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Drug and Alcohol Dependence

Independent and interactive effects of real-time risk factors on later temptations and lapses among smokers trying to quit

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ABSTRACT

Purpose: The current study sought to expand our understanding of relapse mechanisms by identifying the independent and interactive effects of real-time risk factors on temptations and the ability to resist temptations in smokers during a quit attempt.

Procedures: This study was a secondary analysis of data from 109 adult, treatment-seeking daily smokers. Ecological momentary assessment data was collected 4 times a day for 21 days following a quit attempt and was used to assess affect, urge, impulsiveness, recent cigarette exposure, and alcohol use as predictors of temptations to smoke and smoking up to 8 h later. All smokers received nicotine replacement therapy and smoking cessation counseling.

Findings: In multinomial hierarchical linear models, there were significant main (agitation odds ratio (OR) = 1.22, 95% CI = 1.02–1.48; urge OR = 1.60, 95% CI = 1.35–1.92; nicotine dependence measured by WISDM OR = 1.04, 95% CI = 1.01–1.08) and interactive effects (agitation × urge OR = 1.12, 95% CI = 1.01–1.27; urge × cigarette exposure OR = 1.38, 95% CI = 1.10–1.76; positive affect × impulsiveness OR = 2.44, 95% CI = 1.02–5.86) on the odds of temptations occurring, relative to abstinence without temptation. In contrast, prior smoking (OR = 3.46, 95% CI = 2.58–4.63), higher distress (OR = 1.30, 95% CI = 1.06–1.60), and recent alcohol use (OR = 3.71, 95% CI = 1.40–9.89) predicted smoking versus resisting temptation, and momentary impulsiveness was related to smoking for individuals with higher baseline impulsiveness (OR = 1.12, 95% CI = 1.04–1.22).

Conclusions: The risk factors and combinations of factors associated with temptations and smoking lapses differ, suggesting a need for separate models of temptation and lapse.

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1. Introduction

Tobacco use remains the leading cause of preventable death in the United States (Centers for Disease Control and Prevention, 2008; U.S. Department of Health and Human Services, 2004). Although many smokers attempt to quit annually, roughly 95% of smokers who quit for 24 h return to smoking within 3 months (Centers for Disease Control and Prevention, 2011; Fiore et al.,

2008). Understanding relapse processes is critical to identifying intervention targets and improving cessation rates.

In particular, research is needed to understand the proximal, phasic influences on smoking. Differences in the determinants of motivational lapses (i.e., temptations to smoke) and behavioral lapses (i.e., a return to smoking after quitting) may inform treatment delivery. Identifying risk factors for motivational lapses may suggest targets to strengthen a smoker's confidence or commitment to quitting. Likewise, identifying factors that differentiate episodes when smokers resist a temptation and those when they yield to temptation and smoke may help identify early warning signs of cessation failure.

Several studies have attempted to identify antecedents of temptations and smoking using ecological momentary assessment

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(EMA; Stone and Shiffman, 1994) data collected several times daily from smokers attempting to quit (Shiffman, 2009; Shiffman et al., 1996, 2007). Research suggests negative affect and urge differentiate temptations and smoking (Shiffman et al., 1996), however extant studies are limited to comparisons of smokers' first lapse and first temptation event. Each smoking opportunity after quitting is a critical choice point to smoke or abstain, and smokers may have multiple periods of abstinence, temptation, and smoking while quitting (Baker et al., 2011; Prochaska and DiClemente, 1983). Studying the antecedents to multiple temptation and smoking events after quitting, while controlling for smoking status, may build on past research and identify factors that influence smoking behavior more generally.

Additionally, much of the research to date has examined risk factors in independent, not combined models. A recent study by Lam et al. (2014) was among the first to investigate ways relapse risk factors interact. Their results suggested smoking urge significantly interacted with negative affect and being around smokers to influence lapse risk. Specifically, states of negative affect and exposure to others smoking were more strongly associated with lapses in times of low vs. high urge. While these findings suggest the importance of examining multiple predictor models and interactive effects, all risk factors and outcomes were examined concurrently, so the direction of the effect is unclear (i.e., it is possible low urge is due to a recent lapse instead of the cause of smoking). Studying ways risk factors combine to influence smoking risk *before* smoking occurs may improve our understanding of lapse mechanisms and suggest just-in-time interventions.

The current project fills gaps in the literature using time-lagged hierarchical linear modeling to identify risk factors of later temptations and smoking. Additionally, this project is one of the first to examine how well-known relapse risk factors (i.e., affect, urge, and environmental context) interact to predict later temptations or lapses during a quit attempt. According to the relapse model put forth by Marlatt and Gordon (1985), relapse is preceded by a high-risk situation which can include specific emotional and physiological states (i.e., affect, urge) and environmental cues. Available research further supports the role of these risk factors as predictors of smoking behavior. Specifically, smoking to alleviate negative affect (i.e., withdrawal) may maintain smoking over time (Baker et al., 2004), and momentary negative affect predicts temptations and lapses (Minami et al., 2014; Shiffman et al., 1996). At present, it is unknown how positive affect relates to the occurrence of temptations and success resisting them. However, there is evidence that positive affect is inversely related to urge intensity (Doran et al., 2008) and smoking lapse (Strong et al., 2009), independent of negative affect, suggesting a protective role against smoking after quitting. Furthermore, craving or urge to smoke is a central process motivating smoking behavior (Baker et al., 1987; Robinson and Berridge, 1993; Tiffany, 1990) and urge intensity predicts temptations and lapses after quitting (Shiffman et al., 1996). Additionally, aspects of the environment, such as being around other smokers and drinking alcohol, are known predictors of temptations and smoking (Kahler et al., 2009; Shiffman et al., 1996; Zhou et al., 2009).

Prior studies have modeled these risk factors independently, however this may provide limited information about lapse processes because these factors may combine in unique ways to influence risk. For example, craving is theorized to be central to relapse risk, yet it only explains 6% of the variance in smoking behavior across laboratory studies (Tiffany et al., 2009), and smokers often relapse despite using pharmacotherapies designed to attenuate craving intensity (Fiore et al., 2008). These results highlight that urge alone only partially explains smoking behavior, suggesting that it may be important to consider how other momentary factors, such as mood or context, interact with urge to better explain the influence on smoking behavior.

The primary aim of the current project is to identify ways affect, urge, and environmental context interact to influence the occurrence of later temptations and smoking after a target quit smoking day. We contrasted episodes of strong temptation to episodes of untempted abstinence to identify factors influencing temptation risk. We also contrasted episodes of smoking to episodes of strong temptations without smoking to identify factors related specifically to the inability to resist smoking. Based on prior research, we expected negative affect, urge, access to cigarettes, and recent alcohol use would be positively related to temptation and smoking risk, while we expected positive affect would be protective against risk (e.g., Kahler et al., 2009; Lam et al., 2014; Shiffman et al., 1996; Strong et al., 2009). We hypothesized a priori two-way interactions between negative affect, urge, and context. Specifically, we expected high momentary negative affect and urge would synergistically increase risk for later temptations (vs. abstinence) or smoking (vs. temptations) by increasing the incentive value of smoking. We expected heightened urge or negative affect would lead to smoking more often in the presence (vs. absence) of cigarettes or when smokers were disinhibited from recent alcohol use (vs. no alcohol use).

A secondary aim was to examine the influence of impulsiveness on temptations and smoking after quitting. Impulsiveness has been conceptualized as a stable trait differing between individuals, although recent research indicates facets of impulsiveness vary within individuals and are influenced by mood state (Weafer et al., 2013), nicotine deprivation (Field et al., 2006; Mitchell, 2004), and stress exposure (Schepis et al., 2011). Therefore, impulsiveness may be a dynamic, state-dependent construct. To investigate the relation between state and trait impulsiveness, we explored an EMA measure of behavioral impulsiveness as a predictor of temptations and smoking and examined trait impulsiveness as a moderator of this effect. We expected a stronger relation between momentary impulsiveness and smoking for individuals with high (vs. low) baseline impulsiveness. We also explored secondary two-way interactions between behavioral impulsiveness and affect, urge, and context. We expected impulsiveness would undermine the protective effect of positive affect and would exacerbate risk in combination with negative affect, urge, access to cigarettes, or recent alcohol consumption.

2. Method

2.1. Participants

This project analyzed EMA data collected for 21 days post-quit from 109 treatment-seeking smokers engaged in a quit-attempt. All participants received nicotine lozenge treatment (2 mg or 4 mg for 12-weeks based on their time to first cigarette in the morning) and counseling (four 15-min sessions). Eligibility criteria for participation included: at least 18 years old; English literate; heavy smoking ($\geq$10 cigarettes per day for $\geq$6 months with expired carbon monoxide $\geq$8 parts per million); motivation to quit smoking ($\geq$6 on a 10-point scale); no lozenge contraindications (e.g., heart disease, pregnancy or breastfeeding); no bipolar or psychosis history; not living with study participants; and no current use of other tobacco, cessation treatments, marijuana, or illegal drugs.

2.2. Procedure

Participants were screened for eligibility by phone and attended an orientation to complete consent procedures, baseline assessments, and learn to use the EMA device (Palm Z22 Palmtop Computers, Palm Inc., Santa Clara, CA). Participants attended 5 weekly visits from 1 week pre-quit to 3 weeks post-quit and received feedback about EMA adherence.

2.3. Baseline assessments

Pre-quit baseline measures assessed nicotine dependence [Wisconsin Inventory of Smoking Dependence Motives (WISDM-68; Piper et al., 2004) and Fagerström Test for Nicotine Dependence (FTND; Heatherton et al., 1991)], smoking history,