can manage stress effectively when they enroll in treatment at any Stage of Change. Future research needs to find ways to capitalize on TTM variables over the course of the intervention, as well as after treatment ends given that smoking cessation warrants a lifelong commitment.

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### Highlights

- Participants aged 25–64 compared to those aged 18–24 were less likely to relapse at follow-up.
- Not being in a treatment group doubled the odds of relapsing at follow-up.
- Relapse occurred not solely due to smoking addiction severity, but due to immediate precursor factors such as temptations.
- Participants who had higher scores of Reinforcement Management and Self-Reevaluation were more likely to relapse at follow-up.

**Table 1**

Odds Ratios for baseline demographics and severity of smoking variables evaluating the chances of participants who relapsed vs. maintained.

	<i>p</i>	Odds Ratio	95% CI	
			Lower	Upper
<b>Control Group</b>	0.00	<b>2.17***</b>	1.44	3.25
<b>Female</b>	0.86	1.04	0.70	1.53
<b>Non-White</b>	0.10	2.14	0.87	5.27
<b>Education</b>				
College and/or Graduate School	0.17	0.76	0.52	1.12
<b>Marital Status</b>				
Married or Living with Partner	0.82	-	-	-
Not Married	0.56	1.18	0.68	2.04
Separated or Divorced	0.51	0.83	0.48	1.44
Widowed	1.00	0.00	0.00	
<b>Age</b>				
18–24	0.05	-	-	-
25–44	0.01	<b>0.43*</b>	0.23	0.81
45–64	0.01	<b>0.40*</b>	0.2	0.8
65+	0.08	0.51	0.24	1.09
<b>Daily Cigarette Use</b>				
9	0.20	-	-	-
19-Oct	0.38	1.28	0.74	2.24
20–29	0.05	1.74	1.00	3.04
30+	1.14	1.68	0.85	3.33
<b>Time to First Cigarette of the Day</b>				
15 minutes	0.42	-	-	-
30 minutes	0.33	1.34	0.75	2.38
60 minutes	1.00	1.00	0.55	1.81
1–10 hours	0.35	0.78	0.46	1.31
10–1000 hours	0.74	0.85	0.33	2.19
<b>Number of Quit Attempts</b>				
None	0.19	-	-	-
1–2	0.16	1.41	0.87	2.26
3–10	0.03	<b>1.70*</b>	1.05	2.77
11–98	0.37	1.56	0.56	4.07
<b>Longest Time Being Quit</b>				
1 month	0.15	-	-	-
2–12 months	0.3	0.77	0.47	1.26
12–36 months	0.59	0.87	0.52	1.46
36–72 months	0.02	<b>0.42*</b>	0.2	0.89

*Note.* CI = confidence interval.

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 $p < .001$ ,

\*  
 $p < .05$ .

**Table 2**

Odds Ratios for TTM effort variables evaluating the chances of participants who relapsed vs. maintained.

TTM Effort Variables	<i>p</i>	Odds Ratio	95% CI	
			Lower	Upper
<b>Decisional Balance</b>				
Pros	0.16	1.03	0.99	1.06
Cons	0.94	1.00	0.97	1.03
<b>Situational Temptations</b>				
Positive Social	0.77	1.01	0.96	1.06
Negative Affect	0.75	1.01	0.96	1.06
Habit Strength	0.02	<b>1.05*</b>	1.01	1.10
Total	0.00	<b>1.06**</b>	1.03	1.10
<b>Processes of Change</b>				
CC	0.76	0.99	0.95	1.04
CR	0.5	0.98	0.92	1.04
DR	0.09	0.95	0.9	1.01
ER	0.19	1.04	0.98	1.09
HR	0.13	0.96	0.92	1.01
RM	0.04	<b>1.05*</b>	1.00	1.10
SC	0.18	0.97	0.92	1.02
SL	0.72	0.99	0.94	1.04
SO	0.9	1.00	0.95	1.05
SR	0.01	<b>1.08*</b>	1.02	1.13
Experiential	0.49	1.02	0.97	1.07
Behavioral	0.31	0.97	0.92	1.03
Total	0.63	0.96	0.96	1.03

Note. CI = confidence interval.

\*  $p < .05$ ,

\*\*  $p < .00$ .

CC = Counterconditioning, CR = Consciousness Raising, DR = Dramatic Relief, ER = Environmental Reevaluation, HR = Helping Relationship, RM = Reinforcement Management, SC = Stimulus Control, SL = Self-Liberation, SO = Social Liberation, SR = Self-Reevaluation.