EXAMINING MOMENT TO MOMENT AFFECTIVE DETERMINANTS OF SMOKING

RATE FOLLOWING A QUIT ATTEMPT IN A SAMPLE OF HOMELESS ADULT DAILY

SMOKERS: AN ECOLOGICAL MOMENTARY ASSESSMENT STUDY

A Dissertation

Presented to

The Faculty of the Department of Psychology

at the

University of Houston

In Partial Fulfillment

of the Requirements for the Degree

Doctor of Philosophy

in Psychology

by

Elaine Savoy

May 2016

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An Abstract of EXAMINING MOMENT TO MOMENT AFFECTIVE DETERMINANTS OF

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ABSTRACT

Tobacco use, mainly cigarette smoking, is a prevalent and deadly habit, and disproportionately affects homeless individuals, who have fewer resources and increased stressors compared to domiciled smokers. Despite these disadvantages, the majority of homeless smokers report a desire to quit yet little is known about how to facilitate smoking cessation among this population. Limitations of previous work includes small samples and low quit rates – even on the quit date. The current study used ecological momentary assessments (EMAs) and focused on cigarettes smoked per day (CPD) following a specific quit attempt to more effectively study smoking cessation among this group. Using the relapse prevention model to inform the hypotheses, the current study sought to examine whether moment-to-moment changes in affect [e.g., negative affect (NA), positive affect (PA), and stress] predicted changes in CPD following a specific quit attempt among a homeless sample of smokers. Participants were 67 homeless daily smokers aged ≥18 from a transitional shelter program in Dallas, Texas. Separate hierarchical linear modeling (HLM) on each predictor was performed to examine the associations between affective variables and CPD in covariate-adjusted analyses. Model diagnostics were run to test whether necessary model assumptions were met, then HLM was re-run on each predictor to obtain final results. Results indicated that increases in PA during the post-quit week significantly predicted fewer CPD ($p=.0025$). Increases in NA during the post-quit week was marginally associated with greater CPD ($p=.0548$). Homeless smokers may be less likely to increase their cigarette consumption during periods of greater positive affect throughout the post-quit week. Intervention programs could utilize this information as well as recent smoking cessation literature focusing on affective variables (using domiciled smoker samples) to examine the efficacy of a harm reduction approach to eventual cessation.

Key Words: homeless smokers, affect, ecological momentary assessments (EMA), cigarettes per

day (CPD), negative affect, positive affect, stress

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Introduction

Tobacco use is prevalent worldwide and claims 5.4 million lives each year, causing it to be the leading preventable cause of morbidity and mortality in the world (World Health Organization Global Report, 2012). Cigarette smoking comprises the majority of tobacco use relative to the use of other products, such as cigars, pipes, and smokeless tobacco (Centers for Disease Control, 2014c). Cigarette smoking is a continuing health issue for 17.8% of adults and causes more than 480,000 deaths per year in the United States alone with 5.6 million of today's youth younger than 18 years old predicted to die prematurely from a smoking-related disease (Centers for Disease Control and Prevention, 2014; Centers for Disease Control and Prevention, 2014c). Smoking is related to a multitude of negative health outcomes such as increased risk of developing coronary heart disease, stroke, cardiovascular disease, myocardial infarction, and lung disease (Centers for Disease Control, 2014d). Furthermore, smoking can cause a host of different types of cancers including lung, oral and nasal cavity, esophageal, stomach, liver, etc. (Internal Agency for Research on Cancer, 2012). The current smoking prevalence of adults in the United States is 17.8%, and while this is a decrease from previous decades, continued efforts towards smoking intervention and cessation strategies are needed given a lack of significant declines in recent years (Centers for Disease Control and Prevention, 2014a).

The reduction in cigarette smoking among the U.S. population due to public health efforts is commendable, particularly when considering that in 1965, 42.4% of adults smoked (American Lung Association, 2011). Recent decades have seen several gains contributing to today's current prevalence rate, including the advent of nicotine replacement therapy (NRT), the development of manualized cessation treatment protocols, as well as the focus on

prevention and harm reduction in the media and public policy (Centers for Disease Control and Prevention, 2014a). However, these gains mask the fact that the smoking prevalence has become exceedingly concentrated in certain societal groups, including the economically disadvantaged (Centers for Disease Control, 2011a). For example, current statistics indicate that 41.9% of individuals with a General Educational Development equivalent (GED) smoke versus 9.1% of individuals with a college degree. Likewise, 27.9% of those who live below the poverty line smoke compared to the 17.0% living at or above the poverty line (Centers for Disease Control and Prevention, 2014a). Better understanding and addressing these disparities in smoking prevalence represents an important future focus for public health and disease prevention.

In general, most smokers (68.8%) want to quit completely (Centers for Disease Control and Prevention, 2014d). Unfortunately, quitting smoking is extremely difficult: for example, only 42.7% of individuals who wanted to quit smoking in 2010 were able to do so for more than a single day (Centers for Disease Control and Prevention, 2014d). Moreover, quitting smoking may be an even greater challenge for the economically disadvantaged. For smokers living below the poverty line, while between 51.6 and 58.4% made a quit attempt within the past year, only 3.7 to 6.5% achieved smoking cessation. In comparison, between 49.9 and 53.6% of smokers living above the line made a quit attempt within the past year, and 5.5 to 7.4% achieved smoking cessation (Centers for Disease Control, 2011b). Regarding educational differences, persons with fewer than 12 years of education (i.e., no high school diploma) (46.2%) or those with a high school diploma (46.9%) were less likely to make a quit attempt than those with some college (55.9%) or an undergraduate degree (56.0%). Furthermore, cessation achievement increases with level of education, with 3.2% of those

with less than 12 years, and 11.4% of those with an undergraduate degree successfully

quitting (Centers for Disease Control, 2011b).

Some of the disparities in quitting that low socioeconomic (SES) smokers' face may

be due to lack of access to resources and less use of successful interventions for quitting

(Honjo, Tsutsumi, Kawachi, & Kawakami, 2006). In addition, disparities in the use of known

smoking cessation aids can be unintentionally created, as was the case when nicotine

replacement therapy became available over the counter: low SES and higher SES smokers,

who had been using the product at similar rates (19.5% vs. 18.5%), became relatively less

likely to use this important tobacco cessation tool afterwards (17.2% vs. 26.1%; Thorndike et

al., 2002). Unfortunately, smoking accounts for a great deal of the difference in disease

incidence and mortality ascribed to SES (Wardle & Steptoe, 2003). Moreover, low SES

smokers are at higher risk than high SES smokers for developing certain health conditions

like cardiovascular disease and cancer, so that the stakes for successful quitting are quit high

(Vidrine, Reitzel, & Wetter, 2009a; Vidrine, Reitzel, & Wetter, 2009b). Consequently, the

need to understand mechanisms that underlie smoking within low SES smokers is necessary

in order to develop more effective intervention strategies to reduce smoking-related health

disparities.

Another segment of society that suffers from striking smoking-related health

disparities is individuals with mental illness. For example, this population subgroup has

comparatively higher rates of smoking, with a current smoking rate of 34.8% and a lifetime

smoking rate of 55.3% (Lawrence, Mitrou, & Zubrick, 2009; Lasser et al., 2000).

Consequently, they also have an increased risk of morbidity, mortality, and tobacco-related

diseases (Hurt et al., 1996; Druss, Zhao, Von Esenwein, Morrato, & Marcus, 2011). Mental

illness increases the risk of premature mortality (Druss, Zhao, Von Esenwein, Morrato, & Marcus, 2011); when combined with smoking, the potential harm to this subgroup is only further compounded (Thornicroft, 2011). Moreover, these disparities are not confined to clinical disorders. In fact, evidence indicates that smoking prevalence is decreasing in mentally well individuals, whereas prevalence remains steady among individuals who experience psychological distress and disorders (Centers for Disease Control, 2013). For instance, from 1997 to 2011, smoking rates among adults without serious psychological distress significantly dropped (i.e., 24.1% to 18.2%) but remained unchanged among those with serious psychological distress (i.e., 43.6% to 42.1%; CBHSQ, 2013). Despite the associated health risks of smoking, smokers with a moderate to high level of general psychological distress (e.g., individuals with mental illness) are less likely to quit smoking than those with lower levels of psychological distress (Lawrence, Mitrou, & Zubrick, 2011; Hagman, Delnevo, Hrywna, & Williams, 2008).

Unfortunately, low SES and symptoms of mental illness are often paired risk factors for smoking-related health disparities (Harwood, Salsberry, Ferketich, & Wewers, 2007). Moreover, certain population groups experience higher rates of both low SES and mental illness, such as the homeless population. When the aforementioned strains combine in the environment of a homeless individual, they would be further exacerbated by the various stressors these individuals face, thereby making it considerably more difficult to quit smoking and manage the health consequences that tobacco usage carries (Businelle, Cuate, Kesh, Poonawalla, & Kendzor, 2013; Kertesz et al., 2005).

Homeless Smokers

On a given night in the United States, over 600,000 people experience homelessness whether this is in an emergency shelter, transitional housing, or unsheltered setting (The U.S. Department of Housing and Urban Development, 2013). A homeless individual is defined as:

> "1) an individual who lacks a fixed, regular, and adequate nighttime residence; and 2) an individual who has a primary nighttime residence that is a) a supervised publicly or privately operated shelter designed to provide temporary living accommodations (including welfare hotels, congregate shelters and transitional housing for the mentally ill); b) an institution that provides a temporary residence for individuals intended to be institutionalized; or c) a public or private place not designed for, or ordinarily used as, a regular sleeping accommodation for human beings" (Stewart B. McKinney Act, 1987)."

Furthermore, the lifetime homeless rate is 6.2% (Toro et al., 2007), suggesting that homeless individuals comprise a significant minority of the U.S. population.

Homelessness carries a great deal of burdens in tandem with the lack of stable housing, including a dearth of economic resources, lack of access to healthcare, increased risk of disease and substance use, and higher rates of morbidity and premature mortality in comparison to the general U.S. population (Lebrun-Harris et al., 2013). The Substance Abuse and Mental Health Administration found between 20 to 25% of the homeless population in the United States deals with some form of a severe mental illness (National Institute of Mental Health, 2009). Coupled with the stress of homelessness, smoking prevalence rates show that up to 78% of homeless individuals currently smoke (Baggett et al., 2012; Baggett

& Rigotti, 2010; Businelle et al., 2015; Centers for Disease Control and Prevention, 2012; Lee et al., 2005). This elevated smoking rate is one of the key factors contributing to the growing health disparities experienced by low-SES individuals, such as higher rates of illness, both physical and mental, higher costs of healthcare, and shorter life expectancies (Businelle et al., 2010). These health consequences are due to a variety of ailments which can be linked with smoking, such as cancers of the trachea, bronchus, and lung, as well as circulatory and respiratory diseases (Arnsten, Reid, Bierer, & Rigotti, 2004; Baggett, Tobey, & Rigotti, 2013; Butler et al., 2002; Hwang & Henderson, 2010; Weinstein et al., 2013). Some studies have implied that homeless smokers are heavier users of tobacco than domiciled smokers [cf. (Arnsten, Reid, Bierer, & Rigotti, 2004; Butler et al., 2002)]. Consequently, the deaths ascribed to smoking are disproportionately high among homeless adults (Snyder & Eisner, 2004). Despite overall smoking rates in the United States decreasing over time, vulnerable groups like homeless adults use tobacco at high rates, illustrating the importance of this public health issue.

In spite of the alarmingly high prevalence rates, approximately 75% of homeless smokers have reported a desire to quit smoking and 70% plan to make a quit attempt within the next six months (Butler et al., 2002; Okuyemi et al., 2006a, Businelle et al., 2015). These figures are comparable to domiciled smokers (Butler et al., 2002, Businelle et al., 2013). While these are promising figures, lifetime quit rates remain significantly lower than quit rates among smokers who have never experienced homelessness (Baggett, Lebrun-Harris, & Rigotti, 2013). Furthermore, there is surprisingly little known about smoking cessation within the homeless population, with no smoking cessation trials occurring before 2005 (Okuyemi et al., 2006a). The few studies that have been conducted since that time have been

quite recent (Businelle et al., 2014; Okuyemi et al., 2006b; Shelley et al., 2010; Spector, Alpert, & Karam-Hage, 2007) and were predominantly smaller studies which had low abstinence rates and were typically conducted with inclusion criteria including that participants needed to be motivated to quit and willing to undergo a quit attempt.

The Okuyemi et al. (2006b) study was a small trial where 46 homeless smokers were randomized to receive motivational interviewing, which either focused on smoking or smoking and other barriers, and nicotine replacement therapy (i.e., patch or lozenge). The trial included five individual motivational interviewing sessions, six group meetings, and the choice of either the nicotine patch or lozenge. At follow-up, the carbon-monoxide verified 7-day abstinence rate for this trial was 13% at week 8 and 8% at week 26. The Shelley et al. (2010) trial was similar in that it used a motivational interviewing plus pharmacotherapy approach with 58 homeless individuals but added a cognitive behavioral therapy component as well. This 12-week program found that beginning with motivational interviewing and introducing cognitive behavioral components later led to better results given that many of the participants were in the contemplation stage at baseline. The carbon-monoxide verified abstinence rate was 15.5% at 12 weeks and was 13.6% at 24 weeks. Businelle et al. (2014a) compared shelter-based smoking cessation clinic usual care to usual care plus adjunctive contingency management, which included small financial incentives for smoking abstinence. Sixty-eight homeless individuals participated, and there was a significant difference in 4-week post-quit abstinence rates between the adjunctive contingency management group (30%) versus the usual care group (1.7%). Finally, Spector, Alpert, and Karam-Hage's (2007) study was the smallest of the trials with a sample of 11 homeless individuals, of which only 6 completed the study. In this study, participants, all of which were smokers,

either received cognitive behavioral therapy or unstructured support to aid in their cessation attempts. The protocols were administered by medical students in order to broaden their tobacco cessation education, and the (combined group) carbon-monoxide verified abstinence rate was 20.2% by the ninth and final session.

One larger smoking cessation randomized clinical trial has been done with the homeless population as of this date and has found similar results as the previous reports. Okuyemi et al. (2013) conducted the only adequately powered randomized controlled trial to evaluate the effects of including motivational interviewing with standard nicotine replacement therapy among homeless smokers. Four hundred and thirty homeless smokers were randomly assigned into either the standard care control group or the intervention group which received six additional sessions of individual motivational counseling. The carbon-monoxide verified 7-day abstinence rates at week 26 were not-significantly different: 9.3% for the intervention group versus 5.6% for the control group.

These studies show promising results about the possibilities of smoking cessation interventions with the homeless population, but cessation rates are low even in the context of aided attempts providing compensation for participation; therefore, more work is needed to understand how to improve cessation interventions for homeless smokers. Studies indicate that homeless smokers face many obstacles when attempting to quit, such as the ubiquity of smoking around shelters (Okuyemi et al., 2006; Businelle et al., 2013), comorbidity with substance use and mental illness (Okuyemi et al., 2006; North, Eyrich-Garg, Pollio, & Thirthalli, 2010; Businelle et al., 2013), and limited access to smoking cessation interventions (Okuyemi et al., 2006). Given that quit rates are so low even among motivated homeless smokers, studying outcomes other than smoking abstinence may provide a better

understanding of how to improve treatment interventions for this population. For example, meaningful alternate outcomes might include the ability to achieve even brief abstinence on the quit date (Businelle et al., 2014b; Reitzel, Kendzor, Cao, & Businelle, 2013) or patterns related to cigarettes smoked per day following the quit attempt. Such alternative outcomes can be examined using Ecological Momentary Assessment (EMA), which are a range of research methods designed to assess an individual's thoughts, affect, and behaviors in real-time in real-world settings.

EMA

For the majority of research studies, baseline data are obtained in laboratory or clinical settings and typically depend on retrospective self-report for information (Shiffman, Stone, & Hufford, 2008). A participant might come to lab to participate in a smoking cessation study, be asked what his/her average number of cigarettes smoked per day over the preceding week was, and use rounding or estimating of past usage to arrive at a figure that seems fairly accurate. If follow-up data are needed, this data may be collected months after a relapse has occurred, again in a laboratory or clinical setting. One issue with traditional assessment measurement is that it depends on recall for answers, which can be problematic. Bradburn et al. (1987) found that recall can be affected by random error as well as systematic bias, both of which can alter one's ability to effectively remember the desired behavior. As a result, memory is seen as a reconstruction of events from the available information stored rather than an objective restatement. Furthermore, the encoding and retrieval environments will also affect memory recall, particularly for relevant personal experiences (Smith & Vela,

2001). Due to the tendency for traditional assessment measures to be administered in laboratory and clinical settings, it is possible that many of the behaviors in question did not actually occur and therefore were encoded in such locations. Consequently, inquiring about them in labs and clinics may put the participant at a disadvantage for memory retrieval.

Another difficulty with traditional assessment measurement is the commonality of asking participants to collect and condense their experiences, leading to the use of heuristics when answering questions. When a questionnaire requires that a participant thinks back over his or her week and rates the frequency with which a certain behavior occurred, it may sound like a simple procedure but it is influenced by the use of heuristics, which can account for the bias in recall (Bradburn et al., 1987). The availability heuristic, for example, describes how a person will judge the rate at which an event occurs – if an example comes to mind easily, one would decide the event occurs at a higher rate. Again, while this may make sense due to more rarer situations being more difficult to remember, this self-evident point must be countered with the fact that more salient events are more easily recalled, regardless of their frequency. Kihlstrom et al. (2000) found that those who were in a negative mood state were more able to recall negative information, and Eich et al. (1985) showed that subjects experiencing pain not only found it easier to remember past pain-states but also overestimated their magnitude. For example, Redelmeier et al. (2003) conducted a study with subjects who had undergone a colonoscopy 20 to 30 minutes prior and asked them to provide summary ratings of their pain. The study found that these ratings were disproportionately influenced by the subject's peak level of pain as well as the pain at the end of the procedure, indicating that the ratings were not an accurate representation of average pain over the entire colonoscopy experience. Extrapolating from this example, if a smoking study were to focus

on the determinants of relapse and asked a participant to report on events preceding the relapse episode, the participant might recall that his/her urge to smoke was very high as a way to explain the act of relapse rather than truly recalling a sensation of heightened urge.

EMA is an advancement in the field that helps to overcome the shortcomings of traditional assessment measurement. EMA does not refer to a particular method of inquiry but rather a diverse range of methods that track an experience or behavior by using the "repeated collection of real-time data on subjects' behavior and experience in their natural environments" (Shiffman, Stone, & Hufford, 2008, p. 3). EMA approaches can use a variety of tools to assess the participant, such as an electronic diary or smartphone, which have many benefits. One major benefit of this technique is the freedom it allows for participants to complete measures in the setting where the behavior occurs rather than an artificial environment like a research laboratory or clinical office. Furthermore, assessments can now focus on the subjects' current state, as they can be taken in real-time as opposed to asking for recall or summarizing. Along with this advantage, researchers can program the assessment device to prompt random as well as scheduled assessments, as many or as few as desired, which is an important step forward in assessing behaviors. By allowing for repeating measurements within this real-time framework, the ability to study within-subject change as well as symptom change over time or situational antecedents has been refined. This capability allows EMA measures to assess behaviors in a way that is more ecologically valid. In addition, this method is more data rich relative to traditional assessment measurement.

EMA measures, along with real-time, real-word data collection, have resulted in many new areas of study. Thiele et al. (2002) found that EMA methods are already being used to provide new insights into several areas including mood, anxiety disorders, pain,

gastrointestinal disorders, eating and sleep patterns, as well as alcohol use. For instance, a recent study by Dvorak, Pearson, and Day (2014) examined the relationship between mood and patterns of drinking using EMA methods over a 21-day period and found that on planned drinking days, there was a temporal relationship between negative mood states and the acute experience of alcohol use disorder symptoms. These relationships were mediated by coping motives and alcohol use, and the study suggested that emotion regulation should be examined at the event level in order to fully understand these associations, an evaluation that would be better suited for EMA methods. Mak et al. (2012) used EMA methods to study fruit and vegetable consumption in children to ascertain the effects of eating context. The study examined children between 1.5 to 10 years of age over the course of two years and recorded all foods and drinks consumed as well as the context where they were eaten, such as if they were consumed at a table, whether the television was on, etc. Fruits and vegetables were found to be eaten in greater quantities in structured settings like school, as well as at the table when the television was off. As a result, the study suggested that eating contexts should be considered when maximizing the effectiveness of fruit and vegetable interventions. These illustrative studies show how EMA can be applied to a wide variety of topics and expose new avenues of study.

Another area of research which EMA has found great use and success is cigarette smoking behaviors and cessation, with many studies utilizing these procedures. Shiffman, Stone, and Hufford (2008) argued that smoking is a natural fit for EMA use given its clearly distinct small-scale occurrences (e.g., smoking individual cigarettes multiple times throughout the day, lapsing to smoking following a quit attempt at a distinct moment in time). These discrete instances of the behavior easily lend themselves to be tracked and allow

researchers to query participants about factors which may affect these behaviors, such as urge, expectancy, affect, etc. The use of these methods among smoking research has been supported in the literature, with Shiffman (2009) finding that EMA was a more accurate and helpful tool for measuring behaviors such as cigarette consumption. Shiffman (2009) compared global reports, time-line follow back (TLFB) recall, and EMAs to assess daily cigarette consumption. Participants each completed global reports of his/her average number of cigarettes smoked per day, a TLFB assessment of the number of cigarettes smoked the week preceding the quit week, then two weeks of EMAs which focused on the daily cigarette consumption. One week into this two week period, participants did another TLFB assessment of how many cigarettes they had smoked on each day for the previous week. Results showed that global reports and the pre-quit week TLFB were substantially skewed, while the EMA data was not, suggesting that EMA measurements are more accurate for tracking smoking and other smoking-related behaviors.

These findings have led to more work with EMA among the smoking cessation field. For example, Minami, McCarthy, Jorenby, and Baker (2010) were interested in the association between quit attempts, coping, and affect. They used EMA data from smokers and multi-level models to investigate the effects of stressful events on coping while attempting to quit smoking. Researchers found that a solitary coping attempt did not predict a significant change in smoking risk over the next 4-48 hours, but it did predict improved positive and negative affect within 4 hours. The study concluded that while early coping responses may not help a smoker abstain, they can improve the way he/she feels. Other applications of EMA approaches involve different populations. Hoeppner, Kahler, and Gwaltney (2014) investigated the ties between smoking and self-efficacy using EMA among

adolescent smokers. Previous research has demonstrated that adolescent smoking relapse can be predicted by shifts in momentary self-efficacy (Van Zundert, Ferguson, Shiffman, & Engels, 2010). The Hoeppner et al (2014) study advanced the literature in the area by showing that both positive and negative affect were important factors associated with changes in momentary self-efficacy, which in turn may have an effect on the outcome of a quit attempt.

In summary, EMA is a useful research tool that can be implemented using many schedules/modalities of measurement (i.e., daily diaries, random assessments, laptop questionnaires, etc.) to record thoughts, affect, behavior, and the environment in real-word settings. This is what sets these methods apart from conventional laboratory measures and allows for research questions to be asked that inquire about more fine-grained and day-to-day behavioral antecedents that were previously not possible. These methods can help identify behavioral patterns as well as situational and social factors which could increase or decrease a smoker's risk for lapsing/relapsing. This is particularly helpful with smoking cessation research as these behaviors may be distinctive and well-defined. With these approaches already finding success among this particular area of research, the field has been opened to newer questions about the temporal dynamics of smoking cessation and the relationships among the variables which have been identified as significant, such as affect, expectancy, urge, and self-efficacy.

Although EMA has been used in several studies among adult smokers (described further below), its use among homeless individuals has been limited (for exception, see: Businelle et al., 2014b, which represents the parent data used in the current study). Because EMA methodology is ideally suited to understanding the temporal dynamics of smoking

behaviors, using EMA with homeless smokers represents a significant advancement within the field of smoking research. It is critical to better understand these factors among homeless smokers who are trying to quit in order to inform intervention development. The current study is focused on better understanding the role of affective precipitants (as measured by random EMAs) in cigarettes smoked per day during the week following a planned and aided quit attempt among a sample of homeless smokers. The focus on affective precipitants was informed by the theoretical models of addictions such as the relapse prevention model (Witkiewitz & Marlatt, 2004), the basis of which is detailed in the following sections.

Relapse Prevention Model

With the wealth of smoking research, one fact that remains clear is that smoking cessation is difficult to attain and even more challenging to maintain. Twelve-month relapse rates of tobacco cessation attempts range between 84 to 98% (Brandon, Vidrine, & Litvin, 2007; Polivy & Herman, 2002). With such high relapse rates, it is important to know why smoking cessation is such a challenge and how investigators can use this information to design more efficacious cessation interventions. One way to conceptualize the cause of relapse is Witkiewitz and Marlatt's (2004) cognitive behavioral relapse prevention model. This model has foundations in Marlatt's (1985) previous work, which sought to understand the relapse process and explains this phenomenon in the context of high-risk situations. High-risk situations are defined as "a circumstance in which an individual's attempt to refrain from a particular behavior...is threatened" and jeopardizes the perceived control an individual attempts to maintain during abstinence (Witkiewitz & Marlatt, 2004, pg. 224-225).

Traditional assessment techniques have identified three principal high-risk situations that are associated with the majority of relapses: negative emotional states, interpersonal conflict, and social pressure (Marlatt & George, 1984). The relapse prevention model holds that if the individual is able to respond with an effective coping strategy, the probability of relapse in the face of a high-risk situation will significantly decrease.

Newer formulations of the cognitive behavioral relapse model emphasize the role of dynamic relapse processes (stable vs. immediate/probable risks for relapse) more so than previous models, while maintaining the context of high-risk situations (Hendershot, Witkiewitz, George, & Marlatt, 2011). With these models, tonic and phasic influences interact to govern the likelihood of relapse. Tonic or stable influences include one's personality, genetic risk factors, as well as personal beliefs about abstinence (as these beliefs tend to be relatively constant over time). Phasic influences involve both cognitive and affective responses which can vary over time. These responses can include mood, cravings, urges, or changes in outcome expectancies, motivation, or self-efficacy. Witkiewitz and Marlatt (2004) found that tonic processes influence who will be susceptible to relapse, while phasic processes influence when a relapse will occur. A notable strength of this new model is its ability to forecast feedback loops, as reciprocal effects have been shown between a relapse and cognitive or affective elements (Hendershot, Witkiewitz, George, & Marlatt, 2011). Lapses can trigger both physiological (e.g., mitigation of withdrawal symptoms) and cognitive reactions (e.g., the abstinence violation effect, also known as the feelings of guilt and loss of control experienced after a lapse when abstinence had otherwise been maintained), which in turn can affect one's affective state.

Due to the dynamic nature of this model, these interactions may follow a nonlinear pattern and relapse may be sudden. Below is a figure illustrating the relationships among smoking relapse including the hypothesized mechanisms, which can interact and lead to a lapse or relapse.
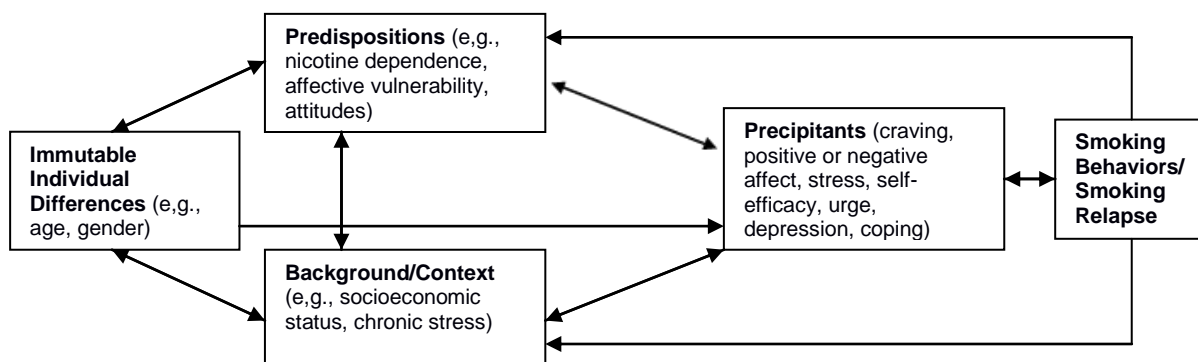

Several key mechanisms are implicated in smoking relapse, including one's background, predispositions, individual differences, as well as precipitants. These precipitants include a host of factors, such as affective state, self-efficacy, coping, interpersonal conflict, and smoking cues. These precipitants can vary both within and between situations, whereas predispositions and background/context factors tend to remain stable across situations. These predispositions and background/context variables were generally the focus of previous models which sought to explain smoking and relapse behaviors (Brandon et al., 2007).

Several EMA studies have examined factors that affect smoking abstinence during a specific quit attempt as guided by the relapse prevention model. In these studies, it is typical to focus on the association between precipitants and smoking behaviors/smoking relapse, and the vast majority of these studies examine the role of only one or two theoretically-based precipitants at a time. For example, Lam et al. (2014) used EMA procedures to test whether

negative affect, alcohol consumption, and the company of others smoking combine and influence smoking outcomes such as smoking urge and lapse. In other words, this study focused on precipitants and their interplay to understand how lapses occur. After testing 300 smokers for 7 days, starting on the quit day, results showed that all three factors were independently and jointly associated with increased risk for smoking urge and lapse. A similar study by Businelle et al. (2013) examined the associations between alcohol consumption and smoking urges during a quit attempt using EMA methods with participants who reported drinking on at least one occasion during the first 7 days of a smoking quit attempt. Findings indicated that on days with high smoking urges (at waking time), alcohol was more likely to be consumed that day and more volatile urges were evident on drinking days. This research indicates previously unrecognized relations between urge and alcohol. Cofta-Woerpel et al. (2011) focused on changes within urge trajectories and negative mood with women using the nicotine patch, hoping to shed light on symptom courses during post-cessation smoking. EMA assessments demonstrated that early lapsers and late lapsers differed in their urges and moods, with early lapsers displaying more volatile and temptation-related urge and negative mood soon after quitting, whereas late lapsers showed more background urge after quitting.

In summary, the relapse prevention model's focus on precipitating variables, which can be measured with EMA methods allows for closer examination of the specific mechanisms that affect smoking behaviors (e.g., craving, affect, self-efficacy). Because of its prominence in relation to smoking behaviors (described more fully in the next section), a commonly

studied precipitant is stress or affect (see inset below).
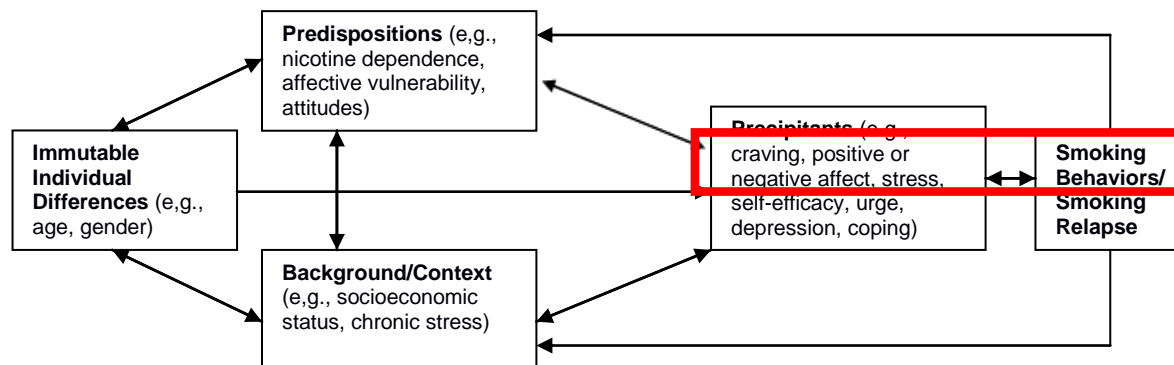
The relapse prevention model highlights the importance of one's moment-to-moment

emotional state and the probability of smoking behavior or smoking relapse, a relationship

which has been supported by previous EMA research (Hodgins, el Guebaly, & Armstrong,

1995; Shiffman, Paty, Gnys, Kassel, & Hickcox, 1996).

Affect

Affect has been implicated as a significant variable within the smoking literature from

the initiation phase of smoking all the way through lapses and relapse. While the onset of

smoking undoubtedly has multiple contributing factors, the negative or positive valence of

one's affect has wide-reaching implications for one's emotional state and behavioral choices

and has been studied for decades with ever-increasing support. Ikard et al. (1969) found a

positive correlation between negative affect and the rate of smoking, a finding which has

been consistently reproduced, confirming that affect and smoking have a deep if not complex

relationship (McKennel, 1970; Coan, 1973; Shiffman, 1993). The associations among affect

and lapse/relapse warrant further study; therefore, affect will be further examined as its components of negative and positive affect.

Negative Affect. Negative affect can be defined as a "general dimension of subjective distress and unpleasurable engagement that subsumes a variety of aversive mood states, including anger, contempt, disgust, guilt, fear, and nervousness, with low negative affect being a state of calmness and serenity" (Watson, Clark, & Tellegen, 1988, p. 1063). While everyone experiences negative affect from time to time, its severity and rate of incidence are seen as dependent upon one's environment as well as individual differences. Negative affect has long been implicated as a factor in smoking and many studies have corroborated this relationship. Brandon and Baker (1991) developed a self-report measure to assess smokers' subjective expected utility, or underlying cognitive factors, for the different possible outcomes of smoking. Of the four main results, reductions of negative affect emerged and differentiated between daily smokers and other levels of smoking (i.e., occasional smokers, formers smokers, and nonsmokers), suggesting the importance of this construct in the daily usage of cigarettes. Furthermore, daily smokers reported greater expectations that cigarettes would relieve negative affective symptoms than occasional smokers, former smokers, and nonsmokers.

Negative affect also influences treatment efficacy. In the 1970's, researchers found that smokers who smoked during negative mood states had lower abstinence rates at the 12-month post-quit mark (26%) when compared with the remaining, non-negative affective state smokers (50%) (Pomerleau, Adkins, & Pertschuk, 1978). Similar results have been found by

Zelman, Brandon, Jorenby, and Baker (1992), who examined this relationship further, comparing a standard tobacco intervention program which involved coping skills training to nonspecific supportive counseling. Results showed that among smokers with high negative affect prior to treatment, supportive counseling was more beneficial than coping skills training, whereas those whose negative affect was low before treatment benefited more from coping skills training. The study performed a post-treatment evaluation of coping skills to test whether negative affect hampered skills training, and results indicated that negative affect indeed may interfere with either the acquisition or execution of coping skills when a person is faced with a stressful situation where negative affect may be amplified. Kinnunen, Doherty, Millitello, and Garvey (1996) extended this finding by showing that when high levels of emotional distress is felt at the beginning of a quit attempt or early abstinence (e.g., nicotine withdrawal), poor outcomes result.

Though these studies have shown a strong connection between negative affect and smoking, a crucial limitation is their reliance on traditional questionnaires to assess patterns of smoking. Considerable evidence has been collected which shows that these kinds of assessments are insufficient to accurately demonstrate situational relationships among smoking and other variables (Shiffman, 1993; Shiffman, Stone, & Hufford, 2008). Traditional assessments have a tendency to overestimate the frequency of behaviors (Homma et al., 2002; Shiffman & Paty, 2003), creating difficulties in studying smoking relapse. Furthermore, this field is interested in within-person variations over time (e.g., how one person's experience of quitting differs from another and whether these differences can inform treatment, etc.). Studies have found that traditional assessments are not sufficient to characterize such experiences (Carney et al., 1998; Searles et al., 2000). EMA methods,

which gather data in real-time and natural environments, reduce summarizing or recall bias. Specifically with negative affect, EMA methodology has frequently been used in smoking research to examine the situational associations that play a role in lapse and relapse. Shiffman and Waters (2004) studied 215 smokers who quit for at least 24 hours and measured negative affect during relapse episodes. Among smokers who lapsed, those who attributed their lapses to stress or a bad mood had begun to demonstrate significantly elevated levels of negative affect up to 6 hours prior to the lapse in comparison to smokers who attributed their lapse to other causes.

Regarding relapse, negative affect has also been associated with a greater chance of lapsing, with 35-100% of smokers reporting a lapse while experiencing some form of negative affect depending on the method of data collection (Borland, 1990, Brandon, Tiffany, Obrenski, & Baker, 1990; Cummings, Jaen, & Giovino, 1985; Shiffman, 1982; Swan, Ward, Jack, & Javitz., 1988). Shiffman, Paty, Gnys, Kassel, and Hickox (1996) used EMA methods and found that negative affect, more so than temptation, accompanied lapses, with participants attributing these lapses to their negative mood states as well as smoking cues, whereas temptations were more likely to be cited as due to behavioral transitions. Shiffman and Waters (2004) found that changes in negative affect over the course of days did not predict lapse risk. However, rapid increases in negative affect were related to relapses, suggesting that acute changes in affect can precipitate smoking lapses.

Other research by Shiffman et al. (2007) used both EMA and traditional questionnaire methods to investigate what situational variables were related to smoking relapse. Participants provided data during ad lib smoking about a variety of constructs, including negative affect. Results indicated that only negative affect predicted first lapse to

smoking following a quit attempt. Interestingly, the study also found that these results were only uncovered by EMA assessments, reiterating the problematic nature of using conventional questionnaires with this kind of smoking research and the unique benefits of EMA methods. Several other EMA studies have since linked negative affect with relapse (Lam et al., 2014), pre-quit cravings (Yeh, McCarthy, & Baker, 2012), and depressive symptoms (Brodbeck, Bachmann, Brown, & Znoj, 2014).

Recent work with EMA assessments has also focused on the relationship between the changing state of one's emotions and lapse/relapse. These momentary changes in affect have been theorized in the past to be responsible for relapsing, due in part to evidence that many smokers are more likely to smoke during a negative affective state (Brandon, 1994) as well as the belief by smokers that doing so will also relieve said negative state (Payne et al., 1991). As a result, smokers may be conditioned to smoke when experiencing negative affect, which could then prime relapse during a cessation attempt. Alternatively, smoking due to negative affect could be the result of dependence so that relapse is related to withdrawal effects. Interestingly, EMA studies which have focused on these variables have found conflicting results, with some reporting no relationship between negative affect and smoking behaviors (Carter et al., 2008; Shiffman et al., 2002; Shiffman et al., 2004) while others have found small but significant associations (e.g., 0.07 points on a 5-point Likert scale; Shapiro et al., 2002). The above findings suggest that more fine-grained study of these affective states is necessary to not only understand their temporal relationships but their underlying mechanisms as well in order to better understand the causes of relapse and the interconnections between the two. Minami, Yeh, Bold, Chapman, and McCarthy (2014) sampled 103 adult, treatment-seeking, daily smokers using EMA measures to study how

changes in affective states affected daily smoking lapse risk. Initial levels of negative affect were linked with smoking, even when smoking status was controlled for, and short-term increases in negative affect predicted lapses for up to a twelve-hour period. This result demonstrates how acute and dynamic changes in one's affective state can have far-reaching implications for lapse risk and warrants further study.

Positive Affect. Relative to negative affect, positive affect has received relatively little attention in the smoking literature. Recent studies have begun to examine what relationships may exist between positive affect and smoking, specifically regarding relapse with interesting results. Shiffman and Kirchner (2009) were studying the levels of satisfaction experienced during ad libitum smoking and found that cigarettes smoked when a person was experiencing intense positive affect led to more satisfaction. In general, the study found that those who found smoking to be the most satisfying were also the ones most at risk for lapsing after a quit attempt, an effect that was not explained by nicotine dependence. However, Doran, Cook, McChargue, Myers, and Spring (2008) showed that the effect of anhedonia (i.e., reduced ability to experience pleasure) on amplified urges to smoke post-quit was mediated by decreased positive affect, not increased negative affect. Reitzel et al. (2010) found that among a diverse group of smokers attempting to quit, those with more positive affect were more likely to be abstinent during post-quit week one and two. Shiffman et al. (2013) were interested in the influence of different cues, including positively valenced ones, on cravings in nicotine-deprived smokers and found that positive affect cues reduced cravings. Taken together, these studies suggest that positive affect merits further attention as a precipitant or suppresor of smoking behaviors in research studies.

Stress. The relapse prevention model also points to stress as a precipitating factor which can contribute to potential lapses/relapse. Stress, which has many definitions, can be nicely summarized as "events or experiences that are normatively or objectively associated with large adaptive demands [and the] individuals' subjective appraisal of their abilities to cope effectively with [them]," (Kassel, Stroud, & Paronis, 2003). Stress and one's responses to these events were long thought to be associated with smoking behaviors, and research in recent decades has helped to support and extend this supposition. Schachter (1978) demonstrated how stressors such as public speaking, simulated airplane noise, and electric shocks resulted in marked increases in number of cigarettes smoked, a finding which has subsequently been supported (Dobbs et al., 1981; Pomerleau & Pomerleau, 1987; Rose et al., 1983).

Many smokers often view their smoking behaviors as an effective way of coping with stress and its consequences and associate their smoking, at least partially, to the apparent calming effects of smoking on stress (i.e., negative reinforcement expectancies; Frith, 1971; Spielberger, 1986). Interestingly, previous research has established that smokers report experiencing higher stress levels than nonsmokers (Wills, 1986). Many smokers report that their smoking increased during periods of stress, anger, anxiety, or sadness (Coan, 1973; Ikard et al., 1969; Shiffman, 1993), further illustrating how strongly smoking is ingrained as a coping response during periods of stress and negative affect. Indeed, Schacter (1978) found that heavy smokers were more irritable when exposed to a simulation of a plane flying overhead and were deprived or smoking or smoked low nicotine cigarettes. Woodson et al. (1983) used a similar design with noise stress and found similar results.

Specifically regarding relapse, there is strong epidemiological and treatment study evidence linking the experience of stress and a return to smoking behaviors among former smokers (McKee et al., 2003; Baer & Lictenstein, 1988; Baer, Lichtenstein, Kamarck, & Ransom, 1989). Studies have shown that the occurrence of stressful life events such as a negative financial event or an adverse health event have damaging effects on abstinence (McKee, Maciejewski, Falba, & Mazure, 2003). It is generally well-accepted that quitting is a difficult and emotionally-trying experience, and individuals often report during the first few weeks of abstinence feeling intense anxiety and irritability, which are associated with withdrawal (Shiffman, 1979). Cohen and Lichtenstein (1990) assessed how changes in stress levels affected quitting at 1, 3, and 6 months following the quit date. Results supported a strong relationship between stress and smoking, and that for those who failed to quit for more than 24 hours, a relatively high and consistent level of stress was maintained for the duration of the 6 month period. These findings are well-supported, with other studies concluding that between 35 to 100% of their samples of smokers cited stress and related negative affective states as contributing factors to their relapses (Marlatt & Gordon, 1980; Shiffman, 1982; Cummings et al, 1985; Baer & Lichtenstein, 1988; Swan et al., 1988; Borland, 1990; Brandon, 1994). McKee et al. (2011) sought to specifically investigate whether stress reduces one's ability to resist lapsing, and if the first cigarette is instigated, whether stress precipitates subsequent smoking. The study found that stress weakened the ability to abstain in a sample of daily smokers who were deprived of nicotine for approximately 15 hours. Furthermore, following stress induction, participants smoked their cigarettes more intensely by increasing their puffs, inhaling at greater depths, and taking shorter times between puffs,

which the authors suggested was due to the reinforcing properties of nicotine and their interplay with stress.

While the literature supporting a link between smoking and stress is robust, studies using EMAs to further investigate these relationships are relatively scarce. Minami et al. (2010) studied the associations between coping with stress and smoking during a quit attempt. Contrary to their hypothesis that stress coping attempts would lead to decreases in smoking during a quit attempt, stress coping did not guard against smoking during the quit attempt. While any stress coping in a 48-hour period was associated with short-term improvements in affect, these gains did not protect against smoking over the next 48 hours. Todd et al. (2005) examined both cross-sectional and prospective analyses for relationships between stress and smoking, and they found that associations seen in the cross-section vanished with the prospective analysis. These results suggest that more research utilizing EMA methods is necessary to better understand these constructs with regards to relapse, particularly studies that focus on stress and affective variables given the strong support in the literature. For example, Shiffman and Waters (2004) found that the risk of relapsing on a given day was not related to the previous day's average stress level or negative mood rating, but a more accurate measurement was using one's momentary ratings of affect in the hours preceding a lapse. In another study focusing on the progression from smoking lapse to relapse, Shiffman et al. (1996) found that among smokers whose lapses were triggered by stress, the time between lapse to relapse was less than those triggered by eating, drinking, or alcohol consumption, suggesting that stress can have an accelerating effect on the relapse process. While these studies can shed new light on intervention strategies, few of these kinds of studies focus on minority populations, such as the homeless, making it difficult to extend

conclusions to these groups as their life experiences and patterns of usage, quitting, and

relapse may differ. As a result, more individualized research is essential in order to better

understand and benefit these populations.

Literature Summary and Current Study Aims and Hypotheses

In summary, smoking is the leading preventable cause of illness and death in the U.S.

and is causally associated with a host of negative health consequences including different

respiratory-related cancers, kidney cancer, gastric cancer, cardiovascular disease, heart

disease, stroke, and diabetes (World Health Organization Global Report, 2012). While the

prevalence of smoking has decreased in recent decades, considerable disparities in tobacco

use exist among disadvantaged populations: in particular, populations with low SES and

individuals with mental illnesses/distress smoke at considerably higher rates than their higher

SES counterparts (Centers for Disease Control, 2011a). Moreover, when these

disadvantages/difficulties collide in a particular population subgroup like homeless adults,

coupled with a myriad of stressors such as a lack of stable housing, higher rates of disease,

and decreased access to healthcare, what we see is exceedingly high rates of smoking (~70-

75%) and exceedingly low rates of quitting (5.6-9.3%) even in the context of an aided

attempt with compensation for participation. Taken together, along with the relative scarcity

of targeted cessation interventions studies, smoking has been recently characterized as a

"neglected addiction" among homeless adults (Baggett et al., 2013, p. 201). Thus, there is a

significant need for further study of smoking and cessation behaviors, and contributing

mechanisms, among homeless adults in order to inform future interventions to affect the

smoking-related health disparities experienced among this group. EMA methods, a variety of research tools that can assess thoughts, affect, and behaviors in real-world settings in real-time, have been found to be especially useful in gathering data about smoking and lapse/relapse. The relapse prevention model argues that an array of factors, including precipitants such as affect and stress, may interact to lead to a lapse/relapse. Both affect (i.e., negative affect and positive affect) and stress have strong links to smoking behavior, especially regarding lapse/relapse, although there are only a few studies specifically investigating these variables among a homeless population, and only one that has used EMAs (Businelle et al., 2014b). Consequently, the aim of this study is to contribute to the extant literature by exploring the relations between real-time negative affect, positive affect, and stress and smoking behaviors following a specific quit attempt among a sample of homeless smokers. Associated hypotheses are as follows:

H1: Moment-to-moment negative affect will predict greater cigarettes smoked per day during the week following a specific quit attempt.

H2: Moment-to-moment positive affect will predict fewer cigarettes smoked per day during the week following a specific quit attempt.

H3: Moment-to-moment stress during the week following the quit attempt will predict greater cigarettes smoked per day.

Methods

Parent Study

Participants. Data for this study were collected by Dr. Michael Businelle with the University of Texas School of Public Health as part of a protocol designed to identify barriers to smoking cessation and predictors of smoking relapse among a sample of 68 homeless smokers in the Dallas area. Individuals who participated in the study resided in semi-private rooms in the transitional shelter at the *Bridge Homeless Assistance Center* in downtown Dallas, TX. All *Bridge* residents are required to return to the shelter by 10:00 pm and sleep in their rooms every night.

Participants were included in the study if they met the following criteria: 1) earned a score of ≥45 on the *Rapid Estimate of Adult Literacy in Medicine* (REALM), signifying a greater than 6th grade English literacy level (i.e., a requirement to complete Ecological Momentary Assessments (EMA) items); 2) were currently enrolled in the transitional shelter program, 3) were willing to quit smoking 7 days from their first visit, 4) were ≥18 years of age, 5) had an expired carbon monoxide (CO) level ≥8 parts per million (ppm), which suggests current smoking, 6) were currently smoking ≥5 cigarettes per day, and 7) were willing and able to attend four assessment sessions and were enrolled in the shelter-based tobacco cessation program. Participation in this project did not affect eligibility for the *Bridge* smoking cessation program.

Procedures. Prior to data collection, proper IRB approval was obtained by the study coordinators to ensure ethical standards were met and maintained throughout the course of the study. Homeless individuals living at the shelter who were interested in smoking

cessation were referred to the *Bridge* tobacco cessation program. This program included six sessions of an American Cancer Society based therapy and support group with nicotine replacement therapy if prescribed by the on-site physician. Each therapy session lasted one hour and was administered by a licensed therapist. Potential participants were screened for eligibility in a private room after their first visit to the *Bridge* tobacco cessation program. For interested parties, written informed consent was obtained, screening was completed, and those who qualified were enrolled in the study.

Participants were then asked to attend a total of six assessment sessions, including the baseline visit (i.e., 1 week pre-quit through 4 week post-quit), with assessments being conducted on six visits. Attendance at the Tobacco Cessation Classes were recommended but not mandated. Visit 1 (one week pre-quit) occurred on the day of screening and was the day of the first assessment. Visit 2 occurred one week after visit 1 and was the scheduled quit date as well as the second assessment day. Visit 3 occurred one week post-quit and was the third assessment day, visit 4 occurred two weeks post quit date, visit 5 was 3 weeks post quit date, and visit 6 occurred four weeks post-quit. Participants completed a variety of study questionnaires either before or after the scheduled Tobacco Cessation Classes, and carbon monoxide level was measured to verify smoking status. Participants received a $30 Wal-Mart gift card for visits 1, 2, 3, 4, and 6 (5 assessments x $30 = up to $150 in gift cards). Participants were contacted for a telephone or in person follow-up appointment 12 weeks after the quit date and asked about their smoking status. Participants who did not attend scheduled visits were contacted by phone and/or mail to obtain self-reported smoking status.

During visit 1 (i.e., one week pre-quit), participants were provided with an LG Optimus T Android smartphone and taught how to use it in order to complete the EMA assessments.

Participants completed the EMA assessments for two consecutive weeks (i.e., one week pre-quit and the first week post-quit) and were compensated upon the return of the smartphone at visit 3 (one week post-quit). Payment for EMA assessments was based on the percentage of phone initiated assessments completed such that higher numbers of completed assessments led to higher value gift cards. If a participant did not return a smartphone during visit 3, he/she was contacted to request that the phone be returned at the next assessment. Overall, participants could have earned a maximum of $230 if they attended all of the assessment sessions and completed at least 90% of the required EMA assessments.

A contingency management group was also introduced for the last 10 participants of the study (Businelle et al., 2014a). Participants who were members of the contingency management group had the opportunity to earn small financial incentives (i.e., $20 gift cards) for maintaining abstinence on the quit date. Gift card amounts increased by $5 for each consecutive week of abstinence (i.e., up to $40 at 4 weeks post-quit). Participants who were unable to maintain abstinence were able to earn incentives at the next visit if abstinence criteria were met, but the gift card amount was restarted to the initial amount (i.e., $20).

Measures.

Traditional (Non-EMA) Measures. These measures, which include questionnaires about smoking, sociodemographics, homelessness, negative experiences, interpersonal dynamics, negative affect, health behavior, and decision making, were used to acquire baseline and follow-up information about the participants. Questionnaire Development System (QDS) software, which uses a computer-administered self-interview format, was used to administer the questionnaires via laptop computer. This method decreases data entry

errors and the need to keep paper copies of raw data. Participants were able to read the question from the laptop screen while simultaneously hearing the question read through earphones, which reduced reading time for low literacy participants. The duration of each visit varied, with visit 1 requiring the longest time (70 minutes) and all other assessments requiring between 25 to 50 minutes.

EMA Measures. Participants were asked to keep the phone with them at all times for two weeks (i.e., starting at baseline through one week post-quit [visit 3]) to complete EMAs. The EMA methodology used was similar to that designed by Shiffman and colleagues (Shiffman et al., 1997; Shiffman et al., 1996; Stone et al., 1998). Three types of assessments were used in the study including time-based sampling (daily diary), random sampling, and event sampling (i.e., pre-cessation smoking, urge assessments, post-cessation lapse). Random sampling and time-based sampling were initiated by the smartphone throughout the two week EMA period. Random sampling involved four smartphone initiated random assessments per day. These were scheduled to be pushed within each participant's normal waking hours. The phone would alert the participant to these random assessments by audibly and visually cueing him/her for 30 seconds. If the participant did not respond after three prompts, the assessment was recorded as missed. Daily diary assessments were completed once a day, every day, 30 minutes after waking, with questions referring to the previous 24 hour period. Event sampling was initiated by the participants. They were asked to record the number of cigarettes smoked by using the "Record Cigarette" icon during the pre-quit week, with an assessment randomly pushed for two of these cigarettes every day. During the post-quit week, participants initiated "Urge Assessments" and "Lapse Assessments" when relevant. Participants were not compensated for participant initiated assessments.

Current Study

Participants. All participants who were included in the parent study were eligible for the current study. The current study focused on the relationship between affect/stress and smoking behavior during the week following a quit attempt among a sample of homeless adults seeking smoking cessation treatment. No further exclusionary criteria were added other than those placed by the parent study; however, the number of participants included in the proposed analyses varied due to EMA compliance. Please note that the post-quit abstinence rate for this sample was exceedingly low (n=10 on the actual quit day, and n=2 by one week post quit; Reitzel, Kendzor, Cao, & Businelle, 2013; Businelle et al., 2014); hence the focus on post-quit smoking rate as the outcome of interest in the current proposal as opposed to smoking abstinence.

Procedures. The current proposal was reviewed and approved by the Committees for the Protection of Human Subjects at the University of Houston. The study's aims focused on the post-quit random and time-based EMAs. Data of interest included negative affect, positive affect, and stress (from random EMAs) and daily smoking rate (from time-based assessments). In addition, data from the QDS baseline assessments were used to describe the sample (e.g., sociodemographics) and as a source of relevant covariates for the analyses.

Measures. Data from the traditional assessments were used to evaluate the demographic characteristics (e.g., age, gender, educational level, ethnicity), homelessness characteristics, and smoking characteristics (e.g., nicotine dependence). Nicotine dependence was ascertained by asking the time to the first cigarette of the day after waking. Originally,

the nicotine dependence variable had four levels (i.e., 0=after 60 minutes, 1=31 to 61

minutes, 2=6 to 30 minutes, and 3=within 5 minutes) but was then transformed into a binary

variable (i.e., smoking more/less than or equal to 30 minutes after waking) due to low

frequencies among several of the original four categories. Data from EMAs (Appendix A)

were used to assess the number of cigarettes smoked per day (CPD) as reported by

participants' responses to a daily diary EMA item reading: "How many cigarettes did you

smoke yesterday?" For the purpose of analyses, this variable was shifted to match the core

affect EMA assessments, which inquired about the participant's current feelings as opposed

to day prior. Negative affect and positive affect were each composite variables from several

single-item responses of the core affect EMA assessments, which are based on the

circumplex model of emotion [as described in Shiffman and Kirchner (2009c)]. For example,

the Negative Affect composite variable comprises the single core items: "I feel

frustrated/angry," "I feel irritable," "I feel miserable," "I feel sad," and "I feel worried." The

Positive Affect variable is the composite of core items: "I feel calm," and, "I feel happy." In

order to assess stress, the single core affect item, "I feel stressed," was used.

Covariates. Sociodemographic variables were included as covariates including gender

and education (i.e., high school diploma or less, some college/Associates degree, Bachelor's

degree or higher). Time was also included to account for the effect of time since the day of

the outcome. Time during the post-quit week was calculated as days from the quit day, with

fractional values allowed to account for different times during the day when random

assessments occurred. Additionally, treatment groups (i.e., usual care vs. contingency

management) were controlled for due to the presence of a contingency management group

among the sample that had been offered small financial incentives in an attempt to increase

smoking abstinence. Lastly, nicotine dependence was included to account for greater addiction to cigarettes and a resulting undue effect on daily CPD.

Analysis. Analyses were performed using SAS version 9.3 (SAS Institute, Cary, N.C.). Participant characteristics were examined using descriptive statistics and frequencies. Differences between participants who provided complete EMA data and those who did not complete EMA assessments were tested using chi-square tests.

First, the CPD variable was shifted due to its inquiry about the previous day's cigarette consumption in order to match the time of the affective variables. Initial models were then run separately, one for each predictor (i.e., NA, PA, and stress), controlling for gender, education, time, treatment group, and nicotine dependence. The purpose of this was to gain preliminary results to examine resilience to the underlying assumptions of the model. Given the repeated measurements of NA, PA, and stress and the nested nature of this data (observations within individuals), hierarchical linear modeling (HLM) was the appropriate approach (Raudenbush & Bryk, 2002). More specifically, a 2-level mixed-regression model [PROC MIXED; (Littell, Milliken, Stroup, Wolfinger, & Schabenberger, 2006)] was run for each predictor including random intercepts, and an interaction term between the predictors and time. Time was included as part of the interaction term to assess how the association between the affective variables and CPD changes over the course of the post-quit week. By including this interaction term, associations between these variables were focused on the post-quit week and allowed results to show what unique associations may exist during this time period.

Second, model diagnostics were completed to assess whether all the necessary model assumptions had been met (i.e., linearity, normality, and homoscedasticity) after these initial models were run. More specifically, model diagnostics were investigated by examining the PRESS statistic, Cook's D, MDFFITS, COVRATIO, COVTRACE, Cook's D, CovParms, and MDFFITS CovParms results to analyze the influence of observations on parameter estimates, the precision of estimates, and on fitted and predicted values. In order to assess the model's normality, the distribution and quantile plots of the residuals were examined. To check for the homoscedasticity assumption, the plots of the residual vs. the predicted value were examined. An iterative process was used to check model assumptions with changes made to the sample (e.g., log transformations, removal of outliers) until model assumptions were adequately met. Next, predictors in the model were mean centered in order to simplify results for graphing and interpretation purposes. Lastly, after these processes were completed, 2-level mixed-regression models were rerun for each predictor to obtain the final results of the analysis.

Results

Of the 68 smokers who originally participated in the study, 57 provided EMA data. Participant characteristics are included in Table 1 (N=57, 61.40% male). The average age of the sample was 48.88, with roughly 54% obtaining a high school diploma. The sample was mainly African American (58.93%), and the average age when homelessness was first experienced was 39.39, with substance use being the main reason cited for the current period of homelessness (33.30%). Regarding smoking behaviors, the baseline average number of

cigarettes smoked per day was 18.14 and 70.18% of the sample waited 30 minutes or less

after waking to smoke their first cigarette. For EMA data, over the post-quit week (7 days),

1,290 out of an expected 1,596 random assessments were completed (80.8%), with each

subject completing an average of 22.6 random assessments and smoking an average of 6.7

cigarettes per day post-quit. Differences on covariates between participants who did (N=57)

and did not complete the EMA assessments (N=10) were examined and indicated no

significant differences (see Table 2).

Diagnostics from initial models revealed a violation of the normality assumption. A log

transformation of the CPD variable was made to assure a normal distribution and that model

assumptions were met. Subsequently, influence analyses (Cook & Weisberg, 1982) were run

after the log transformations were made, and results indicated that 4 subjects had the greatest

impact on the fixed effect and covariance parameters and thus were considered outliers that

should be removed.

Results from the final models indicated that of the affective variables only positive

affect was significantly related to CPD during the post-quit week in covariate-adjusted

analyses (see Tables 3-5). Specifically, increases in PA (β=-0.484, SE=0.156, p=.0025)

predicted fewer CPD (Table 4). However, increases in NA (β=0.345, SE=1.990, p=.0548)

showed a non-significant trend towards a greater CPD (Table 3). Finally, stress's (β=0.136,

SE=0.132, p=0.3005) relationship to CPD during the post-quit week was found to be non-

significant (Table 5). Results also revealed a significant time effect for all affective variables

(NA p=.0020, PA p=.0007, stress p=.0197). The time effects were graphed using a one

standard deviation above and below the mean split (see Figures 1-3). Results showed similar

effects for all the predictors whereby for both low and high levels of the different affective variables, CPD increased as time progressed into the post-quit week.

Discussion

Smoking and its harmful consequences are an ongoing health issue for 17.8% of all adults in the United States (CDC, 2014). A particularly vulnerable population is homeless adults, of which a reported 78% use tobacco and among whom tobacco use is not adequately addressed by treatment professionals (Baggett et al., 2012; Baggett & Rigotti, 2010; Businelle et al., 2015; Centers for Disease Control and Prevention, 2012; Lee et al., 2005). Much of the current smoking cessation and intervention literature has focused on domiciled smokers, while homeless smokers may face a different set of stressors, which research suggests may exacerbate smoking (Snyder & Eisner, 2004) and complicate cessation attempts (Okuyemi et al., 2006; Businelle et al., 2013). Among potential avenues of promising EMA research on smoking cessation among homeless smokers have been relationships between affective variables (e.g., negative affect, positive affect, stress) and smoking cessation outcomes (e.g., abstinence), but previous studies have struggled with small sample sizes, low abstinence rates, and shown mixed results, with some finding promising outcomes (e.g., Shiffman et al., 2007; Shiffman & Kirchner, 2009; Lam et al., 2014; Yeh, McCarthy, & Baker, 2012; Brodbeck, Bachmann, Brown, & Znoj, 2014) and others no relationship (e.g., Carter et al., 2008; Shiffman et al., 2002; Shiffman et al., 2004).

The present study has extended this field of research by investigating the impact of affective variables on the amount of cigarettes smoked per day among a sample of homeless

smokers during the post-quit week of a cessation attempt. This population has received relatively little attention regarding smoking cessation in comparison to domiciled smokers despite the many differences that exist between these groups [e.g., higher rates of smoking surrounding them, higher rates of comorbid substance use and mental illness, limited access to healthcare (Businelle et al., 2013)]; therefore, one of the goals of this study was to learn more about the relationships between these variables and smoking cessation outcomes among homeless smokers making a specific quit attempt. Because of the low base rates of abstinence – even on the quit day – among this sample, an alternate but potentially meaningful milestone of the association between affective variables with CPD was the outcome of interest. Results indicated that changes in one's emotions led to significant changes in the consumption of cigarettes smoked per day post-quit attempt. Specifically, increases in PA related to fewer cigarettes smoked. Furthermore, the significant time interaction with PA points to the importance of specific time periods when affect influences cigarette consumption. The graph showed that for both high and low levels of PA, CPD increased as time progressed during the post-quit week. These results are interesting given the significant relationship found between PA and CPD. It may be that while those experiencing increasing PA smoked fewer cigarettes, the specific time periods associated with these fluctuations should be further investigated as suggested by the significant time interactions. As a result, focusing on changes within one's affective state, particularly in the days following a quit attempt when CPD are lower, may represent an avenue of interest and potential behavior change for intervention programs targeting this population. The non-significant trend whereby increasing NA was associated with greater CPD, and the

associated time interaction, further highlights the potential of this line of inquiry in designing cessation interventions and improving cessation outcomes.

Recent research has focused on negative and positive affect as variables of interest for intervention revision and development. PA has been found to play an important role in smoking cessation research, and new studies have focused on mood management and positive psychology to capitalize on these relationships. Branstrom, Penilla, Perez-Stable, and Munoz (2010), for example, created an online study which theorized that those with high levels of PA would be more successful in their quitting and more likely to persist in their quit attempts compared to those with lower levels, and that those with low levels of PA would benefit more from the mood-management component than those with higher levels. The mood-management tool offered participants 8 social-learning-oriented lessons, which included a 30-minute relaxation exercise; an interactive tool to record CPD, number of pleasant activities engaged in that day, and overall mood of the day; as well as encouragement to learn new ways to influence their mood and to use them in appropriate situations (i.e., when NA arose). Participants were encouraged to increase the frequency of pleasant activities and were provided ideas of activities to engage. They were asked to chart the interaction between number of pleasant activities engaged in and mood as well as mood with CPD. Results indicated that PA affected smoking cessation by increasing persistence in trying to quit and increasing study retention. Initial confidence in one's ability to quit was significantly predictive of abstinence at 30 days, 1 month, 3 months, and 6 months. Given the high rates of psychological co-morbidity often seen in homeless adults (Amore & Howden-Chapman, 2012; de la Haye et al., 2012; NIMH, 2013), cessation interventions focused on mood-management similar to the one described here may be beneficial for capitalizing on the

positive association between PA and lower CPD smoked following a quit attempt seen in the present study.

PA may also be affected through the application of positive psychology, which looks to enhance positive thoughts, feelings, and behaviors and has been shown to enhance well-being when administered individually for at least four weeks (Sin & Lyubomirsky, 2009). Kahler et al. (2013) sought to develop a manualized treatment for smoking cessation, which used positive psychology exercises, and test its feasibility among smokers with low PA who wished to quit smoking. Participants received 8 weeks of nicotine replacement therapy (i.e., nicotine patch) while simultaneously attending an 8-week combination group and individual treatment, which focused on enhancing positive emotions. The initial two weeks of intervention entailed group therapy and focused on practicing the positive psychology-smoking cessation exercises. The third week was the target quit date, and all subsequent weeks consisted of individual meetings with counseling provided. The final meeting allowed participants to review all the exercises they learned and to identify which exercises they would like to continue to use. The study included no comparison group but reported a 31.6% abstinence rate at 6 month, which was higher than Fiore et al. (2008) six-month abstinence rate for multiple studies of smokers receiving the nicotine patch (23%). The authors of the positive psychology-based intervention also argued that their achieved abstinence rate was particularly significant given the baseline low PA of the participants. These results also suggest the promise of PA-focused interventions in addressing mechanisms underlying cessation, as well as those potentially tied to cessation milestones like a reduction in CPD, among at-risk groups.

The interventions addressing PA during the quitting process represent approaches to facilitate smoking cessation, but they all used domiciled smokers in their samples. The current study revealed the importance of affect for homeless smokers during the post-quit week as well, suggesting the importance of considering these mechanisms when intervening with homeless smokers. As the literature currently stands, more research targeting homeless smokers' needs to be done as the generalizability of such findings cannot be assumed given the potential uniqueness of homeless adult smokers relative to domiciled adult smokers (Businelle et al., 2013).

In order to apply the above summarized interventions with homeless smokers, alterations may be needed to accommodate the challenges in quitting faced by homeless smokers. These challenges can complicate the quitting process in ways that domiciled smokers do not face, and for these reasons interventions need to be scrutinized and possibly modified prior to implementation. Smoking among homeless adults is far more acceptable than it is among domiciled smokers (Okuyemi et al., 2006), and homeless smokers are subjected to far more smokers than their domiciled peers (Businelle et al., 2013). Lower motivation to quit, lower self-efficacy for quitting, and greater exposure to stressors relative to domiciled socioeconomically disadvantaged smokers has also been reported in recent studies, highlighting the major differences between these groups (Businelle et al., 2013). These factors can make attempting to quit seem difficult for the homeless smoker and maintaining or achieving even brief abstinence even more challenging. Reitzel et al. (2014) found that even shelter proximity can complicate quit attempts as nearness to the shelter was associated with increased overall NA and stress. These findings illustrate how homeless smokers seeking to quit smoking can face substantial difficulties, both emotional and

environmental, which can confound quit attempts and reduce the efficacy of empirically supported treatments. Stress did not predict increased CPD during the week post-quit in the current study, but this may be reflective of the exceedingly high stress encountered on a daily basis by homeless individuals in the first place. Businelle et al. (2013) compared the characteristics of domiciled versus homeless smokers and found the latter are exposed to greater numbers of various stressors than their domiciled counterparts. Consequently, these differences in stress may be another factor which needs to be accounted for when developing treatments for smoking cessation for homeless smokers.

Previous research has shown that successful tobacco abstinence usually necessitates multiple attempts (Borland, Partos, Yong, Cummings, & Hyland, 2012) whereby a smoker motivated to quit will usually have to "recycle" through multiple quit attempts after relapse episodes (Bold et al., 2015). For homeless smokers who start a cessation program with low levels of PA, their numbers of CPD might be expected to be higher during the post-quit week, making abstinence more unlikely to be attained early in the initial attempt. Treatment providers could utilize this knowledge to address and normalize the non-linear path to abstinence that homeless smokers may encounter, which may be particularly important given the stressful nature of shelter living (Reitzel et al., 2014).

By using knowledge about "recycling" quit attempts as well as current findings about the relationships between affect, CPD, and time, a new approach to tobacco intervention for homeless smokers could be developed that stressed harm reduction. By emphasizing a reduction in number of cigarettes smoked rather than complete abstinence, not only might a more attainable goal be set for this population given their abstinence rates from previous studies (Okuyemi et al., 2006b; Shelley et al., 2010; Businelle et al., 2014a; Spector, Alpert,

& Karam-Hage, 2007), but interventions might be able to better capitalize on recycle attempts or maintenance trials, where individuals complete a post-quit attempt smoking the same number of cigarettes that they started with (Cinciripini, Wetter, & McClure, 1997). Instead of these outcomes being seen as treatment failures by homeless smokers and their interventionists, they could be reframed as normal stages on the path to a healthier lifestyle, one which eventually includes no tobacco. This idea could be bolstered by principles from the positive psychology and mood management strategies described by previous studies as well as focusing these efforts early into a quit attempt. This goal could be achieved by inviting homeless smokers to be aware of their emotions and behaviors; encouraging and supporting activities which are beneficial to a healthier lifestyle (i.e., greater physical activity, increased social contact); providing emotionally supportive groups where these feelings can be expressed and/or processed; and supplying structure to the day. These kinds of activities and resources, in combination with cessation medication and education about tobacco cessation and the effects (including the possibility/probability of relapse) specific to the homeless population could be more successful approaches to addressing the chronic problem of cigarette/nicotine dependence among homeless smokers.

While this study has added to a small but vital literature on smoking cessation among homeless smokers, its limitations should be noted. In particular, the small sample size and relatively short-follow up period should be considered when reviewing results. Relations of interest may differ if longer periods of follow-up were examined than one week post-quit. Furthermore, the sample was recruited from one transitional homeless shelter so results may not generalize to other homeless samples (e.g., those with a higher proportion of women and

homeless families, those in other areas of the country where homeless smoking policies may differ).

Future studies might focus on the link found between PA and post-quit CPD during the post-quit week more specifically by using the time-varying effect model (TVEM), which can be used to analyze and interpret complex, time-varying relationships related to dichotomous variables [i.e., smoking lapse/relapse following a quit attempt, (Shiyko, Lanza, Tan, Li, & Shiffman, 2012; Tan, Shiyko, Li, Li, & Dierker, 2012)]. The time-varying effect model has already been applied to EMA studies to distill more fine-grained insights about time-varying constructs. For example, Vasilenko et al. (2014) used TVEM to better understand time-varying predictors including smoking urge, momentary craving, NA, and baseline nicotine dependence and their associations with whether a smoker would lapse at different times after a quit attempt in a placebo-controlled study of domiciled smokers. Participants completed 4 random daily EMAs, and treatment group participants were provided NRTs for 8 weeks post-quit. The authors originally used a traditional multi-level modeling approach and found that all the hypothesized predictors were associated with smoking lapse. Subsequently, the TVEM approach revealed that baseline dependence, momentary craving, and NA were all predictive of smoking post-quit attempt but at varying times during the 2 week post-quit period. Craving had the strongest relationship with smoking and strengthened with time (climaxing at the 12th day), while stronger baseline dependence corresponded with greater odds of smoking during the first week of post-quit (though this relationship became non-significant by 8 days post-quit). Most relevant to this study, the relationship between NA and smoking consistently increased after the 7th day post-quit, an interesting result in comparison to this study's own findings. These results suggest that craving and nicotine dependence may

play larger roles during the early days of a quit attempt but become less important after around a week to 12 days, after which affective variables, like NA, become more important to lapse.

Vasilenko et al. (2014) also examined how mono and combination pharmacotherapy differed from placebo conditions during the 2 week post-quit period. Results indicated that smokers who were given NRTs showed lower odds of smoking during the first week of post-quit compared to placebos, but these results became non-significant by the second week. These results suggest that current NRTs are most effectual during the first week of the post-quit attempt, when craving and baseline dependence are at their highest. After this point, when affect plays a larger role in smoking lapse, intervention programs, such as the ones outlined above (i.e., mindfulness, positive psychotherapy) may be helpful as added means of support to aid smokers through their quit attempt. It should be noted that this study was done with domiciled smokers, but future studies could examine whether similar relationships between affective variables and CPD were found among homeless smokers.

In summary, the current study adds to the literature by providing more information about homeless smokers and factors related to CPD smoked following a specific quit attempt. Results indicated that experiencing higher levels of PA in the week following a post-quit attempt led to fewer numbers of CPD. Significant time effects also showed that CPD increased as the post-quit week progressed for both high and low levels of PA, suggesting that targeting interventions early during the post-quit week would be a useful area of further study. Although the current study did not address the application of these results to intervention protocols, the relationship between affect and smoking cessation milestones has already been supported among domiciled smokers with positive psychotherapy and mood

management showing promising effects (Branstrom et al., 2010; Kahler et al., 2013). Future research could focus on applying the concepts from these interventions and adapting them to a homeless population and a shelter setting. Furthermore, studies might also take advantage of TVEM, which would allow for time-varying questions to be answered using the EMA data and ultimately contribute to more effective and beneficial treatments for smoking cessation among homeless adults.

References

American Lung Association (2011). *Trends in Tobacco Use.* Retrieved from

http://www.lung.org/finding-cures/our-research/trend-reports/Tobacco-Trend-

Report.pdf

Ames, S. C., Patten, C. A., Offord, K. P., Pennebaker, J. W., Croghan, I. T., Tri, D. M.,

Stevens, S. R., & Hurt, R. D. (2005). Expressive writing intervention for young adult

cigarette smokers. *Journal of Clinical Psychology, 61,* 1555-1570.

doi:10.1002/jclp.20208

Amore, K., & Howden-Chapman, P. L. (2012). Mental health and homelessness. In S. Smith

(Ed.), *International Encyclopedia of Housing and Home* (268-273). Amsterdam, The

Netherlands: Elsevier.

Arnsten, J. H., Reid, K., Bierer, M., & Rigotti, N. (2004). Smoking behavior and interest in

quitting among homeless smokers. *Addictive Behaviors, 29,* 1155–1161. doi:

10.1016/j.addbeh.2004.03.010

Baer, J. S., & Lichtenstein, E. (1988). Classification and prediction of smoking relapse

episodes: An exploration of individaul differences. *Journal of Consulting and

Clinical Psychology, 56,* 104-110.

Baer, J. S., Lichtenstein, E., Kamarck, T., & Ransom, C. C. (1989). Prediction of smoking

relapse: Analysis of temptations and transgressions after intial cessation. *Journal of

Consulting and Clinical Psychology, 57,* 623-627.

Baggett, T. P., Anderson, R., Freyder, P. J., Jarvie, J. A., Maryman, K., Porter, J., & Rigotti,

N. A. (2012). Addressing tobacco use in homeless populations: A survey of health

care professionals. *Journal of Health Care for the Poor and Underserved, 23,* 1650-1659. doi: 10.1353./hpu.2012.0162

Baggett, T. P., & Rigotti, N. A. (2010). Cigarette smoking and advice to quit in a national sample of homeless adults. *American Journal of Preventative Medicine, 39,* 164-172.

Baggett, T. P., Lebrun-Harris, L. A., & Rigotti, N. A. (2013). Homelessness, cigarette smoking and desire to quit: Results from a US national study. *Addiction, 108,* 2009-2018, doi: 10.1111/add.12292

Baggett, T. P., Tobey, M. L., & Rigotti, N. A. (2013). Tobacco use among homeless people – addressing the neglected addiction. *The New England Journal of Medicine, 369,* 201-204. doi: 10.1056/NEJMp1301935

Bock, B. C., Papandonatos, G. D., de Dio, M. A., Abrams, D. B., Azam, M. M., Fagan, M., Sweeney, P. J., Stein, M. D., & Niaura, R. (2014). Tobacco cessation among low-income smokers: Motivational enhancement and nicotine patch treatment. *Nicotine & Tobacco Research, 16,* 413-422. doi:10.1093/ntr/ntt166

Bold, K. W., Rasheed, A. S., McCarthy, D. E., Jackson, T. C., Fiore, & Baker, T. B. (2015). Rates and predictors of renewed quitting after relapse during a one-year follow-up among primary care patients. *Annals of Behavioral Medicine, 49,* 128-140. doi: 10.100/s12160-014-9627-6

Borland, R. (1990). Slip-ups and relapse in attempts to quit smoking. *Addictive Behavior, 15,* 235–245.

Borland, R., Partos, T. R., Yong, H-H., Cumming, K. M., & Hyland, A. (2012). How much

    unsuccessful quitting activity is going on among adult smokers? Data from the

    International Tobacco Control Four Country cohort survey. *Addiction, 107,* 673-682

Brandon, T. H. (1994). Negative affect as motivation to smoke. *Current Directions in*

    Psychological Science, 3, 33-37.

Brandon, T. H., & Baker, T. B. (1991). The smoking consequences questionnaire: The

    subjective expected utility of smoking college students. *Psychological Assessment, 3,*

    484-491.

Brandon, T. H., Tiffany, S. T., Obremski, K. M., & Baker, T. B. (1990).Postcessation

    cigarette use: The process of relapse. *Addictive Behaviors, 15,* 105–114.

Brandon, T. H., Vidrine, J. I., & Litvin, E. B. (2007). Relapse and relapse prevention. *Annual*

    Review of Clinical Psychology, 3, 257-284. doi: 10.1146/annurev.clinpsy.3.022806.

    091455

Branstrom, R., Penilla, C., Perez-Stable, E. J., & Munoz, R. F. (2010). Positive affect and

    mood management in successful smoking cessation. *American Journal of*

    Behavioral Health. 34, 553-562.

Brodbeck, J., Bachmann, M. S., Brown, A., & Znoj, H. J. (2014). Effects of depressive

    symptoms on antecedents of lapses during a smoking cessation attempt: An

    ecological momentary assessment study. *Addiction, 109,* 1363-1370. doi:

    10/111/add.12563180-185.

Brodbeck, J., Bachman, M. S., & Znoj, H. (2013). Distinct coping strategies differentially predict urge levels and lapses in a smoking cessation attempt. *Addictive Behaviors, 38,* 2224-2229. doi:10.1016/j.addbeh.2013.02.011

Brown, R. A., Lujuez, C. W., Kahler, C. W., & Strong, D. R. (2002). Distress tolerance and duration of past smoking cessation attempts. *Journal of Abnormal Psychology, 111,*

Brown, H., & Prescott, R. (1999). *Applied mixed models in medicine*. West Sussex, England: John Wiley and Sons, LTD.

Businelle, M. S., Cuate, E. L., Kesh, A., Poonawalla, I. B., & Kendzor, D. E. (2013). Comparing homeless smokers to economically disadvantaged domiciled smokers. *American Journal of Public Health, 103,* S218-S220. doi: 10.2105/AJPH.2013.301336

Businelle, M. S., Kendzor, D. E., Kesh, A., Cuate, E. L., Poonawalla, I. B., Reitzel, L. R., Okuyemi, K. S., & Wetter, D. W. (2014a). Small financial incentives increase smoking cessation in homeless smokers: A pilot study. *Addictive Behaviors, 39,* 717-720. doi: 10.1016/j.addbeh.2013.11.017

Businelle, M. S., Kendzor, D. E., Reitzel, L. R., Costello, T. J., Cofta-Woerpel, L., Li, Y., Mazas, C. A., Vidrine, J. I., Cinciripini, P. M., Greisinger, A. J., Wetter, D. W. (2010). Mechanisms linking socioeconomic status to smoking cessation: A structural equation modeling approach. *Health Psychology, 29,* 262-273. doi: 10.1037/a0019285

Businelle, M. S., Ma, P., Kendzor, D. E., Reitzel, L. R., Chen, M., Lam, C, Bernstein, I., &
	Wetter, D. W. (2014b). Predicting quit attempts among homeless smokers seeking
	cessation treatment: An ecological momentary assessment study. *Nicotine & Tobacco*
	Research, 16, 1371-1378. doi: 10.1093/ntr/ntu088

Businelle, M. S., Lam, C. Y., Kendzor, D. E., Cofta-Woerpel, L., McClure, J. B., Cincirpini,
	P. M., & Wetter, D. W. (2013). Alcohol consumption and urges to smoke among
	women during a smoking cessation attempt. *Experimental and Clinical*
	Psychopharmacology, 21, 29-37. doi: 10.1037/a0031009

Businelle, M. S., Poonawalla, I. B., Kendzor, D. E., Rios, D., Cuate, E. L., Savoy, E J., Ma,
	P., Baggett, T. P., & Reitzel, L. R. Smoking policy change at a homeless shelter:
	Attitudes and effects. *Addictive Behaviors*, in press

Butler, J., Okuyemi, K. S., Jean, S., Nazir, N., Ahluwalia, J. S., & Resnicow, K. (2002).
Smoking
	characteristics of a homeless population. *Substance Abuse, 23*, 223–231. doi:
	10.1080/08897070209511495

Carney, M. A., Tennen, H., Affleck, G., del Boca, F. K., & Kranzler, H. R. (1998). Levels
	and patterns of alcohol consumption using timeline follow-back, daily diaries and
	real-time "electronicinterviews." *Journal of Studies on Alcohol and Drugs, 59,* 447–
	454.

Carter, B. L., Lam, C. Y., Robinson, J.D., Paris, M. M., Waters, A. J., Wetter, D. W., &
	Cincirpini, P. M. (2008). Real-time craving and mood assessments before and after

smoking. *Nicotine & Tobacco Research*, *10, 1165*–1169. doi:

10.1080/14622200802163084

Center for behavioral health statistics and quality (CBHSQ)– Data spotlight. (2013).

Smoking rate among adults with serious psychological distress remains high.

Retrieved from http://www.samhsa.gov/data/spotlight/spot120-smokingSPD.pdf

Centers for Disease Control and Prevention (2011a). *CDC health disparities and inequalities*

report – United States, 2011. Morbidity and Mortality Weekly Report, 60, 109.

Centers for Disease Control and Prevention (2011b). *Quitting smoking among adults –*

United Sates, 2001-2010. Morbidity and Mortality Weekly Report, 60, 1513-1519.

Centers for Disease Control and Prevention (2012). *Current cigarette smoking among adults*

- United States, 2011. Morbidity and Mortality Weekly Report, *61*, 889–907.

Centers for Disease Control and Prevention (2014a). *Current cigarette smoking among*

adults – United States, 2005-2013. Morbidity and Mortality Weekly Report, 63, 1108-

1112.

Centers for Disease Control and Prevention. (2014b). *Current cigarette smoking among*

adults—United States, 2005–2013. Morbidity and Mortality Weekly Report, 63,

1108–1112.

Centers for Disease Control and Prevention (2014c). *Smoking & tobacco use – Fast facts.*

Retrieved from http://www.cdc.gov/tobacco/data_statistics/fact_sheets/fast_facts/

Centers for Disease Control and Prevention (2014d). *Smoking and tobacco use – Health*

effects of cigarette smoking. Retrieved from

http://www.cdc.gov/tobacco/data_statistics/fact_

sheets/health_effects/effects_cig_smoking/index.htm.

Centers for Disease Control and Prevention (2014d). *Smoking & tobacco use – Quitting*

tobacco. Retrieved from

http://http://www.cdc.gov/tobacco/data_statistics/fact_sheets/cessation

/quitting/index.htm.

Centers for Disease Control and Prevention (2013). *Vital signs: Current cigarette smoking*

among adults aged ≥ 18 years with mental illness – United States, 2009 – 2011.

Morbidity and Mortality Weekly Report, 62, 81-87.

Cinciripini, P. M., Wetter, D. W., & McClure, J. B. (1997). Scheduled reduced smoking:

Effects on smoking abstinence and potential mechanisms of action. *Addictive*

Behaviors, 22, 759-767. doi:10.1016/S0306-4603(97)00061-0

Coan, R. (1973). Personality variables associated with cigarette smoking. *Journal of*

Personality and Social Psychology, 26, 86-104.

Cofta-Woerpel, L., McClure, J. B., Li, Y., Urbauer, D., Cinciripini, P. M., & Wetter, D. W.

(2011). Early cessation success or failure among women attempting to quit smoking:

Trajectories and volatility of urge and negative mood during the first postcessation

week. *Journal of Abnormal Psychology, 120,* 596-606. doi: 10.1037/a0023755

Cohen, S., & Lichtenstein, E. (1990). Perceived stress, quitting smoking, and smoking

relapse. *Health Psychology, 9,* 466-478.

Cook, R. D., & Weisberg, S. (1982). *Residuals and influence in regression*. New York:

Chapman and Hall.

Cummings, K. M., Jaen, C. R., & Giovino, G. (1985). Circumstances surrounding relapse in a group of recent exsmokers. *Preventive Medicine, 14,* 195–202.

D'Angelo, M. E. S., Reid, R. D., Hotz, S., Irvine, J., Segal, R. J., Blanchard, C. M., & Pipe, A. (2005). Is stress management training a useful addition to physician advice and nicotine replacement therapy during smoking cessation in women? Results of a randomized trial. *American Journal of Health Promotion, 20,* 127-134. doi:10.4278/0890-1171-20.2.127

de la Haye, K., Green, H. D. Jr., Kennedy, D. P., Zhou, A., Golinelli, D., Wenzel, S. L., & Tucker, J. S. (2012). Who is supporting homeless youth? Predictors of support in personal networks. *Journal of Research on Adolescence, 22,* 604-616.

Dobbs, S. D., Strickler, D. P., & Maxwell, W. E., (1981). The effects of stress, and relaxation in the presence of stress on urinary pH and smoking behavior. *Addictive Behaviors, 6,* 345-353.

Doran, N., Cook, J., McChargue, D., Myers, M., & Spring, B. (2009). Cue-Elicited negative affect in impulsive smokers. *Psychology of Addictive Behaviors, 22,* 249-256. doi: 10.1037/0893-164x

Druss, B. G., Zhao, L., Von Esenwein, S., Morrato, E. H., & Marcus, S. C. (2011). Understanding excess mortality in persons with mental illness: 17-year follow up of a nationally representative US survey. *Medical Care, 49,* 599-604.

Dvorak, R. D., Pearson, M. R., & Day, A. M. (2014). Ecological momentary assessment of acute alcohol use disorder symptoms: Associations with mood, motives, and use on planned drinking days. *Experimental and Clinical Psychopharmacology, 22,* 285-297. doi: 10.1037/a0037157

Eich, E., Reeves, J. L., Jaeger, B., Graff-Radford, S. B. (1985). Memory for pain: Relation between past and present pain intensity. *Pain*, 223, 375–379.

Fiore, M. C., Jaén, C. R., Baker, T. B., Bailey, W. C., Benowitz, N. L., Curry, S. J.,…Henderson, P. N. (2008). Treating tobacco use and dependence: 2008 update U.S. public health

Fiore, M. C., Jaén, C., Baker, T., Bailey, W. C., Benowitz, N. L., Curry, S. J., ... Wewers, M. E. (2008). Treating tobacco use and dependence: 2008 update. Rockville, MD: US Department of Health and Human Services. Public Health Service.

Frith, C. D. (1971). Smoking behavior and its relation to the smoker's immediate experience. *British Journal of Social and Clinical Psychology, 10,* 73-78.

Hagman, B. T., Delnevo, C. D., Hrywna, M, & Williams, J. M. (2008). Tobacco use among those with serious psychological distress: Findings from the national survey of drug use and health, 2002. *Addictive Behaviors, 33,* 582-592.

Harwood, G. A., Salsberry, P., Ferketich, A. K., & Wewers, M E. (2007). Cigarette smo,ing, socioeconomic status, and psychosocial factors: Examining a conceptual framework. *Public Health Nursing, 24,* 361-371. doi: 10.111/j.1525-1446.2007.00645.x

Hendershot, C. S., Witkiewitz, K., George, W. H., & Marlatt, G. A. (2011). Relapse prevention for addictive behaviors. *Substance Abuse Treatment, Prevention, and Policy, 6,* doi: 10.1186/1747-597X-6-17

Hodgins, D. C., el Guebaly, N., & Armstrong, S. (1995). Prospective and retrospective reports of mood states before relapse to substance use. *Journal of Consulting and Clinical Psychology, 63,* 400-407.

Hoeppner, B. B., Kahler, C. W., & Gwatlner, C. J. (2014). Relationship between momentary affect states and self-efficacy in adolescent smokers. *Health Psychology, 33,* 1507-1517. doi: 10.1037/hea0000075.

Homma, Y., Ando, T., Yoshida, M., Kageyama, S., Takei, M., Kimoto, K., Ishizuka, O., Gotoh, M., & Hashimoto, T. (2002). Voiding and incontinence frequencies: Variability of diary data and required diary length. *Neurology & Urodynamics, 21,* 204–209.

Honjo, K., Tsutsumi, A., Kawachi, I., & Kawakami, N. (2006). What accounts for the relationship between social class and smoking cessation? Results of a path analysis. *Social Science & Medicine, 62,* 317-328.

Hurt, R. D., Offord, K. P., Croghan, I. T., Gomez-Dahl, L., Kottke, T. E., Morse, R. M., & Melton, L. J. III. (1996). Mortality following inpatient addictions treatment: Role of tobacco use in community-based cohort. *Journal of the American Medical Association, 275,* 1097-1103.

Hwang, S. W., & Henderson, M. J. (2010). Health care utilization in homeless people: Translating research into policy and practice. In (Working Paper No. 10002 ed., Vol. 2012): Agency for Healthcare Research and Quality.

Ikard, F. F., Green, P. E., & Horn, D. (1969). A scale to differentiate between types of smoking as related to the management of affect. *International Journal of the Addictions, 4,* 649-659.

International Agency for Research on Cancer. A review of human carcinogens. Part E: Personal habits and indoor combustions. (2012). Lyon, France, International Agency

for Research on Cancer. IARC Monographs on the Evaluation of Carcinogenic Risks to Humans.

Juliano, I., & Brandon, T. (2002). Effects of nicotine dose, instructional set, and outcome expectancies on the subjective effects of smoking in the presence of a stressor. *Journal of Abnormal Psychology, 111,* 88-97.

Kahler, C. W., Spillane, N. S., Day, A. Clerkin, E. M., Parks, A., Leventhal, A. M., Brown, R. A. (2014). Positive psychotherapy for smoking cessation: Treatment development, feasibility, and preliminary results. *The Journal of Positive Psychology: Dedicated to furthering research and promoting good practice, 9,* 19-29. doi: 10.1080/17439760.2013..826716

Kassel, J. D., Stroud, L. R., & Paronis, C. A. (2003). Smoking, stress, and negative affect: Correlation, causation, and context across stages of smoking. *Psychological Bulletin, 129,* 270-304. doi: 10.1037/0033-2909.129.2.270

Kertesz, S. G., Larson, M. J., Horton, N. J., Winter, M., Saitz, R., & Samet, J. H. (2005). Homeless chronicity and health-related quality of life trajectories among adults with addictions. *Medical Care, 43,* 574-585.

Kihlstrom, J. F., Eich, E., Sandbrand, D., & Tobias, B. A. (2000). Emotion and memory: Implications for self-report. *The science of self-report: Implications for research and practice,* p. 81–100.

Kinnunen, T., Doherty, K., Millitello, F. S., & Garvey, A. J. (1996). Depression and smoking cessation: Characteristics of depressed smokers and effects of nicotine dependence. *Journal of Consulting and Clinical Psychology, 64,* 791-798.

Lam, C. Y., Businelle, M. S., Aigner, C. J., McClure, J. B., Cofta-Woerpel, L., Cinciripini, P. M., & Wetter, D. W. (2014). Individual and combined effects of multiple high-risk triggers on postcessation smoking urge and lapse. *Nicotine and Tobacco Research, 16,* 569-575. doi:10.1093/ntr/ntt190

Lasser, K., Boyd, J. W., Woolhandler, S., Himmelstein., D. U., McCormick, D., Bor, D. H. (2000). Smoking and mental illness: A population-based prevalence study. *Journal of the American Medical Association, 284,* 2606-2610. doi:10.1001/jama.284.20.2606

Lawrence, D., Mitrou, F., & Zubrick, S. R. (2009). Smoking and mental illness: Results from population surveys in Australia and the United States. *BMC Public Health, 9,* 285.

Lawrence, D., Mitrou, F., & Zubrick, S. R. (2011). Non-specific psychological distress, smoking status, and smoking cessation: United States national health interview survey 2005; *BMC Public Health, 11,* 256.

Lebrun-Harris, L. A., Bagget, T. P., Jenkins, D. M., Sripipatana, A., Sharma, R., Hayashi, A., & Daly, C. A., & Ngo-Metzger, Q. (2013). Health status and health care experiences among homeless patients in federally supported health centers: Findings from the 2009 Patient Survey. *Health Services Research, 48,* 992-1017. doi: 10.111/1475-6773.12009

Lee, T. C., Hanlon, J. G., Ben-David, J., Booth, G. L., Cantor, W. J., Connelly, P. W., & Hwang, S. W. (2005). Risk factors for cardiovascular disease in homeless adults. *Circulation, 111,* 2629–2635.

Littell, R. C., Milliken, G. A., Stroup, W. W., Wolfinger, R. D., & Schabenberger, O. (2006). *SAS for mixed models.* (2nd ed.). Cary, NC: SAS Institue Inc.

Mak, T., Prynne, C. J., Cole, D., Fitt, E., Roberts, C., Bates, B., & Stephen, A. M. (2012).

    Assessing eating context and fruit and vegetable consumption in children: New

    methods using food diaries in the UK National Diet and Nutrition Survey Rolling

    Programme. *The International Journal of Behavioral Nutrition and Physical Activity,*

    9, 1-15. doi: 10.1186/1479-5868-9-126

Marlatt, G. A. (1985). Relapse prevention: Theoretical rationale and overview of the model.

    In G.A. Marlatt & J. R. Gordon (Eds.), *Relapse prevention* (p. 250-280). New York:

    Guilford Press.

Marlatt, G. A., & George, W. H. (1984). Relapse prevention: Introduction and overview of

    the model. *British Journal of Addiction, 79,* 261-273.

Marlatt, G. A., & Gordon, J. R. (1980). Determinants of relapse: Implications for the

    maintenance of behavior change. In: Davidson, P. O.; Davison, S. M., editors.

    Behavioral medicine: Changing health lifestyles. New York: Brunner/Mazel; 1980. P.

    410-452.

McCulloch, C., & Searle, S. (2001). *Generalized, linear, and mixed models.* New York: John

    Wiley & Sons, Inc.

McKee, S. A., Maciejewski, P. K., Falba, T., & Mazure, C. M. (2003). Sex differences in the

    effects of stressful life events on changes in smoking status. *Addiction, 98,* 847-855.

McKee, S. A., Sinha, R., Weinberger, A. H., Sofuoglu, M., Harrison, E. L. R., Lavery, M., &

    Wanzer, J. (2011). Stress decreases the ability to resist smoking and potentiates

    smoking intensity and reward. *Journal of Psychopharmacology, 25,* 490-502. doi:

    10.1177/0269881110376694

McKennell, A. C. (1970). Smoking motivation factors. *British Journal of Social and Clinical Psychology, 9,* 8-22.

Minami, H., McCarthy, D. E., Jorenby, D. E., & Baker, T. B. (2010). An ecological momentary assessment analysis of relations among coping, affect and smoking during a quit attempt. *Addiction, 106,* 641-650. doi:10.111/j.1360-0443.2010.03243.x

Minami, H., Yeh, V. M., Bold, K. W., Chapman, G. B., & McCarthy, D. E. (2014). Relations among affect, abstinence motivation, and confidence, and daily smoking lapse risk. *Psychology of Addictive Behaviors, 28,* 276-288. doi: 10.1037/a0034445

National Institute of Mental Health. (2009). Statistics. Retrieved from http://www.nimh.nih.gov.

National Institute of Mental Health (2012). Serious mental illness (SMI) among U.S. adults. Retrieved from http://www.nimh.nih.gov/health/statistics/prevalence/serious-mental-illness-smi-among-us-adults.shtml.

North, C. S., Eyrich-Garg, K. M., Pollio, D. E., &Thirthalli, J. (2010). A prospective study of substance use and housing stability in a homeless population. *Social Psychiatry and Psychiatric Epidemiology,45,* 1055-1062.

Okuyemi, K. S., Caldwell, A. R., Thomas, J. L., Born, W., Richter, K. P., Nollen, N., Braunstein, K., & Ahluwalia, J. S. (2006). Homelessness and smoking cessation: Insights from focus groups. *Nicotine & Tobacco Research, 8*(2), 287-296. doi: 10.1080/14622200500494971

Okuyemi, K. S., Goldade, K., WHembolua, G. L., Thomas, J. L., Eischen, S., Sewali, W., Guo, H., Connett, J. E., Grant, J., Ahluwalia, J. S., Resnicow, K., Owen, G., Gelberg, L., & Jarlais, D. D. (2013). Motivational interviewing to enhance nicotine patch

treatment for smoking cessation among homeless smokers: A randomized controlled trial. *Addiction, 108,* 1136-1144. doi: 10.1111/add.12140

Okuyemi, K. S., Thomas, J. L., Hall, S., Nollen, N. L., Richter, K. P., Jeffries, S. K., et al. (2006b). Smoking cessation in homeless populations: A pilot clinical trial. *Nicotine & Tobacco Research, 8*, 689-699.

Parrott, A. (1999). Does cigarette smoking cause stress? *American Psychology, 54,* 817-820.

Payne, T. J., Schane, M. L., Levis, D. J., & Colletti, G. (1991). Exposure to smoking-relevant cues: Effects on desire to smoke and topographical components of smoking behavior. *Addictive Behaviors, 16,* 467-479.

Piasecki, T. M., Kenford, S. L., Smith, S. S., Fiore, M. C., & Baker, T. B. (1997). Listening to nicotine: Negative affect and the smoking withdrawal conundrum. *Psychological Science, 3,* 184-189. doi:10.1111/j.1467-9280.1997.tb00409.x

Polivy, J., & Herman, C. P. (2002). If at first you don't succeed: False hopes of self-change. *American Psychologist, 19,* 76-83. doi: 10.1037//0003-066X.57.9.677

Pomerleau, O. F., Adkins, D., & Pertschuk, M. (1978). Predictors of outcome and recidivism in smoking cessation treatment. *Addictive Behaviors, 3,* 65-70.

Pomerleau, C. S., & Pomerleau, O. F. (1987). The effects of a psychological stressor on cigarette smoking and on sbusequent behavioral and physiological responses. *Psychophsyiology, 24,* 278-285.

Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical linear models: Applications and data analysis methods. (*2nd ed.). Thousand Oaks, CA: Sage Publications, Inc.

Redelmeier, D. A., Katz, J., Kahneman, D. (2003). Memories of colonoscopy: A randomized trial. *Pain, 104*, 187–194.

Reitzel, L. R., Kendzor, D. E., Cao, Y., & Businelle, M. S. (2013). Subjective social status predicts quit-day abstinence among homeless smokers. *American Journal of Health Promotion, 29,* 43-45. doi: 10.1186/1471-2458-11-135

Reitzel, L. R., Mazas, C. A., Cofta-Woerpel. L., Li, Y., Cao. Y., Businelle, M. S., Cinciripini., P M., & Wetter, D. W. (2010). Subjective social status affects smoking abstinence during acute withdrawal through affective mediators. *Addiction, 105,* 928-936. doi: 10.111/j.1360-0443.2009.02875.x

Rose, J. E., Ananda, S., & Jarvik, M. E. (1983). Cigarette smoking during anxiety-provoking and monotonous tasks. *Addictive Behaviors, 8,* 353-359.

Schacter, S. (1978). Pharmacological and psychological determinants of smoking. *Annals of Internal Medicine, 88,* 104-114.

Searles, J. S., Helzer, J. E., & Walter, D. E. (2000). Comparison of drinking patterns measured by dailyreports and timeline follow back. *Psychology of Addictive Behaviors,* 14, 277–286.

Shapiro, D., Jamner, L. D., Davtdov, D. M., & James, W. (2002). Situations and moods associated with smoking in everyday life. *Psychology of Addictive Behavior, 16*, 342–345.

Shelley, D., Cantrell, J., Wong, S., Warn, D., Shelley, D., Cantrell, J., et al. (2010). Smoking cessation among sheltered homeless: A pilot. *American Journal of Health Behavior, 34*, 544-552.

Shiffman, S. (1979). The tobacco withdrawal syndrome. In N. A. Krasnegor (Ed.), *Cigarette smoking as a dependence process* (NIDA Research Monogrpah No. 23, p. 153-184). Rockville, MD: Public Health Service.

Shiffman, S. (1982). Relapse following smoking cessation: A situational analysis. *Journal of Consulting and Clinical Psychology, 50,* 71–86.

Shiffman, S. (1993). Assessing smoking patterns and motives. *Journal of Consulting and Clinical Psychology, 61,* 732-742.

Shiffman, S. (2009). How many cigarettes did you smoke? Assessing cigarette consumption by global report, time-line follow-back, and ecological momentary assessment. *Health Psychology, 28,* 519-526. doi: 10.1037/a0015197

Shiffman, S., Balabanis, M. H., Gwaltney, C. J., Paty, J. A., Gnys6 M., Kassel, J. D., Hickcox, M., & Paton, S. M. (2007). Prediction of lapse from associations between smoking and situational antecedents assessed by ecological momentary assessment. *Drug and Alcohol Dependence, 91,* 159-168.

Shiffman, S., Dunbar, M., Kirchner, T., Li, X., Tindle, H., Anderson, S., & Scholl. S. (2013). Smoker reactivity to cues: Effects on craving and smoking behavior. *Journal of Abnormal Psychology, 122,* 264-280. doi: 10.1037/a0028339

Shiffman, S., Gwaltney, C. J., Balabanis, M., Liu, K. S., Paty, J. A., Kassel, J. D., Hickcox, M., & Gnys, M. (2002). Immediate antecedents of cigarette smoking: An analysis from ecological momentary assessment. *Journal of Abnormal Psychology, 111*, 531–545.

Shiffman, S., Hickcox, M., Paty, J. A., Gnys, M., Richards, T., & Kassel, J. D. (1997).
Individual differences in the context of smoking lapse episodes. *Addictive Behaviors,*
22, 797-811.

Shiffman, S., Hickcox, M., Paty, J. A., Gnys, M., Kassel, J. D., & Richards, T. J. (1996).
Progression from a smoking lapse to relapse: Prediction from abstinence violation
effects, nicotine dependence, and lapse characteristics. *Journal of Consulting and*
Clinical Psychology, 64, 993-1002.

Shiffman, S., & Kirchner, T. R. (2009). Cigarette-by-cigarette satisfactiond uring ad libitum
smoking. *Journal of Abnormal Psychology, 118,* 348-259. doi: 10.1037/a0015620

Shiffman, S., & Paty, J. A. (2003). Using an electronic diary to capture frequent events.
Presented at From Quality of Life to Patient Outcomes Assess. Res. Agenda for a
Paradigm Shift, Drug Information Association, Baltimore, MD.

Shiffman, S., Paty, J. A., Gnys, M., Kassel, J. A., & Hickcox, M. (1996). First lapses to
smoking: Within-subjects analysis of real-time reports. *Journal of Consulting &*
Clinical Psychology, 64, 366-379.

Shiffman, S., Paty, J. A., Gwaltney, C. J., Dang, Q. (2004). Immediate antecedents of
cigarette smoking: An analysis of unrestricted smoking patterns. *Journal of Abnormal*
Psychology, 113, 166–171.

Shiffman, S., Stone, A. A., & Hufford, M. R. (2008). Ecological momentary assessment.
Annual Review of Clinical Psychology, 1-32. doi:
10.1146/annurev.clinpsy.3.022806.091415

Shiyko, M. P., Lanza, S. T., Tan, X., Li, R., & Shiffman, S. (2012). Using the time-varying

    effect model (TVEM) to examine dynamic associations between negative affect and

    self confidence on smoking urges: Differences between successful quitters and

    relapsers. *Prevention Science, 13,* 288–299. doi:10.1007/s11121-011-0264-z.

Smith, S., & Vela, E. (2001). Environmental context-dependent memory: A review and

    meta-analysis. *Psychonomic Bulletin & Review,* 8, 203-220. doi:

    10.3758/BF03196157

Shiffman, S., & Waters, A. J. (2004). Negative affect and smoking lapses: A prospective

    analysis. *Journal of Consulting and Clinical Psychology, 72,* 192-201.

Sin, N. L., & Lyubomirsky, S. (2009). Enhancing well-being and alleviating depressive

    symptoms with positive psychology interventions: A practice-friendly meta-analysis.

    Journal of Clinical Psychology, 65, 467–487.

    doi:http://dx.doi.org/10.1002/jclp.20593

Snyder, L. D., & Eisner, M. D. (2004). Obstructive lung disease among the urban homeless.

    Chest Journal, 125(5), 1719-1725. doi:10.1378/chest.125.5.1719

Spector, A., Alpert, H., & Karam-Hage, M. (2007). Smoking cessation delivered by medical

    students is helpful to homeless population. *Academic Psychiatry, 31*, 402-405.

Spielberger, C. D. (1986). Psychological determinants of smoking behavior. In R. D.

    Tollison (Ed.), *Smoking and society: Toward a more balanced assessment (*p. 89-

    134). Lexington, MA: Heath.

Stewart B. McKinney Act of 1987, 42 U.S.C. §§ 103 (1987).

Stone, A. A., Schwartz, J. E., Neale, J. M., Shiffman, S., Marco, C. A., Hickcox, M., Paty, J., Porter, L. S., & Cruise, L. J. (1998). A comparison of coping assessed by ecological momentary assessment and retrospective recall. *Journal of Personality & Social Psychology, 74*, 1670-1680.

Swan, G. E., Denk, C. E., Parker, S. D., Carmelli, D., Furze, C. T., & Rosenman, R. H. (1988). Risk factors for late relapse in male and female ex-smokers. *Addictive Behaviors, 13,* 253-266.

Swan, G. E., Ward, M. M., Jack, L. M., & Javitz, H. S. (1993). Cardiovascular reactivity as a predictor or relapse in male and female smokers. *Health Psychology, 12,* 451–458.

Tan, X., Shiyko, M. P., Li, R., Li, Y., & Dierker, L. (2012). A time-varying effect model for intensive longitudinal data. *Psychological Methods, 17,* 61–77. doi:10.1037/a0025814.

Thiele, C., Laireiter, A-R., Baumann, U. (2002). Diaries in clinical psychology and psychotherapy: A selective review. *Clinical Psychology and Psychotherapy, 9,* 1–37.doi: 10.1002/cpp.302

Thorndike, A. N., Biener, I., & Rigotti, N. A. (2002). Effect on somking cessation of switching nicotine replacement therapy to over-the-counter status. *American Journal of Public Health, 92,* 437-442.

Thornicroft, G. (2011). Physical health disparities and mental illness: The scandal of premature mortality. *The British Journal of Psychiatry, 199,* 441-442. doi: 10.1192/bjp.bp.111.092718

Todd, M., Armeli, S., Tennen, H., Carney, M. A., Ball, S. A., Kranzler, H. R.,& Affleck, G. (2005). Drinking to cope: A comparison of questionnaire and electronic diary reports. *Journal of Studies on Alcohol, 66*, 121–129.

Toro, P. A., Tompsett, C. J., Lombardo, S., Philippot, P., Nachtergael, H., Galand, B., et al. (2007). Homelessness in Europe and the United States: A comparison of prevalence and public opinion. *Journal of Social Issues, 6*, 505-524.

The U.S. Department of Housing and Urban Development. (2013). *The 2013 Annual Homeless Assessment Report (AHAR) to Congress.* Retrieved from https://www.onecpd.info/ resources/documents/ahar-2013-part1.pdf

Van Zundert, R. M. P., Ferguson, S. G., Shiffman, S., & Engels, R. C. M. E. (2010). Dynamic effects of self-efficacy on smoking lapses and relapse among adolescents. *Health Psychology, 29,* 246–254. doi:10.1037/a0018812

Vasilenko, S. A., Piper, M. E., Lanza, S. T., Liu, X., Yang, J., & Li, R. (2014). Time-varying processes involved in smoking lapse in a randomzied trial of smoking cessation therapies. *Nicotine and Tobacco Research, 16,* S135-S143. doi:10.1093/ntr/ntt185

Verbke, G., & Molenberghs, G. (2000). *Linear mixed models for longitudinal data.* New York: Springer-Verlag.

Vidrine, J. I., Reitzel, L. R., & Wetter, D. W. (2009a). Smoking and health disparities. *Current Cardiovascular Risk Reports, 3,* 403-408.

Vidrine, J. I., Reitzel, L. R., & Wetter, D. W. (2009b). The role of tobacco in cancer health disparities. *Current Oncology Reports, 11,* 475-481.

Wardle, J., & Steptoe, A., (2003). Socioeconomic differences in attitudes and beliefs about healthy lifestyles. *Journal of Epidemiology & Community Health, 57,* 440-443.

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect. *Journal of Personality and Social Psychology, 54,* 1063-1070.

Weinstein, L. C., Lanoue, M. D., Plumb, J. D., King, H., Stein, B., & Tsemberis, S. (2013). A primary care-public health partnership addressing homelessness, serious mental illness, and health disparities. *The Journal of the American Board of Family Medicine, 26,* 279-287. doi: 10.3122/jabfm.2013.03.120239

Wills, T. A. (1986). Stress and coping in early adolescence: Relationships to substance use in urban school samples. *Health Psychology, 5,* 503-530.

Witkiewitz, K., & Marlatt, G. A. (2004). Relapse prevention for alcohol and drugs: That was Zen, this is Tao. *American Psychologist, 59,* 224-235. doi: 10.1037/0003-066X.59.4.224

Woodson, P. P., Buzzi, R., & Battig, K. (1983). Effects of smoking on vegetative reactivity to noise. *Sozial und Praventivmedizin, 28,* 240-241.

World Health Organization Global Report. (2012). Mortality attributable to tobacco. http://whqlibdoc.who.int/publications/2012/9789241564434_eng.pdf.

Yeh, V. M., McCarthy, D. E., & Baker, T. B. (2012). An ecological momentary assessment analysis of prequit markers for smoking-cessation failure. *Experimental and Clinical Psychopharmacology, 20,* 479-488. doi: 10.1037/a0029725

Zelman, D. C., Brandon, T. H., Jorenby, D. E., & Baker, T. B., (1992). Measures of affect

and nicotine dependence predict differential response to smoking cessation

treatments. *Journal of Consulting and Clinical Psychology, 60,* 943-952.

Appendix A

EMA Measures*

Post-Quit Daily Diary

How many cigarettes did you smoke yesterday? _____ (use the keypad to type in your response)

Core Items. Mark the response that most applies to you RIGHT NOW.

I feel irritable.	1/strong disagree	2/disagree	3/neutral	4/agree	5/strongly agree
I feel happy.	1/strong disagree	2/disagree	3/neutral	4/agree	5/strongly agree
I feel content.	1/strong disagree	2/disagree	3/neutral	4/agree	5/strongly agree
I feel frustrated/angry.	1/strong disagree	2/disagree	3/neutral	4/agree	5/strongly agree
I feel sad.	1/strong disagree	2/disagree	3/neutral	4/agree	5/strongly agree
I feel worried.	1/strong disagree	2/disagree	3/neutral	4/agree	5/strongly agree
I feel miserable.	1/strong disagree	2/disagree	3/neutral	4/agree	5/strongly agree

I feel restless.	1/strong disagree	2/disagree	3/neutral	4/agree	5/strongly agree
I feel stressed.	1/strong disagree	2/disagree	3/neutral	4/agree	5/strongly agree
I feel hostile.	1/strong disagree	2/disagree	3/neutral	4/agree	5/strongly agree
I feel calm.	1/strong disagree	2/disagree	3/neutral	4/agree	5/strongly agree

* Only the random and daily diary assessments were included of the EMA assessments as these were the only assessments used for the purposes of the current study.

Tables and Figures

Table 1. Baseline Participant Characteristics (N=57)

Variable	N(%)/M[SD]
Demographic Characteristics	
Age	48.88 [9.03]
Gender	--
Male	35 (61.40)
Female	22 (38.60)
Education	--
High school diploma or less	31 (54.39)
Some college/Associates degree	20 (35.09)
Bachelor's degree or higher	6 (10.53)
Ethnicity	--
African American	33 (58.93)
Ethnicity other than African American	23 (41.07)

Married/Partnered (% yes)	23 (40.40)
Homelessness Characteristics	
Age at first homelessness episode	39.39 [13.04]
# of separate homelessness occasions	3.75 [7.18]
Lifetime homelessness (years)	3.28 [3.75]
Reasons for homelessness (% yes)	--
Lost my job	2 (3.50)
Evicted from house/apartment	15 (26.30)
Substance use	19 (33.30)
Mental illness	11 (19.30)
Inability to pay medical bills	6 (10.50)
Family problems	2 (3.50)
Legal problems	2 (3.50)
Smoking Characteristics	
Average CPD (Baseline)	18.14 [10.37]

Years smoking	29.04 [11.43]
Lifetime quit attempts ≥ 24 hours	--
0-2 times	23 (40.40)
3-5 times	19 (33.30)
6+ times	15 (26.30)
Nicotine Dependence	
Smoking more than 30 mins after waking	17 (29.82)
Smoking within 30 mins after waking	40 (70.18)

Table 2. Chi-Square Results of Included (N=57) vs. Excluded Participants (N=10) for Model

Covariates

Variable	DF	X^2 Value	P Value
Gender	1	0.2688	0.0641
Education	2	2.6013	0.2724
Treatment Group	1	0.2384	0.6254
Nicotine Dependence	1	0.0001	0.9911

Table 3. Final Model of Negative Affect (NA) Predicting Cigarettes Smoked Per Day Post-

Quit with Mean-Centered Variables

Effect	Estimate	SE	DF	t value	p value
Intercept	4.174	1.989	37.2	2.10	0.0427
NA	0.345	0.179	630	1.92	0.0548
NA*Time	-0.211	0.068	614	-3.10	0.0020
Time	-0.008	0.054	609	-0.15	0.8824
Gender (Ref=Male)	1.226	1.298	35.2	0.95	0.3510
Education (Ref=Bachelor's Degree or Higher)					
High School or Less	-0.977	2.052	36.6	-0.48	0.6367
Some College/Associates Degree	-0.654	2.174	36.4	-0.30	0.7652
Treatment Group (Ref=Usual Care)	-0.113	2.190	33.7	-0.05	0.9592
Nicotine Dependence (Ref=30 mins or less)	2.017	1.394	34.9	1.45	0.1568

Table 4. Final Model of Positive Affect (PA) Predicting Cigarettes Smoked Per Day Post-

Quit with Mean-Centered Variables

Effect	Estimate	SE	DF	t value	p value

Intercept	4.213	1.951	37.4	2.16	0.0373
PA	-0.484	0.160	620	-3.04	0.0025
PA*Time	0.222	0.064	609	3.42	0.0007
Time	-0.009	0.054	607	-0.17	0.8611
Gender (Ref=Male)	1.492	1.273	35.4	1.17	0.2488
Education (Ref=Bachelor's Degree or Higher)					
High School or Less	-1.112	2.012	36.8	-0.55	0.5841
Some College/Associates Degree	-0.867	2.134	36.7	-0.41	0.6869
Treatment Group (Ref=Usual Care)	-0.197	1.146	33.8	-0.009	0.9274
Nicotine Dependence (Ref=30 mins or less)	2.011	1.367	35.2	1.47	0.1501

Table 5. Final Model of Stress Predicting Cigarettes Smoked Per Day Post-Quit with Mean-Centered Variables

Effect	Estimate	SE	DF	t value	p value
Intercept	4.207	1.957	37.5	2.15	0.0381
Stress	0.136	0.132	630	1.04	0.3005

Stress*Time	-0.110	0.047	612	-2.34	0.0197
Time	-0.023	0.054	609	-0.43	0.6669
Gender (Ref=Male)	1.313	1..275	35.4	1.03	0.3104
Education (Ref=Bachelor's Degree or Higher)					
High School or Less	-0.930	2.018	36.8	-0.46	0.6475
Some College/Associates Degree	-0.627	2.139	36.7	-0.29	0.7712
Treatment Group (Ref=Usual Care)	-0/256	2.155	34	-0.12	0.9061
Nicotine Dependence (Ref=30 mins or less)	1.966	1.370	35.2	1.44	0.1600

Figure 1. Graph of Interaction between Time and Negative Affect during Post-Quit Week
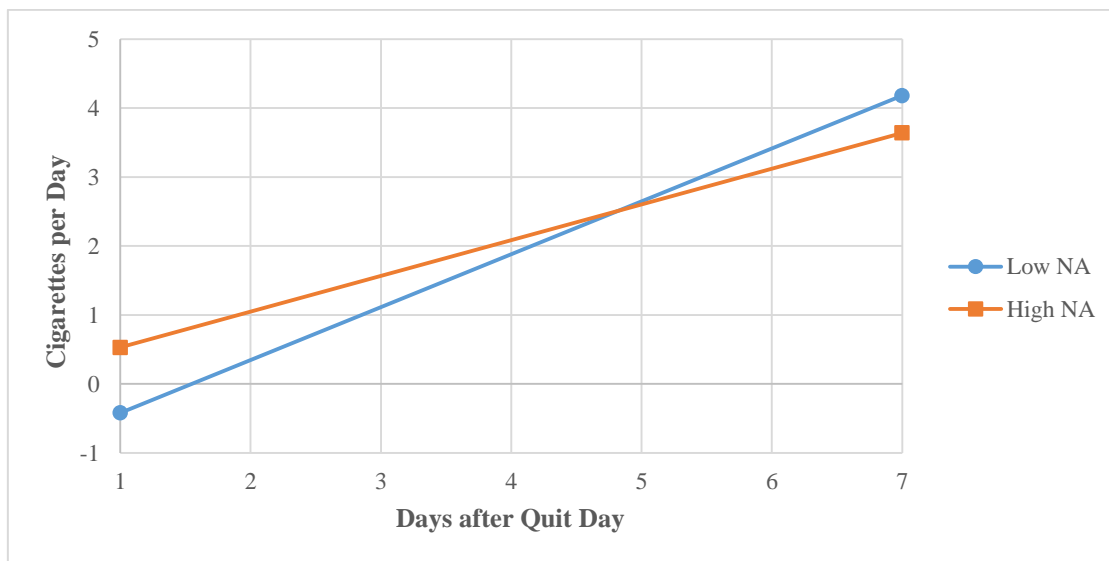
using Mean-Centered Variables

Figure 2. Graph of Interaction between Time and Positive Affect during Post-Quit Week
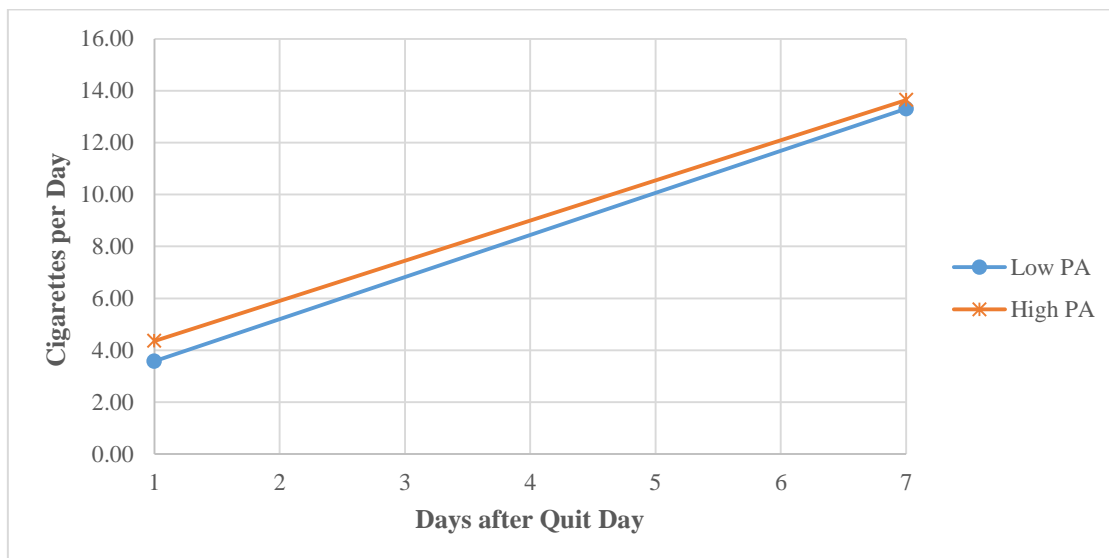
using Mean-Centered Variables

Figure 3. Graph of Interaction between Time and Stress during Post-Quit Week using Mean-

Centered Variables