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How Happiness and Optimism Relate to Smoking

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HOW HAPPINESS AND OPTIMISM RELATE TO SMOKING

by

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Abstract

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Cigarette smoking decreases health and increases mortality. Researchers have devoted much attention to factors that promote smoking (e.g., depression), but have paid little attention to factors that buffer against smoking. Positive psychology may provide a useful framework to complement our current knowledge of cigarette smoking and treatment. The current study investigated the relation between positive psychology constructs (i.e., happiness and optimism) and smoking status, smoker type, and cessation success using path analysis with data from college students (SONA) and an online sample (MTurk). Data from 1,292 (N_{SONA} = 582, N_{MTurk} = 710) participants showed that most participants were female (66.3%), single (59.4%) or married (24.1%), and Caucasian (67.2%) or African American (23.1%). Approximately 17% were current smokers, 62.8% were non-smokers, 6.5% were light smokers, 5.6% were heavy smokers, 12.1% were stable ex-smokers, and 2.7% were recent ex-smokers. Due to the significant differences between SONA and MTurk samples, analyses were performed separately. Path analysis for SONA showed non-significant relations or were inconclusive possibly due to the small sample sizes. Path analysis for MTurk revealed a significant relation between depression and dispositional optimism and cessation success. Dispositional optimism was a stronger predictor of cessation success relative to depression. However, dispositional optimism and depression predicted a higher likelihood of being a recent (vs. stable) ex-smoker. Future research should establish the relation between positive constructs and smoking by including larger and more diverse samples, applying sophisticated statistical methods, evaluating pilot studies, and comparing positive psychology models with other traditional models of addiction.

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Fifty years after the original Surgeon General's report on the health consequences of tobacco use, studies continue to generate new evidence of how tobacco contributes to disease (U.S. Department of Health and Human Services [USDHHS], 2014). Cigarette smoking remains responsible for a poorer overall health and a higher risk for mortality (USDHHS, 2014). Efforts to control tobacco consumption have helped reduce the prevalence of cigarette smoking from 42% in 1965 to 18% in 2012 (USDHHS, 2014). Currently, almost 17% of adults in the United States have smoked in the past month (Jamal et al., 2015). Notably, almost 70% of adult daily smokers are interested in quitting, 43% have attempted to quit smoking in the past year, and 55% of ever smokers have successfully quit smoking (Agaku, King, & Dube, 2014; USDHHS, 2014).

Cigarette smoking is a complex behavior maintained by biological, psychological, social, and affective factors (T. B. Baker, Brandon, & Chassin, 2004). For instance, nicotine is responsible for the continued use of cigarettes by preventing aversive affective states caused by withdrawal symptoms in abstaining smokers (T. B. Baker et al., 2004; Delfino, Jamner, & Whalen, 2001; U.S. Department of Health and Human Services, 2010). Smoking cues, social cues, time of day, and pleasant moods have been predictors of cigarette smoking in both light and heavy smokers (T. B. Baker et al., 2004; Salgado-García, Cooper, & Taylor, 2013; Shiffman et al., 2013; T. Taylor & Cooper, 2010).

Research on smoking has revealed several predictors of smoking status and cessation. To name a few, impulsivity (Bloom, Matsko, & Cimino, 2014), stress (Sun, Buys, Stewart, & Shum, 2011), and depression (Salgado-García, Zuber, et al., 2013; Trosclair & Dube, 2010) have been found to be related to smoking. Specifically, recent research has demonstrated that depression predicts smoking rates cross-sectionally and longitudinally (Shahab et al., 2015). However,

researchers have paid less attention to positive factors that buffer against smoking or promote cessation. Positive psychology, an emerging field in the study of substance use, has provided an alternative framework to investigate factors that promote well-being and inhibit unhealthy behaviors (Krentzman, 2013; Seligman & Csikszentmihalyi, 2000). Thus, theories and constructs derived from positive psychology could be useful in understanding cigarette smoking and further help create more effective cessation treatments (Krentzman, 2013).

Positive Psychology

Positive psychology involves the study of positive experiences and traits as well as the institutions that promote their growth (Duckworth, Steen, & Seligman, 2005). Three related domains that progressively lead to the desired outcome of positive psychology, happiness and well-being, have been proposed: the *pleasant life*, the *engaged life*, and the *meaningful life* (Seligman, 2003). The pleasant life consists of the positive emotions experienced during past, present, and future-oriented events (Duckworth et al., 2005; Seligman & Csikszentmihalyi, 2000). The engaged life consists of using positive individual traits and strengths to derive continuous gratification (Duckworth et al., 2005; Seligman, 2003). The meaningful life consists of using such traits and strengths to serve something larger than the self through institutions that foster the development of positive emotions and traits (Seligman, 2003).

Proponents of positive psychology have noted that current psychology practice and research has mainly relied upon disease-based models to identify pathology and minimize psychological distress (Seligman & Csikszentmihalyi, 2000). The disease model was strongly adopted in the field of psychology after the Veterans Affairs and the National Institute of Mental Health were created, as these institutions allocated much of their funds to the treatment and research of mental illness (Seligman & Csikszentmihalyi, 2000). Positive psychology seeks to

revive one of the old missions of psychology—promotion of a better self—by identifying, fostering, and amplifying strengths that lead to physical and psychological well-being (Kobau et al., 2011; Seligman & Csikszentmihalyi, 2000). Moreover, positive psychology strives to provide a holistic understanding of life experiences to complement our current knowledge of illness and pathology (Kobau et al., 2011). Importantly, positive psychology assumes that positive traits are not the opposite of negative traits, and the absence of one does not necessarily mean the presence of the other (Duckworth et al., 2005). Therefore, positive psychology focuses on development of strengths and hypothesizes that specific strengths buffer against particular disorders to help individuals reach beyond the repair of weakness (Seligman & Peterson, 2003).

Positive psychology has gained increased acceptance as a useful theory and also has led to exploration of new treatments that promote well-being while decreasing mental illness. Notably, meta-analyses examining the effectiveness of positive psychology interventions (PPIs) have found that PPIs significantly increased well-being and decreased depressive symptoms with moderate but sustainable effect sizes up to 6 months after PPIs were delivered (Bolier et al., 2013; Sin & Lyubomirsky, 2009). Moreover, a small pilot study found that PPIs increased happiness, optimism, and positive emotions while decreasing alcohol consumption and dependence compared to a control group that was untreated (Akhtar & Boniwell, 2010). However, effectiveness of PPIs has not been widely evaluated in substance use research.

Thus, positive psychology could provide a framework to help expand our understanding of smoking behavior. Positive psychology could also allow researchers to evaluate the potential mechanisms through which positive constructs influence smoking and well-being. Furthermore, research investigating the relation between positive constructs and substance use could also help generate effective individual or group smoking cessation treatments. Two important positive

psychology constructs have been particularly useful in understanding well-being—happiness and optimism—and these are discussed in greater detail here.

Happiness, Health, and Smoking

Well-being, happiness, and positive affect are fundamental—and sometimes interchangeable—constructs in positive psychology (Diener, 2000; Seligman & Peterson, 2003). *Well-being* is a broad construct that includes personal growth, positive affect, happiness, and life satisfaction (Diener, 2000). Research has provided evidence that well-being is related to psychological and physical health, prevention and recovery from disease, stress reduction, health improvement, and promotion of healthy behaviors and adaptive coping strategies (Vázquez, Hervás, Rahona, & Gómez, 2009). Notably, well-being has been found to protect against cardiovascular disease and unhealthy behaviors (Boehm & Kubzansky, 2012). *Happiness*, a component of well-being, is defined as a stable trait of positive affective and cognitive life evaluations (Diener, 2000). Happiness has been described as the outcome of positive psychology (Seligman & Peterson, 2003), as the consequence of putting strengths into action (Seligman & Peterson, 2003), and as a subjective experience expressed in the present of the pleasant life (Seligman & Csikszentmihalyi, 2000).

Well-being, happiness, and positive affect have been found to be important for general psychological and physical health, but there is a paucity of research on positive psychology as it relates to substance use (e.g., Krentzman, 2013). The few studies addressing well-being, happiness, and positive affect have provided some insight, but mixed results, on the relation between happiness and smoking. For instance, Adan and Sanchez-Turet (2000) found that college student smokers had lower happiness scores than non-smokers. Even smokers with low levels of addiction (i.e., light smokers) have reported a decrease in positive affect after smoking

(Kassel et al., 2007). Similarly, findings from two epidemiological studies in the United States have revealed a negative association between being a smoker and well-being and happiness (Kobau et al., 2013; McCann, 2010).

Some studies have found that smoking and nicotine may promote or facilitate positive affect in smokers, while others have reported affect to be unrelated to smoking status. For example, college student smokers have reported less sadness after smoking their first cigarette of the day (Adan & Sanchez-Turet, 2000). Other studies have found that smokers who abstained for 10 hr reported less happiness in response to viewing psychometrically validated positive film clips (e.g., stand-up comedy, a happy ending) compared to smokers who had smoked 15 min before being exposed to the same stimuli (Dawkins, Acaster, & Powell, 2007; Dawkins & Powell, 2011). Moreover, two studies that collected smoking data using a diary found that positive affect was positively associated with smoking cravings and increased smoking behavior, especially for female light smokers (Delfino et al., 2001; Thomsson, 1997). Other research has found that use of the nicotine patch, compared to a placebo patch, increased positive affect in smokers (Gilbert et al., 2008). In addition, a few studies have *not* found any relation between well-being and smoking status. For instance, a study that included a representative sample of undergraduate students found no association between smoking status and well-being (Davoren, Fitzgerald, Shiely, & Perry, 2013). Finally, Leventhal et al. (2013) noted that positive affect was not associated with motivation to smoke after controlling for negative affect.

Research on smoking cessation has found a relation with happiness. Happiness has been associated with confidence in resisting cravings and quitting smoking (Bränström, Penilla, Pérez-Stable, & Muñoz, 2010; Rabois & Haaga, 2003). Ex-smokers who had quit for one year or more have reported more happiness compared to current smokers and similar levels of happiness than

non-smokers (Shahab & West, 2009, 2012). A randomized controlled trial (RCT) comparing a standardized behavioral smoking treatment with a control group that did not receive treatment found that positive affect was higher in smokers who quit relative to those who relapsed and those who did not quit (Lam et al., 2012). Another RCT found that smokers who quit reported improved affect compared to smokers who did not quit (Piper, Kenford, Fiore, & Baker, 2012). A third RCT found that positive affect was related to successful short- and long-term quitting after smoking cessation interventions, especially in a smoking cessation program with a mood management condition that intended to increase positive affect (Bränström et al., 2010). Finally, a meta-analysis has provided compelling evidence for a robust effect of smoking cessation on positive affect increase (G. Taylor et al., 2014).

Conversely, individuals with more depressive symptoms are less likely to quit smoking (Leventhal, Ramsey, Brown, LaChance, & Kahler, 2008). One study found that smokers with a history of major depressive disorder who experienced increased symptoms after quitting were less likely to remain abstinent from smoking (Burgess et al., 2002). Another study found that depressive symptoms decreased significantly after the quit date, and smokers who remained abstinent reported less depressive symptoms than smokers who relapsed during the first two weeks after quitting (Kahler et al., 2002). In addition, a small pilot study found that smokers receiving a cessation intervention that included behavioral activation reported less depressive symptoms and greater smoking abstinence rates than smokers receiving the cessation intervention alone (MacPherson et al., 2010).

Research on PPIs for smoking cessation is scarce. One small study recently evaluated the feasibility of a PPI for smoking cessation (Kahler et al., 2013). This intervention included six components. Half of the components occurred before quitting smoking and included identifying

personal strengths useful for cessation, daily writing three good things related to their cessation experience, and writing and reading a gratitude letter to an important person. The other half occurred after quitting smoking and included daily engaging in at least two enjoyable experiences for 3 min, listening to and eliciting details about good events other people reported, and increasing awareness of positive behavior toward others. The authors found that the intervention achieved a 32% cessation rate six months after the quit date—a rate higher than that of standard interventions—while buffering the increase of depressive symptoms. Nevertheless, this study did not include a control group, which makes it unclear if the improvements noted were due to PPI or standard components of smoking cessation treatment.

The discrepant findings previously presented on the relation between well-being and smoking may be partly due to the differences in the conceptualization of well-being, the instruments used to measure happiness, the heterogeneous populations, and the current dearth of research. First, broader concepts of well-being—i.e., happiness—relate more consistently with being a non-smoker and a stable ex-smoker (e.g., Adan & Sanchez-Turet, 2000; Kobau et al., 2013; Shahab & West, 2009, 2012) than specific concepts of well-being—i.e., positive affect. Second, research has not incorporated standardized and validated measures of happiness consistently. Last, there is less research on the relation between happiness and smoking than research on the relation between positive affect and smoking. Thus, there is a need for more well-being research that includes a conceptualization of happiness as a broad concept measured with standardized instruments that allow for future study comparisons.

Optimism, Health, and Smoking

Optimism has been defined as having a positive affective and cognitive evaluation of the future (Peterson, 2000). These positive evaluations of the future could be general or specific

(Peterson, 2000). *Dispositional optimism* has been defined as a general expectation that positive events will happen more often than bad events (Carver, Scheier, & Segerstrom, 2010; Peterson, 2000). Individuals with high levels of dispositional optimism are more persistent in complicated tasks, focus less on negative aspects of an experience, are proactive, and use problem-focused coping (Carver et al., 2010). An *optimistic explanatory style* is a construct based on learned helplessness theory and attributional style, where individuals attribute the causes of negative events as external, unstable, and specific (Peterson, 2000; Peterson et al., 1982). Dispositional optimism and optimistic explanatory style have been conceptualized as functional traits that promote health (Schwarzer, 1994). Both aspects of optimism are negatively related to depression (Reilley, Geers, Lindsay, Deronde, & Dember, 2005; Schwarzer, 1994) and positively related to happiness (Cheng & Furnham, 2003; Schwartz et al., 2002). However, dispositional optimism and optimistic explanatory style differ in the degree to which the positive expectations are general or specific, respectively (Peterson, 2000). Also, dispositional optimism and optimistic explanatory style seem to be weakly to moderately correlated with each other, which indicates both constructs measure unique components of optimism (Hjelle, Belongia, & Nesser, 1996; Isaacowitz, 2005; Reilley et al., 2005; Tomakowsky, Lumley, Markowitz, & Frank, 2001). In addition, dispositional optimism is a stronger predictor of well-being than optimistic explanatory style (Isaacowitz, 2005).

Research on optimism and health has shown mixed results. Optimism is associated with a reduced likelihood of cardiovascular disease (Boehm & Kubzansky, 2012; Kubzansky, Sparrow, Vokonas, & Kawachi, 2001) and reduced mortality (Steptoe, Dockray, & Wardle, 2009). A meta-analysis investigating the relation between optimism and clinical health outcomes (e.g., physical symptoms, pain reports, and biological markers) found a significant

mean effect size and a positive relation between optimism and health outcomes across studies (Rasmussen, Scheier, & Greenhouse, 2009). Also, optimism has been associated with healthy behaviors and higher concentrations of antioxidants in aging adults (Boehm, Williams, Rimm, Ryff, & Kubzansky, 2013; Kelloniemi, Ek, & Laitinen, 2005). A longitudinal study found that optimism was related to increases in physical activity and healthy diet across the years (Giltay, Geleijnse, Zitman, Buijsse, & Kromhout, 2007). Moreover, optimism seems to protect against the inflammatory response caused by stress and mediate the relation between stress and psychological health (Bretherton & McLean, 2014) and healthy behaviors (Gill & Loh, 2010). In addition, optimistic explanatory style has been related to higher vitality and mental health compared to a pessimistic explanatory style (Maruta, Colligan, Malinchoc, & Offord, 2002). Nevertheless, optimism has not been consistently related to positive outcomes (Carver et al., 2010). For instance, a longitudinal study found that optimism was related to higher consumption of alcohol across 15 years (Giltay et al., 2007). Also, even though individuals with high scores in optimism are more likely to consume more vegetables and fruits, they consume the same amount of "junk food" as individuals with high scores in pessimism (Kelloniemi et al., 2005). Notably, optimistic explanatory style has predicted increases in depressive symptoms over time in previous research (Isaacowitz & Seligman, 2002).

Research on the relation between optimism and smoking is scarce and findings are complex. For instance, individuals who are less optimistic are also more likely to smoke than individuals who are more optimistic (Boehm et al., 2013). Similarly, several studies have found that optimism has been related to being a non-smoker (Giltay et al., 2007; Kelloniemi et al., 2005; Steptoe, Wright, Kunz-Ebrecht, & Iliffe, 2006). However, a study investigating smoking in adolescents did not find a significant relation between optimism and smoking status (Tyc et

al., 2004). Moreover, optimism has not predicted participation in a smoking cessation intervention in low-income women (Pohl, Martinelli, & Antonakos, 1998). Therefore, optimism may be a weaker predictor of smoking status and cessation success compared to happiness. Notably, to our knowledge, no research has been conducted on the relation between optimistic explanatory style and smoking.

The Current Study

Even though studies have addressed the relation between well-being and various factors associated with smoking, researchers have paid less attention to the relation between happiness and smoking or cessation success. In fact, to date we found only one study that directly assessed the relation between cigarette smoking and happiness measured with a validated instrument (Mojs, Stanisławska-Kubiak, Skommer, & Wójciak, 2009). In addition, the relation between dispositional optimism or optimistic explanatory style and smoking has not been investigated widely and the small body of research in this area has been conducted with older adults and in European countries. Thus, few studies have investigated the relation between optimism and smoking in diverse samples. Notably, only one study has assessed the efficacy of PPIs in smoking cessation (Kahler et al., 2013). Therefore, there is little information about how positive constructs may directly contribute to smoking behavior and successful cessation. Also, the indirect mechanisms through which positive constructs may contribute to cessation success remain uncertain.

The purpose of this study was to investigate the relation of happiness, dispositional optimism, optimistic explanatory style, and depression with smoking status and cessation success. The investigation of these relations may elucidate if positive constructs (i.e., happiness, optimism, and optimistic explanatory style) are stronger predictors of smoking status and

cessation success compared to more traditional psychological constructs (e.g., depression). Also, this investigation may allow us to test whether positive constructs moderate the relation between depression and smoking. Consequently, results may allow future researchers to test experimental manipulations of happiness and optimism and evaluate the effect on smoking behavior and cessation to generate improved smoking cessation treatments.

We hypothesized that, after controlling for smoking covariates (e.g., gender, ethnicity, age, nicotine dependence) and recruitment method (see below), positive constructs (i.e., happiness, dispositional optimism, and optimistic explanatory style) would be stronger predictors of smoking status and quitting success than depression. Specifically, lower levels of depression and higher levels of positive constructs (i.e., happiness, dispositional optimism, optimistic explanatory style) will predict being a non-smoker (vs. current smoker), a light smoker (vs. heavy smoker), and a stable ex-smoker (vs. recent ex-smoker). We also hypothesized that positive constructs would moderate the relation between depression and smoking status, smoker type, and cessation success, such that individuals with high depression scores and high happiness and optimism scores would be more likely to be non-smokers (vs. current smokers), light smokers (vs. heavy smokers), and be stable ex-smokers (vs. recent ex-smokers).

Methods

Participants

Due to its wide reach, ubiquitous accessibility, and multiple advantages, the Internet is useful and convenient to recruit a wide range of participants for health research (Alessi & Martin, 2010; Smith, 2014; Teo, 2013). Specifically, Internet surveys on smoking and substance use have been successful at recruiting diverse and large numbers of participants (Ramo & Prochaska, 2012). Amazon's Mechanical Turk (MTurk) is a recently developed venue to

reliably collect data online for a small monetary compensation (Buhrmester, Kwang, & Gosling, 2011).

To maximize the number of participants and enhance sample diversity, we collected data using an online survey distributed through SONA-Systems and MTurk. To capture non-smokers, heavy smokers, light smokers, and ex-smokers in the United States, the inclusion criteria were being 18 years of age or older, a resident in the United States, and fluent in English.

Power Analysis

We conducted two *a priori* power analyses using effect sizes obtained from research on well-being and smoking status (Kobau et al., 2013) and well-being and cessation success (G. Taylor et al., 2014). The first power analysis allowed us to estimate the sample size needed for the present study based on the adjusted proportions of well-being (i.e., global life satisfaction) and smoking status. Kobau and colleagues showed that 95.3% of non-smokers reported life satisfaction compared to 92.4% of smokers. We calculated the number of smokers and non-smokers who reported life satisfaction and those who reported dissatisfaction. Using this information, we calculated an odds ratio using online software (MedCalc Software, 2015). The value for the odds ratio was $OR = 1.67$, $p < .001$. Afterward, using G*Power software (Buchner, Erdfelder, Faul, & Lang, 2014), we calculated a total sample size of 196 based on values $OR = 1.67$, $\alpha = .05$, and $\beta = .80$. The second power analysis allowed us to estimate the sample size considering a previous meta-analysis on well-being and cessation success (G. Taylor et al., 2014). Using G*Power and based on Cohen's $d = .22$, $\alpha = .05$, and $\beta = .80$, the sample size estimated for this study was 514. Thus, overall, we would require at least 514 participants to find effects for well-being on smoking status and cessation success.

Measures

Participants were assessed through an online survey that included demographic, smoking behavior, nicotine addiction, depression, happiness, and optimism questionnaires. The measures were piloted with seven adult volunteers (3 males and4 females) who varied in age (approximate range from 22 to 45 years old), race (African American, White, and Hispanic), and educational background (from high school diploma to graduate students). All volunteers reported the survey was clear, easy to understand, and denied observing problematic questions or formatting. Volunteers spent 8 to 11 min to complete the survey packet in a paper-and-pencil version.

Demographic questionnaire. Information about age was collected by asking participants to enter their age numerically. To assess gender, three options were provided to participants: *male* (0), *female* (1), and *other* (2), with an option to identify their gender if participants chose "other." Responses on educational level included: *Less than high school* (1), *high school diploma/GED or equivalent* (2), *some college* (3), *college graduate (e.g., B.A., B.S.)* (4), and *post-graduate degree (e.g., Masters, Ph.D., M.D.)* (5). To assess marital status, participants were able to choose one of the following options: *single (never married)* (1), *married* (2)*, living with someone* (3), *separated* (4), *divorced* (5), and *widow/widower* (6). Race and ethnicity were assessed according to National Institutes of Health standards (Office of Management and Budget, 1997). Participants were allowed to answer one or more of the following categories: *American Indian/Alaska Native* (1), *Asian* (2), *Black or African American* (3), *Hispanic or Latino* (4), *Native Hawaiian or Pacific Islander* (5), and *White* (6).

Smoking behavior. A modified version of a tobacco use behavior questionnaire, which includes standard smoking questions and has been employed in previous research, was used (O'Loughlin, Dugas, O'Loughlin, Karp, & Sylvestre, 2014; Rodríguez-Esquivel, Cooper, Blow,

& Resor, 2009; USDHHS, 2014). Age of smoking onset was assessed by asking, "At what age did you first smoke a tobacco cigarette, even if it was a puff?" Current smoking was assessed using two questions. The first question asked participants if they have smoked at least 100 cigarettes in their lifetime and the second question asked participants if they have smoked at least one cigarette in the past 30 days, with response options of *yes* (1) and *no* (0) for each question. To assess smoking status, participants chose one of the following orthogonal categories: *I have never smoked before, not even a puff* (0), *I have smoked a few cigarettes in my lifetime, just to try them* (1)*, I quit smoking more than a year ago* (2), *I quit smoking within the past year* (3)*, I smoke at least once a month, but not weekly* (4), *I smoke at least once a week, but not daily* (5), *I smoke from 1 to 9 cigarettes per day* (6), *I smoke from 10 to 20 cigarettes per day* (7), *I smoke more than a pack (20 cigarettes) a day* (8). For a continuous count of cigarettes smoked and to assess the validity of smoking status responses, a specific question asked the number of cigarettes smoked per day and another question asked how many days the participant has smoked in the past 30 days. For a continuous count of quitting attempts, a question will ask the number of times smokers have tried to quit in the past 12 months. For smokers who have tried to quit in the past, a question asked about the duration of participants' longest quit attempt with the following answer options: *I have never quit* (1)*, one day* (2)*, more than a day but less than a week* (3)*, one week* (4)*, more than a week but less than a month* (5)*, 1 to 3 months* (6)*, 4 to 6 months* (7)*, 6 to 12 months* (8)*,* and *more than one year* (9)*.*

Nicotine dependence. Nicotine dependence was assessed with two measures: a widely used instrument in smoking research and an instrument based on DSM-IV and ICD-10 diagnostic criteria. The Fagerström Test for Nicotine Dependence (FTND; Heatherton, Kozlowski, Frecker, & Fagerström, 1991) is a 6-item questionnaire that measures the degree of

dependence to nicotine. The first item asked "How soon after you wake up do you smoke your first cigarette" and included the following response options: *5 minutes or less* (3), *6 to 30 minutes* (2)*, 31 to 60 minutes* (1)*,* and *over 60 minutes* (0). The second question asked, "Is it hard for you to not smoke in places where it is not allowed like in church, at the library, or at the movies?" with response options: *yes* (1) and *no* (0). The third item asked, "Which cigarette would you hate to give up the most?" with response options: *the first one of the day* (1) and *other* (0). The fourth item asked, "How many cigarettes per day do you smoke?" with response options: *10 or less* (0), *11 to 20* (1), *21 to* 30 (2), and *31 or more* (3). The fifth item asked, "Do you smoke more when you first wake up than during the rest of the day?" with response options: *yes* (1) and *no* (0). The sixth question asked, "Do you smoke even when you are so sick that you are in bed most of the day?" with response options: *yes* (1) and *no* (0). Item responses were summed yielding a score range from 0 to 10. Higher scores indicate higher levels of nicotine dependence. Even though the FTND is widely used in smoking research, it has low internal consistency (Cronbach's $\alpha = 0.61$; Heatherton et al., 1991).

The Cigarette Dependence Scale-12 (CDS-12; Etter, Le Houeze, & Perneger, 2003) is a 12-item measure based on DSM-IV and ICD-10 diagnostic criteria, which has been validated using an Internet survey. The item scales range from 1 to 5. Instrument scores range from 12 to 60, with higher scores denoting higher cigarette dependence. This instrument has demonstrated high internal consistency (Cronbach's $\alpha = .90$) and test-retest reliability after 18 days ($r = .84$; Etter et al., 2003). The CDS-12 has been able to discriminate between occasional smokers and daily smokers. Also, it is sensitive to changes over time between smokers who switched from daily to occasional smoking and smokers who did not alter their status (Etter et al., 2003). CDS-12 scores have predicted subsequent smoking cessation and withdrawal after a month (Etter,

2005). Generally, this instrument has demonstrated better psychometric properties than the FTND (Etter, 2005; Etter et al., 2003).

Depression. The Center for Epidemiologic Studies—Depression Scale (CES-D; Radloff, 1977) is a 20-item instrument that assessed depressive symptoms continuously. Response options range from 0 (*rarely or none of the time*) to 3 (*most or almost all of the time*). Total scores range from 0 to 60, with higher scores denoting more depressive symptoms. Initial research set a cutoff score of 16 that indicates "significant symptoms." This cutoff score has been able to discriminate between clinical patients and the general population. This instrument has demonstrated adequate reliability (Cronbach's α ranging from .84 to .90) and a test-retest correlation of .59 after eight weeks. Moreover, the CES-D is sensitive to changes after treatment for depression.

Happiness. Two scales were used to assess dispositional happiness. First, the Subjective Happiness Scale (SHS; Lyubomirsky & Lepper, 1999) is a 4-item instrument that measures general happiness, where each item is rated on a 7-point Likert-type scale. The composite score was calculated by averaging the four items, with the fourth item being reverse coded. Composite scores range from 1 to 7 with higher scores denoting more happiness. The SHS has reliability coefficients (Cronbach's α) ranging from .79 to .94 and an average Cronbach's α = .86 across different samples—e.g., college, high school, adult community settings, and retirement community settings—(Lyubomirsky & Lepper, 1999). Lyubomirsky and Lepper (1999) showed that test-retest reliability is relatively stable after 1 year in an adult sample (r = .55); this measure correlates positively with optimism, positive affect, and extraversion; and correlates negatively with depression and neuroticism. Second, the Happiness Measure (HM; Fordyce, 1988) is a 2-item instrument assessing happiness. The first item measures happiness with an 11-point

happiness scale with higher scores denoting increased happiness. The second item asks for the proportion of time spent in happy, unhappy, and neutral moods. The combination score is calculated by multiplying the score of the first item by 10, adding the percentages of the second item, and dividing the total by 2. This instrument has demonstrated stability over a 4-month period (r = .67) and similar psychometric properties across different samples (Fordyce, 1988). The HM correlates positively with other happiness instruments and negatively with depression; it predicts high energy, high self-esteem, healthy personality, extraversion, optimism, low fear, hostility, tension, anxiety, guilt, anger, and other negative emotions (Fordyce, 1988).

Optimism. The Life Orientation Test-Revised (LOT-R; Scheier, Carver, & Bridges, 1994) is a 10-item instrument that assesses dispositional optimism and pessimism. Response options range from 0 (*strongly* disagree) to 4 (*strongly* agree). Items 2, 5, 6, and 8 are filler items that are not scored. Total scores range from 0 to 24 with higher scores denoting more optimism after items 3, 7, and 9 are reverse coded. The internal reliability of the instrument has been acceptable (Cronbach's α = .78; Scheier et al., 1994). The LOT-R has demonstrated relatively stable test-retest reliability from 13 weeks (r = .72; Scheier et al., 1994) to two years—no significant change in model fit from year one to year three—(Robinson-Whelen, Kim, MacCallum, & Kiecolt-Glaser, 1997). The LOT-R correlates significantly and positively with self-mastery and self-esteem, whereas it correlates negatively with dispositional anxiety and neuroticism (Scheier et al., 1994).

The Attributional Style Questionnaire (ASQ; Peterson et al., 1982) is an instrument that assesses the degree to which individuals differ in the causal evaluation of events. This instrument consists of 12 events (six positive and six negative) that are rated on a 7-point scale on three dimensions: internality, stability, and globality. Item ratings are averaged for each

dimension. Composite scores are obtained by summing the three dimensions for positive events and negative events separately. A composite positive attributional score can be calculated by summing the total score of positive events and divide it by the number of positive events. Positive attributional scores range from 3 to 21, with higher scores denoting more positive (i.e., optimistic) attributional style. Initial reliability indices demonstrated that the ASQ dimensions have internal consistencies ranging from .44 to .69. Internal consistency for positive events is Cronbach's α = .75 and .72 for negative events. Moreover, this instrument has a 5-week test-retest reliability ranging from .57 to .70. Initial evidence also demonstrated that the ASQ is related to depressive symptoms when attributions are internal, stable, and global. Conversely, the ASQ can also be interpreted to reflect optimistic explanatory style, where causes of negative events are attributed as external, unstable, and specific. It has been recommended to distinguish between negative and positive attributions in behavioral research (Hjelle et al., 1996).

Procedure

Participants were recruited from the University of Memphis SONA-Systems subject pool and MTurk. Participants in both systems were able to see the study (SONA) or task (MTurk) from a list of options. All participants were directed to a consent form that included information about the purpose of the study, inclusion criteria, the possible implications of the results, an explanation of how anonymity was maintained, and contact information for the investigators. After consenting to the study, participants were directed to an Internet survey delivered through Qualtrix. The external link to Qualtrix was designed to ensure that participant responses were not linked to their SONA or MTurk accounts. After participants completed the survey, they were directed to a "thank you" page that confirmed compensation for their time—e.g., course credit or monetary compensation. SONA students received one credit as part of their

Introduction to Psychology course requirements. MTurk participants received a monetary compensation of $0.50 for their time. This compensation was slightly above the median hourly rate of $1.38 reported in Horton and Chilton (2010), considering that participants could answer the survey in 20 min or less. The "thank you" page for MTurk participants displayed a password and instructions to enter this password on MTurk's webpage to receive their compensation.

Approach to Analysis

First, we categorized smoking status into *non-smokers* and *current smokers.* Non-smokers were defined as those who had not even smoked a puff (O'Loughlin et al., 2014) and those who have smoked "just to try it," but had smoked less than 100 cigarettes in their lifetime and had not smoked in the past 30 days. Current smokers were defined as those who reported having smoked at least 100 cigarettes in their lifetime and currently smoking in the past 30 days (USDHHS, 2014). Second, we categorized smoker type into *light smokers* as those who currently smoke from 1 to 9 cigarettes per day (Ahluwalia et al., 2006), and *heavy smokers* as those who smoke 10 or more cigarettes per day. Third, we categorized *cessation success* into *recent ex-smokers* as those who had quit within the past year and *stable ex-smokers* as those who had quit for more than a year (Shahab & West, 2009).

We calculated the reliability of all instruments (Table 1), especially to compare FTND with CDS-12 and SHS with HM. We selected the CDS-12 (vs. FTND) and SHS (vs. HM) measures for path analysis based on the greatest reliability coefficients (i.e., Cronbach's α). Overall, we observed high reliability across instruments, except for the FTND and the HM measures.

Table 1
*Reliability of Instruments and Correlations (*N = *1292)*

				Correlations					
Instrument	Items	%	α	1	2	3	4	5	6
1. FTND	6	17.3	.62	1					
2. CDS-12	12	90.6	.92	.78**	1				
3. CES-D	20	93.3	.92	.08**	.08**	1			
4. SHS	4	100.0	.86	-.06*	-.06*	-.61**	1		
5. HM	2	100.0	.20	-.07*	-.05	-.59**	.80**	1	
6. LOT-R	6	100.0	.84	-.05	-.05	-.59**	.65**	.58**	1
7. ASQ-OES	18	100.0	.82	-.05	-.03	-.17**	.28**	.26**	.23**

Note. FTND = Fagerström Test for Nicotine Dependence; CDS-12 = Cigarette Dependence Scale – 12; CES-D = Center for Epidemiologic Studies Depression Scale; SHS = Subjective Happiness Scale; HM = Happiness Measure; LOT-R = Life Orientation Test-Revised; ASQ-OES = Attributional Style Questionnaire - Optimistic Explanatory Style.
** $p < .01$. * $p < .05$.

Path analysis is a multivariate analysis method used to evaluate complex associations among variables, the direction of such associations, the contribution of predictor (i.e., exogenous) variables on outcome variables (i.e., endogenous), moderation effects between predictor variables and outcome variables, and overall model fit. In this investigation, we used path analysis to evaluate complex models. Our models included smoking status, smoker type, and cessation success as the outcome (endogenous) variables. Predictor (exogenous) variables in the models included happiness (i.e., SHS), dispositional optimism (i.e., LOT-R), optimistic explanatory style (i.e., ASQ-OES), depression (i.e., CES-D), and covariates (e.g., age, nicotine dependence, number of cessation attempts in the past year).

Results

We analyzed data from 1,292 participants of which 582 participants were recruited through SONA and 710 participants through MTurk. For the full sample, most participants were female (66.3%), single (59.4%) or married (24.1%), Caucasian (67.2%) or African American (23.1%). Notably, 31.7% of participants had smoked at least 100 cigarettes in their lifetime and 20.5% had smoked at least one cigarette in the past 30 days. Based on our operational

definitions, 17.1% of the full sample was classified as current smokers, 62.8% as non-smokers, and 20.1% did not meet criteria for categorization (e.g., smoking in the past month but less than 100 lifetime cigarettes, monthly or weekly smoking). Approximately, 6.5% of participants reported light patterns of smoking and 5.6% reported heavy patterns of smoking. Stable ex-smokers comprised 12.1% and recent ex-smokers were 2.7% of the total sample. On average, participants reported smoking tobacco for the first time at age 16 (SD = 3.5). On average, participants reported smoking 1.7 cigarettes per day (SD = 5.1) and indicated trying to quit smoking less than 1 time per year (M = 0.4, SD = 1.5). Means and percentages by recruitment method (i.e., SONA and MTurk) can be observed in Table 2. Due to the significant differences between SONA and MTurk samples in demographic characteristics, predictors, and covariates analyses were performed separately for each sample.

SONA Univariate Analyses

First, we performed univariate analyses for the University of Memphis student sample recruited through SONA to investigate the relations between positive psychology constructs (i.e., happiness, dispositional optimism, optimistic explanatory style), depression, and smoking variables (i.e., smoking status, smoker type, and quitting success). Non-smokers were more likely to be Black or African American (χ^2 (1) = 18.00, $p < .001$) and less likely to be White (χ^2 (1) = 25.72, $p < .001$) than current smokers. As shown in Table 3, current smokers were, on average, 3 years older than non-smokers (t (55.8) = -2.69, p = .009). As expected, current smokers smoked more cigarettes per day (t (52) = -6.36, $p < .001$), smoked more days in the past month (t (52) = -11.53, $p < .001$), reported more quit attempts in the past year (t (52) = -3.80, $p < .001$), had greater length previous quit attempt (t (85.4) = -7.83, $p < .001$), showed higher

Table 2

Comparisons between Mechanical Turk and Memphis SONA Samples

	SONA (N = 582)		MTurk (N = 710)				
Continuous Variable	*M*	*SD*	*M*	*SD*	*t*	*df*	*p*
Age	21.2	5.6	35.9	12.6	27.95	1017.1	< .001
Age of first smoke	16.2	2.7	16.1	3.8	-0.14	661.6	.887
Average cpd	0.5	2.1	2.8	6.5	8.76	844.6	< .001
Days smoked past 30 days	2.1	6.8	5.6	11.1	7.08	1176.9	< .001
Quit attempts past year	0.3	1.4	0.4	1.5	1.38	967.3	.168
Longest quit attempt	3.9	3.6	5.1	3.7	5.77	1290	< .001
FTND	0.2	0.6	0.9	2.0	10.05	881.9	< .001
CDS-12	18.4	6.8	22.1	11.8	7.01	1170.0	< .001
CES-D	17.8	10.6	15.5	12.0	-3.69	1284.0	< .001
SHS	5.0	1.3	4.8	1.5	-2.48	1282.2	.013
HM	63.1	19.3	60.1	22.3	-2.61	1286.2	.009
LOT-R	14.0	4.9	14.3	5.9	1.05	1289.9	.293
ASQ-OES	16.1	2.4	15.4	2.5	-4.91	1290	< .001
Categorical Variable	*N*	%	*N*	%	χ^2	*df*	*p*
Gender					36.8	2	< .001
Male	145	24.9	289	40.7			
Female	437	75.1	420	59.2			
Other	0	0.0	1	0.1			
Marital Status						5	< .001
Single	527	90.6	240	33.8			
Married	30	5.2	282	39.7			
Living with partner	14	2.4	112	15.8			
Separated	1	0.2	12	1.7			
Divorced	9	1.6	56	7.9			
Widow/Widower	1	0.2	8	1.1			
Race/Ethnicity							
American Indian/Alaska Native	11	1.9	15	2.1	0.1	1	.777
Asian	27	4.6	49	6.9	3.0	1	.086
Black/African American	236	40.6	63	8.9	180.4	1	< .001
Hispanic/Latino	23	4.0	53	7.5	7.1	1	.008
Native Hawaiian/Pacific Islander	3	0.5	4	0.6	0.01	1	.907
White	308	52.9	560	78.9	97.7	1	< .001
Other	9	1.6	6	0.9	1.4	1	.242

Table 2 *(Continued)*
Comparisons between Mechanical Turk and Memphis SONA Samples

Categorical Variable	*N*	%	*N*	%	χ^2	*df*	*p*
At least 100 cigarettes						1	< .001
No	506	86.9	377	53.1			
Yes	76	13.1	333	46.9			
Smoked in the past 30 days						1	< .001
No	500	85.9	527	74.2			
Yes	82	14.1	183	25.8			
Smoking Status						8	< .001
Never smoked	333	57.2	172	24.2			
Smoked a few cigarettes	151	26.0	209	29.4			
Quit more than a year ago	18	3.1	138	19.4			
Quit within the past year	13	2.2	22	3.1			
Smoke monthly	17	2.9	19	2.7			
Smoke weekly	20	3.4	24	3.4			
Smoke 1 to 9 cpd	23	4.0	61	8.6			
Smoke 10 to 19 cpd	6	1.0	46	6.5			
Smoke more than 1 pack	1	0.2	19	2.7			
Smoking categories							
Non-smoker[a]	457	89.6	354	67.8	72.8	1	< .001
Current smoker[a]	53	10.4	168	32.2			
Light smoker[b]	23	76.7	61	48.4	7.8	1	.005
Heavy smoker[b]	7	23.3	65	51.6			
Stable ex-smoker[c]	18	58.1	138	86.3	13.8	1	< .001
Recent ex-smoker[c]	13	41.9	22	13.8			

Note. cpd = cigarettes per day; FTND = Fagerström Test for Nicotine Dependence; CDS-12 = Cigarette Dependence Scale – 12; CES-D = Center for Epidemiologic Studies Depression Scale; SHS = Subjective Happiness Scale; HM = Happiness Measure; LOT-R = Life Orientation Test-Revised; ASQ-OES = Attributional Style Questionnaire - Optimistic Explanatory Style. Subscripts represent pairwise comparisons.

Table 3

Comparison by Smoking Category in SONA Sample

	Non-Smoker ($N = 457$)		Current Smoker ($N = 53$)				
Variable	*M*	*SD*	*M*	*SD*	*t*	*df*	*p*
Age	20.6	4.4	23.7	8.0	-2.69	55.8	.009
Age of first smoke	16.2	2.9	15.8	2.3	1.01	123.1	.316
Average cpd	0.0	0.1	4.1	4.6	-6.36	52	< .001
Days smoked past 30 days	0.0	0.4	18.6	11.7	-11.53	52	< .001
Quit attempts past year	0.0	0.4	1.9	3.5	-3.80	52	< .001
Longest quit attempt	3.3	3.6	6.1	2.3	-7.83	85.4	< .001
CDS-12	17.3	5.3	27.9	10.6	-7.16	55	< .001
CES-D	17.3	10.4	20.0	10.9	-1.79	508	.075
SHS	5.1	1.3	4.7	1.3	2.02	508	.044
LOT-R	14.1	4.8	13.5	4.9	0.84	508	.401
ASQ-OES	16.1	2.4	15.9	2.2	0.67	508	.505
	Light ($N = 23$)		Heavy ($N = 7$)				
Age	23.7	8.4	28.0	13.9	-1.03	28	.314
Age of first smoke	15.7	2.9	15.7	1.4	0.02	27	.982
Average cpd	5.1	2.8	13.0	6.5	-3.14	7	.018
Days smoked past 30 days	26.2	7.1	25.7	11.3	0.14	28	.888
Quit attempts past year	1.3	1.5	0.5	0.8	1.26	27	.218
Longest quit attempt	5.6	2.1	5.4	3.0	0.18	28	.857
CDS-12	32.3	8.4	38.6	12.2	-1.55	28	.133
CES-D	19.1	10.6	15.6	7.7	0.81	28	.425
SHS	4.5	1.1	5.4	1.2	-1.78	28	.085
LOT-R	12.7	5.2	14.0	4.5	-0.58	28	.566
ASQ-OES	16.9	1.8	15.8	2.5	1.27	28	.216
	Stable ($N = 18$)		Recent ($N = 13$)				
Age	28.2	11.6	22.0	3.9	2.10	21.8	.048
Age of first smoke	16.5	2.7	16.5	1.7	0.08	28	.938
Average cpd	0.1	0.2	0.2	0.6	-0.68	29	.505
Days smoked past 30 days	0.5	1.5	0.9	1.8	-0.73	29	.471
Quit attempts past year	0.1	0.2	2.2	2.5	-3.04	12.2	.010
Longest quit attempt	7.6	2.8	7.2	2.2	0.49	29	.625
CDS-12	18.4	5.3	19.2	5.8	-0.38	29	.707
CES-D	17.5	9.7	18.2	9.4	-0.21	29	.835
SHS	5.0	1.2	4.6	0.9	0.94	29	.356

Table 3 *(Continued)*
Comparison by Smoking Category in SONA Sample

	Stable (N = 18)		Recent (N = 13)				
Variable	*M*	*SD*	*M*	*SD*	*t*	*df*	*p*
LOT-R	14.7	5.1	11.9	5.1	1.48	29	.149
ASQ-OES	15.6	3.0	15.6	1.3	0.07	24.7	.948

Note. cpd = cigarettes per day; FTND = Fagerström Test for Nicotine Dependence; CDS-12 = Cigarette Dependence Scale – 12; CES-D = Center for Epidemiologic Studies Depression Scale; SHS = Subjective Happiness Scale; HM = Happiness Measure; LOT-R = Life Orientation Test-Revised; ASQ-OES = Attributional Style Questionnaire - Optimistic Explanatory Style. Subscripts represent pairwise comparisons.

nicotine dependence (t (55) = -7.16, $p < .001$) and lower happiness scores compared to non-smokers (t (508) = 2.02, p = .044). Light smokers reported smoking less cigarettes per day (t (7) = -3.14, p = .018) compared to heavy smokers. Light and heavy smokers did not differ in nicotine dependence, depression, happiness, dispositional optimism, or optimistic explanatory style. Recent ex-smokers were more likely to be single (χ^2 (2) = 6.53, p = .038) compared to stable ex-smokers. Stable ex-smokers were more likely to be Black or African American (χ^2 (1) = 6.53, p = .011). Recent ex-smokers were younger than stable ex-smokers (t (21.8) = 2.10, p = .048) and reported more quit attempts in the past year (t (12.2) = -3.04, p = .010) compared to stable ex-smokers. Similar to light and heavy smokers, recent and stable ex-smokers did not differ in depression, happiness, dispositional optimism, or explanatory style scores.

MTurk Univariate Analyses

As above, an identical set of univariate analyses were performed to observe the relation between positive psychology constructs, depression, and smoking variables for the MTurk sample. Non-smokers were more likely to be single (41.5%) or married (38.7%) compared to current smokers (31.5% and 32.7%, respectively; (χ^2 (5) = 17.49, p = .004). Also, Asian participants were more likely to be non-smokers than current smokers (9.6% vs. 3.6%; (χ^2 (1) =

5.86, p = .015). As shown in Table 4, current smokers were, on average 2.6 years older than non-smokers (t (520) = -2.35, p = .019). As expected, current smokers smoked more cigarettes per day (t (167.1) = -14.54, p < .001), smoked more days in the past month (t (160.1) = -28.12, p < .001), reported higher nicotine dependence (t (185.7) = -19.34, p < .001) and higher depression scores (t (287.5) = -2.58, p = .011) compared to non-smokers.

Light and heavy smokers did not differ in terms of gender, marital status, race or ethnicity, or length of time of their longest quit attempt. However, light smokers reported smoking 37.3% fewer cigarettes (t (124) = -10.29, p < .001), fewer days smoked in the past month (t (58.8) = -3.35, p = .001), and lower nicotine dependence scores (t (124) = -6.95, p < .001) than heavy smokers (Table 4). Notably, light and heavy smokers did not differ in depression, happiness, or optimism levels.

Recent ex-smokers were more likely to report smoking at least one cigarette in the past 30 days than stable ex-smokers (18.2% vs. 5.1%; χ^2 (1) = 5.09, p = .024). Also, recent ex-smokers were 6.6 years younger, on average, compared to stable ex-smokers (t (158) = 2.21, p = .029; Table 4). Recent ex-smokers reported more quit attempts in the past year (t (22.9) = -7.14, p < .001), shorter length of abstinence during their longest quit attempt (t (23.7) = 3.06, p = .005), and higher nicotine dependence (t (22.6) = -3.66, p = .001) compared to stable ex-smokers. There was a marginally significant difference in depression scores (t (24.1) = -2.01, p = .056) between recent (M = 22.6, SD = 17.7) and stable (M = 14.7, SD = 11.9) ex-smokers. Stable and recent ex-smokers did not differ significantly in happiness or optimism scores.

Table 4

Comparisons by Smoking Category in MTurk Sample

	Non-Smoker (*N* = 354)		Current Smoker (*N* = 168)				
Variable	*M*	*SD*	*M*	*SD*	*t*	*df*	*p*
Age	34.2	11.8	36.8	12.7	-2.35	520	.019
Age of first smoke	16.5	4.4	15.9	3.4	1.59	335.3	.112
Average cpd	0.0	0.2	10.1	9.0	-14.54	167.1	< .001
Days smoked past 30 days	0.0	0.3	23.2	10.5	-28.12	160.1	< .001
Quit attempts past year	0.0	0.0	1.5	2.5	-7.48	167.0	< .001
Longest quit attempt	3.3	3.6	5.5	2.7	-7.78	424.7	< .001
CDS-12	16.7	4.6	37.2	13.4	-19.34	185.7	< .001
CES-D	14.4	11.4	17.5	13.3	-2.58	287.5	.011
SHS	4.9	1.4	4.8	1.5	0.94	520	.347
LOT-R	14.5	5.9	13.8	6.0	1.26	520	.208
OES	15.4	2.3	15.4	2.5	0.09	520	.928
	Light (*N* = 61)		Heavy (*N* = 65)				
Age	35.4	12.5	39.7	12.7	-1.94	124	.055
Age of first smoke	16.1	3.4	15.2	3.6	1.30	124	.195
Average cpd	6.9	3.9	18.5	8.1	-10.29	93.0	< .001
Days smoked past 30 days	26.5	7.1	29.7	1.4	-3.35	58.8	.001
Quit attempts past year	1.7	2.3	1.3	3.3	0.72	124	.474
Longest quit attempt	5.3	2.7	5.1	2.6	0.33	124	.743
CDS-12	36.4	9.9	47.7	8.4	-6.95	124	< .001
CES-D	17.6	12.8	16.9	12.1	0.33	124	.744
SHS	4.9	1.3	4.6	1.5	1.28	124	.203
LOT-R	14.6	5.3	13.3	6.3	1.28	124	.201
OES	15.6	2.3	15.2	2.5	0.89	124	.374
	Stable (*N* = 138)		Recent (*N* = 22)				
Age	40.6	13.1	34.0	12.0	2.21	158	.029
Age of first smoke	15.7	3.5	16.9	3.7	-1.47	157	.145
Average cpd	1.2	5.2	2.3	5.0	-0.81	140	.417
Days smoked past 30 days	0.2	1.0	3.5	7.9	-1.95	20.1	.065
Quit attempts past year	0.1	0.5	1.5	0.9	-7.14	22.9	< .001
Longest quit attempt	8.8	1.1	7.6	1.7	3.06	23.7	.005
CDS-12	17.7	5.7	26.9	11.5	-3.66	22.6	.001
CES-D	14.7	11.9	22.6	17.7	-2.01	24.1	.056
SHS	4.8	1.5	4.2	1.7	1.47	158	.144

Table 4 *(Continued)*
Comparisons by Smoking Category in MTurk Sample

	Stable (N = 138)		Recent (N = 22)				
Variable	*M*	*SD*	*M*	*SD*	*t*	*df*	*p*
LOT-R	14.1	6.2	15.1	7.0	-0.71	158	.480
ASQ-OES	15.3	2.6	14.4	3.0	1.45	158	.150

Note. cpd = cigarettes per day; FTND = Fagerström Test for Nicotine Dependence; CDS-12 = Cigarette Dependence Scale – 12; CES-D = Center for Epidemiologic Studies Depression Scale; SHS = Subjective Happiness Scale; HM = Happiness Measure; LOT-R = Life Orientation Test-Revised; ASQ-OES = Attributional Style Questionnaire - Optimistic Explanatory Style. Subscripts represent pairwise comparisons.

Path Analyses

Path models were tested using Mplus (Version 7.4; Muthén & Muthén, 1998-2015). Endogenous (i.e., dependent) variables were binary and included smoking status (i.e., non-smoker vs. current smokers), smoker type (i.e., light vs. heavy smoker), and cessation success (i.e., stable vs. recent ex-smokers). Continuous exogenous (i.e., independent) variables included happiness, dispositional optimism, optimistic explanatory style, and depression as well as the interaction terms created for moderation analysis (i.e., happiness X depression, dispositional optimism X depression, and optimistic explanatory style X depression). Covariates included age, race and ethnicity, marital status, quit attempts in the past year, and duration of longest quit attempt. We allowed covariances among endogenous variables, direct paths, and residuals of endogenous variables to vary freely in the model (Hoyle, 2012). Our models were saturated with $df_M = 0$.

Variables were normally distributed but presented missing data. Therefore, we used robust maximum likelihood (MLR) estimation for our models. Maximum likelihood (ML) estimation calculates parameter values that maximize the log likelihood of estimates given the data (Myung, 2003) and has been previously recommended as a technique to effectively deal with missing data (Schafer & Graham, 2002). MLR estimation has added advantages, such as

being a more efficient estimator that provides more stable solutions compared to non-robust estimators for non-normal distributions (Yuan & Bentler, 1998). MLR estimation for saturated models does not provide model fit indices (e.g., RMSEA, CFI) in Mplus, as they may inflate Type I error rates in non-normal distributions (Nevitt & Hancock, 2000). Thus, we considered the Bayesian Information Criterion (BIC; Schwarz, 1978) to compare three nested models that increased in complexity with each of the two samples in our data (i.e., SONA and MTurk).

We tested a set of baseline models that included the direct paths between depression, happiness, optimism, and optimistic explanatory style and each endogenous variable (e.g., smoking status, smoker type, and cessation success). The second set of models (i.e., interaction models) included the direct paths mentioned previously and interaction terms created for moderation analysis. We centered our exogenous variables to interpret statistically significant interactions. The third set of models (i.e., full models) included direct paths, interaction terms, and covariates previously found to discriminate between current and non-smokers, light and heavy smokers, and recent and stable ex-smokers. Lower BIC values indicated that models were more likely to have generated the data and, therefore, a better fit (West, Taylor, & Wu, 2012). BIC differences of 10 or more demonstrate very strong evidence of better fit (Raftery, 1995). Table 5 shows the BIC indices for each set of models. BIC values indicated that adding interaction terms to baseline models demonstrated a decrease in model fit. However, models with interactions and covariates showed better fit than baseline models. Thus, we interpreted the estimates and paths of full models for both SONA and MTurk.

First, the SONA path model demonstrated that individuals who identified as White (*Est.* = .50, *OR* = 18.17, $p < .001$), those who were older (*Est.* = .11, *OR* = 1.06, $p = .037$), and those with higher nicotine dependence (*Est.* = .47, *OR* = 1.21, $p < .001$) were more likely to be current

smokers. However, after controlling for these covariates, neither direct paths nor interactions were significantly related to smoking status (current smokers vs. non-smokers). Small sample sizes in smoker type (light vs. heavy smokers) and cessation success (recent vs. stable ex-smokers) prevented accurate parameter estimations and model interpretations. Separate logistic regression models for each outcome (i.e., smoking status, smoker type, cessation success) were conducted to investigate relationships that path analyses were not able to test. These follow-up analyses yielded similar results and confirmed that the only predictors of smoking status were White race (B = 2.70, OR = 14.91, p = .002), age (B = 0.07, OR = 1.07, p = .023), and nicotine dependence (B = 0.18, OR = 1.19, p < .001). Logistic regression models did not reveal significant predictors for smoker type (all ps > .10) and confirmed uninterpretable results for cessation status.

Second, the MTurk path model (see Figure 1) demonstrated that, after controlling for race and ethnicity, marital status, age, and nicotine dependence, neither direct paths nor interactions were significantly related to smoking status or smoker type. Only nicotine dependence significantly predicted being a current smoker (*Est.* = .79, OR = 1.24, p < .001) and a heavy smoker (*Est.* = .64, OR = 1.14, p < .001). Nevertheless, after controlling for age (*Est.* = -.24, OR = 0.88, p = .030), quit attempts (*Est.* = .76, OR = 31.89, p < .001), length of last quit attempt (*Est.* = -.20, OR = 0.68, p = .031), and nicotine dependence (p = .189), recent ex-smokers were more likely to experience depression (*Est.* = .29, OR = 1.17, p < .001) and dispositional optimism (*Est.* = .56, OR = 1.88, p <.001) relative to stable ex-smokers[1].

[1] We found a significant moderate correlation between cessation success and length of last quit attempt (r = -.51, p < .001). In addition stable ex-smokers were significantly more likely to report their last quit attempt to have lasted longer than a year when compared to recent-ex-smokers (χ^2 (1) = 29.85, p < .001; 95.7% vs. 59.1%, respectively). Both findings may suggest that participants were reporting the length of their current quit attempt.

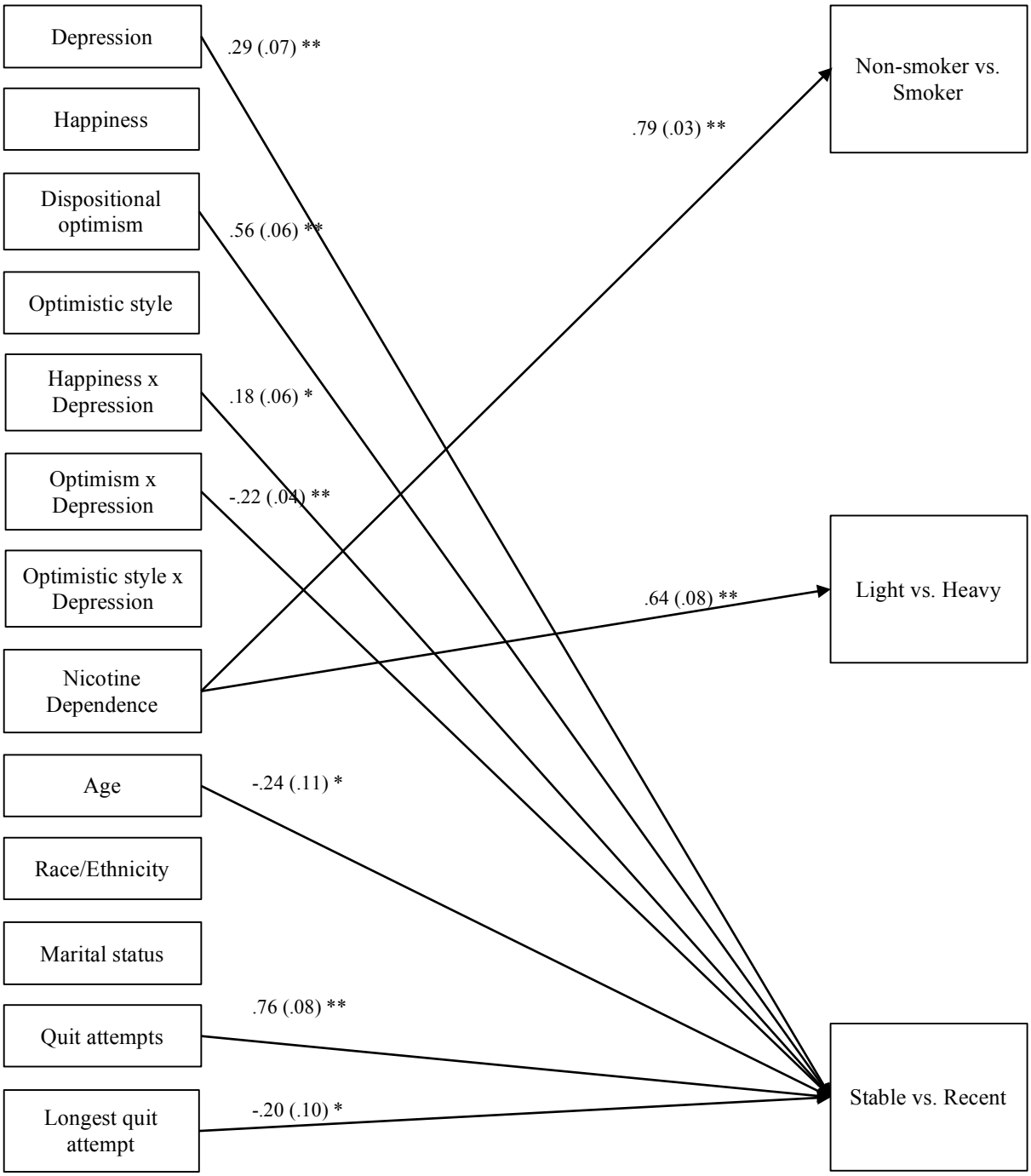

Figure 1. Path analysis full model. Estimates are standardized path coefficients with standard errors (in parenthesis) using MTurk data ($N = 673$). For clarity of presentation, only statistically significant paths are shown and covariance estimates are not presented. * $p < .05$. ** $p < .001$.

The interactions between happiness and depression (*Est*. = .18, *OR* = 1.06, *p* = .008) and dispositional optimism and depression (*Est.* = -.22, *OR* = 0.98, *p* < .001) were significant. For each unit increase in happiness, the odds of depression predicting being a recent (vs. stable) ex-smoker increased, whereas for each unit increase in dispositional optimism, the odds of depression predicting being a recent (vs. stable) ex-smoker decreased. Separate logistic regression models for each outcome (i.e., smoking status, smoker type, cessation success) were then conducted. These analyses revealed that, in addition to nicotine dependence (*B* = 0.22, *OR* = 1.25, *p* < .001), dispositional optimism (*B* = 0.13, *OR* = 1.13, *p* = .046) was a predictor of smoking status, a result not observed in path analysis. Logistic regression results confirmed that only nicotine dependence (*B* = 0.14, *OR* = 1.15, *p* < .001) was a significant predictor of smoker type. Compared to path analysis, logistic regression results for cessation success revealed that depression (*p* =.080), age (*p* = 0.50), and length of last quit attempt (*p* = .119) were not a significant predictor of cessation status. Dispositional optimism (*B* = 0.92, *OR* = 2.51, *p* = .001) and quit attempts (*B* = 3.46, *OR* = 31.89, *p* < .001) remained as significant predictors. Interactions between happiness and depression (*B* = .06, *OR* = 1.06, *p* = .037) and dispositional optimism and depression (*B* = -.02, *OR* = 0.98, *p* = .007) also remained significant. Notably, even though happiness did not predict cessation success, the interaction term of happiness X depression was a significant predictor of cessation success. In addition, even though depression and dispositional optimism predicted cessation success in a positive direction, the interaction term of dispositional optimism X depression was negative. These results contradicted main effects and may have indicated the effects of suppression, which has been defined as the introduction of a second predictor that changes the estimate and its *p*-value of an initial predictor (Ludlow & Klein, 2014). Evidence of suppression was supported, as the

interaction terms were not significant in the interaction model but were significant in the full model when covariates were included. Previous authors have indicated that suppression may result in erroneous interpretation of moderators (Tu, Gunnell, & Gilthorpe, 2008). Therefore, we adjusted our full model by eliminating the interaction terms from the analysis. The BIC of the final model was 626.8, which indicated better fit (BIC difference of 10 or more; Raftery, 1995) than the full model (BIC = 671.0; Table 5). The final model (Figure 2) confirmed that, after controlling for covariates, depression, happiness, optimism, and optimistic explanatory style were not related to smoking status or smoker type. Also, the final model confirmed that, after controlling for age (p = .201), quit attempts (OR = 8.78, p <. 001), length of last quit attempt (OR = 0.65, p = .017), and nicotine dependence (p = .071), recent ex-smokers were more likely to experience depression (*Est.* = .36, OR = 1.15 p < .001) *and* dispositional optimism (*Est.* = .49, OR = 1.48, p < .001) relative to stable ex-smokers. Hierarchical logistic regression for cessation status was conducted to investigate relationships that path analyses were not able to test. Similar to the nested path models tested in path analysis, the first step included depression, happiness, dispositional optimism, and optimistic explanatory style. The second step included the interaction terms previously mentioned. The third step included age, quit attempts, length of last quit attempt, and nicotine dependence as covariates. The obtained results were similar to those for the path analysis and also revealed evidence of suppression, as the interaction terms became significant predictors after adding covariates to the regression model.

Table 5
Comparison of BIC Indices by Model Complexity

Sample	Baseline Model	Interaction Model	Full Model	Final Model
SONA	492.0	533.7	378.8	—
MTurk	996.3	1050.6	671.0	626.8

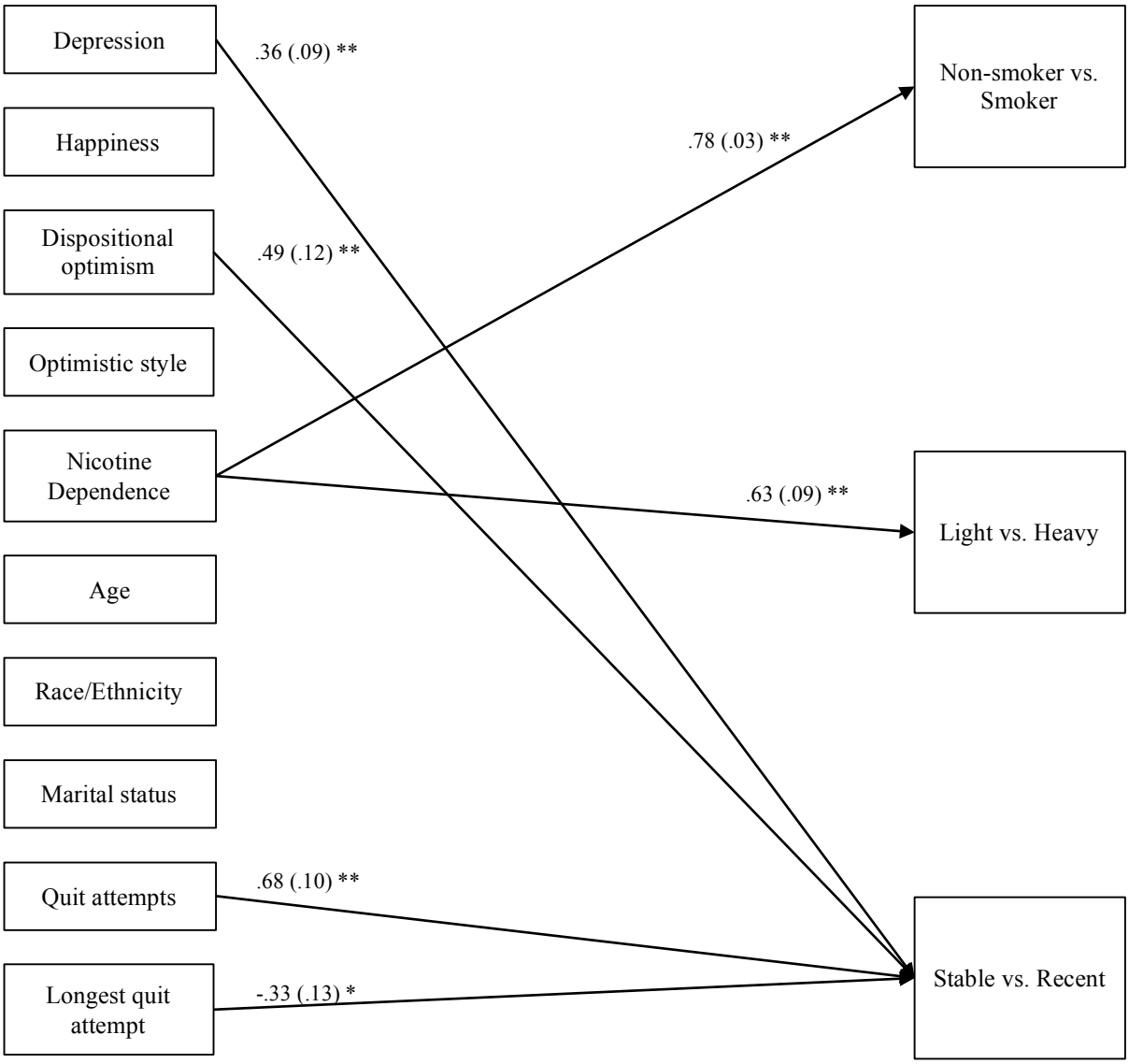

Figure 3. Path analysis final model. Estimates are standardized path coefficients with standard errors (in parenthesis) using MTurk data ($N = 673$). For clarity of presentation, only statistically significant paths are shown and covariance estimates are not presented. * $p < .05$. ** $p < .001$.

Discussion

The present study investigated the relation between depression and positive constructs depression and smoking-related indicators in a college student sample and an online sample. We hypothesized that, after controlling for specific covariates (e.g., gender, ethnicity, age, nicotine dependence), lower levels of depression and higher levels of positive constructs (i.e., happiness, dispositional optimism, optimistic explanatory style) would predict being a non-smoker (vs. current smoker), a light smoker (vs. heavy smoker), and a stable ex-smoker (vs. recent ex-smoker). We also hypothesized that positive constructs would moderate the relation between depression and smoking status, smoker type, and cessation success, such that individuals with high depression scores and high happiness and optimism scores would be more likely to be non-smokers (vs. current smokers), light smokers (vs. heavy smokers), and be stable ex-smokers (vs. recent ex-smokers).

Comparisons between samples revealed that college students (i.e., SONA) differed with respect to demographic and smoking characteristics from our online sample (i.e., MTurk). Hence, analyses were performed separately for each sample. Notably, 10.4% of college students reported currently smoking, which is lower than the U.S. rate for adult current smokers overall (17%, Jamal et al., 2015). Univariate analyses applied to the college students revealed that non-smokers were younger, more likely to be African American, less likely to be White, and less dependent on nicotine compared to smokers. Non-smokers also reported greater levels of happiness than current smokers, but did not differ in dispositional optimism and optimistic explanatory style. No differences in depression or positive psychology constructs were found between light and heavy smokers and stable and recent ex-smokers. After controlling for race and ethnicity, age, and nicotine dependence, path analysis confirmed that the positive constructs,

depression, and their interaction terms were not significantly related to smoking status. These results may suggest that race, age, and, higher nicotine dependence may better predict being a smoker than the positive constructs or depression scores in college students. Specifically, White or Caucasian individuals were 18 times more likely to identify as current smokers when compared to other racial and ethnic groups. Path analysis results for smoker type and cessation success were inconclusive. Further logistic regression analyses did not reveal significant predictors of smoker type and confirmed problematic interpretation of the initial results. The lack of relation between positive constructs, depression and smoker type and cessation success may likely be due in part to low rates of light and heavy smokers (5.2%) and stable and recent ex-smokers (5.3%) within this sample.

Path analysis results for the MTurk data were interpretable and revealed, contrary to our hypotheses, that happiness and optimistic explanatory style were not related to smoking status, smoker type, or cessation success. These results stand in contrast to research findings from epidemiological, college student, and general smoker data, which have shown that happiness predicts being a non-smoker and a stable ex-smoker (e.g., Adan & Sanchez-Turet, 2000; Kobau et al., 2013; Shahab & West, 2009, 2012). One difference worth noting is that these studies used customized or single-item questions to assess happiness. Thus, the discrepancy between our results and those of others may be due in part to the prior studies relying upon less valid measurements of happiness. If so, this highlights a need to use instruments with greater psychometric support in future investigations of how happiness affects smoking behavior. Also, to our knowledge, optimistic explanatory style has not been previously investigated in smoking research. Our results may provide initial evidence that optimistic attributions to negative events

may not be related to smoking behavior, but replication is needed to provide a more definitive answer.

After controlling for covariates, path analysis revealed a significant relation between depression and dispositional optimism and cessation success. However, both dispositional optimism and depression predicted a higher likelihood of being a recent (vs. stable) ex-smoker. This result provides support for one important assumption of positive psychology: negative and positive factors are independent predictors of behavior (Duckworth et al., 2005). Similar to previous studies, it is possible that depression may promote shorter periods of abstinence (Burgess et al., 2002). Alternatively, recent quitting may promote more depressive symptoms, especially for those who report a history of depression (Tsoh et al., 2000). Concurrently, dispositional optimism may also promote shorter periods of abstinence. Several studies have found that unrealistic optimism—perceiving one's risk to be below average—is related to underestimating the health risks of smoking and overestimating the likelihood of successful quitting, which may perpetuate relapse (Peterson, 2000; Weinstein, Marcus, & Moser, 2005; Weinstein, Slovic, & Gibson, 2004). However, the relation between dispositional optimism and unrealistic optimism is small (r = .25; Khallad, 2010) and dispositional optimism has predicted proactivity in learning about health risks (Carver et al., 2010). Thus, an alternative explanation would be that shorter periods of abstinence may increase dispositional optimism and motivate recent ex-smokers to keep trying cessation after relapse. Previous researchers have proposed that recent quitters who have many previous quit attempts may also have higher levels of dispositional optimism (Haaga, 1990), but this assumption and the direction of this relation has not been investigated. Nevertheless, it is possible that recent ex-smokers may be optimistic and

believe that their most recent quit attempt may lead to successfully maintaining their cessation efforts.

To further understand how positive constructs affected the relation between cessation success and depression, we performed moderation analyses. We found that interpretation of interaction terms was problematic, as the direction of one interaction was incongruent with main effects and estimates became significant after adding covariates to the model. Additionally, we found that most covariate estimates did not change in significance when comparing the final model to the full model. Previous studies have shown that suppression and other reversal paradoxes may occur by chance (Ludlow & Klein, 2014) and interpretation of moderation results may be erroneous (Tu et al., 2008). It is possible that the small sample size for recent ex-smokers, unreliable instruments, multicollinearity, and a correlational design may have contributed to suppression (Ludlow & Klein, 2014; Tu et al., 2008). Nevertheless, it is unlikely that suppression could be due to unreliable instruments or multicollinearity, as instruments showed reliability estimates greater than .80 and other authors have posited that multicollinearity is not an issue in moderation analysis (Disatnik & Sivan, 2016).

Future Directions

To our knowledge, this is the first study to assess the relation between positive psychology constructs and different smoking indicators. Even though our data did not support the value of integrating positive psychology constructs in smoking cessation interventions, this may remain an area worthy of continued pursuit. Other studies have found a relation between smoking and optimism (Boehm et al., 2013; Giltay et al., 2007; Kelloniemi et al., 2005; Steptoe et al., 2006). Also, previous research has provided evidence that PPIs can increase happiness and dispositional optimism while decreasing substance use and dependence relative to a no-

treatment control group (Akhtar & Boniwell, 2010). In addition, preliminary but limited evidence suggests that PPIs can enhance positive affect and happiness, which in turn may help decrease smoking and/or aid smoking cessation efforts (e.g., Bränström et al., 2010; Kahler et al., 2013).

Researchers wishing to continue investigating the relation of positive constructs and smoking are encouraged to recruit larger and more diverse samples to employ other complex analytic methods. For instance, latent variable mixture modeling is an analytic method that allows researchers to observe complex patterns in the data that predict a latent categorical variable (i.e., group membership) that could, in turn, predict behavioral outcomes (Berlin, Williams, & Parra, 2014). Thus, complex patterns across depression, happiness, and dispositional optimism may be able to predict profiles (e.g., high depression and low happiness, high depression and high optimism) that could further predict smoking behavior (e.g., being a non-smoker vs. current smoker). In addition, researchers could use experimental designs to study the relation between positive constructs and smoking. For instance, smokers with no intention to quit could be randomized to an experimental condition that increases dispositional optimism or a control condition and observe subsequent smoking frequency or latency of smoking. Such experiments may help establish the directionality of the causal relation between dispositional optimism and smoking behavior.

Moreover, researchers may expand this line of research by examining other positive constructs as they relate to smoking. For instance, research on gratitude and hope seem worth pursuing. Gratitude has been found to be related to delayed discounting of monetary gains, a predictor of substance abuse (DeSteno, Li, Dickens, & Lerner, 2014; Dickens & DeSteno, 2016; MacKillop et al., 2010). Similarly, delayed discounting has also predicted being a smoker (vs.

never smoker) and smoking relapse (F. Baker, Johnson, & Bickel, 2003; Sheffer et al., 2014). Thus, it is not surprising that gratitude has also been shown to be negatively related to smoking (Chen, Ye, Hu, Li, & Jiang, 2012). Hope has also been studied in the context of substance abuse, with preliminary research (from cross-sectional studies) suggesting that hope is related to smoking status (Berg, Ritschel, Swan, An, & Ahluwalia, 2011; Berg, Schauer, Rodgers, & Narula, 2012; Wilson, Syme, Boyce, Battistich, & Selvin, 2005). Also, when compared to current smokers, ex-smokers seem to have higher levels of hope (Berg et al., 2012). Future investigations that systematically test the added efficacy of optimism, gratitude, and hope in smoking cessation may provide more effective smoking cessation interventions and, in turn, increase cessation rates and decrease relapse rates.

Limitations

This study, which focused intently on the relation between positive constructs and smoking behavior, was undertaken in part to identify factors that could potentially enhance effectiveness of current smoking cessation treatments. We realized at the outset that the correlational design of this study would not allow us to infer causal effects of happiness and dispositional optimism on smoking status and cessation success, even if consistent significant relations were obtained. Small-scale interventions are needed to begin to address causality, such as the pilot study recently reported by Akhtar and Boniwell (2010), who found their 8-week workshop based on positive psychology principles to be superior to no treatment at increasing well-being (e.g., happiness, optimism, and positive emotions) and decreasing alcohol consumption with "alcohol-misusing" adolescents. Perhaps it is time to implement a similar small-scale pilot study to explore the independent or incremental benefits of incorporating elements of positive psychology in smoking cessation treatments.

In addition, even though we tested three nested models that increased in complexity, we did not test competing path models that reflected different associations or directions among variables. For instance, withdrawal models of addiction have demonstrated that withdrawal symptoms (i.e., aversive physical and emotional consequences) produced after abstinence from nicotine intake are responsible for continued smoking (USDHHS, 2010). Therefore, a competing model that tests for mediation of nicotine dependence through happiness and optimism could be tested. A competing model like this could help reveal if happiness and optimism can indeed decrease the impact of nicotine dependence on smoking status. Stress-health models (Lazarus, 1985; Lazarus & Launier, 1978) suggest that stress and perceived resources to face stressors can affect health behaviors. As previous research has found that optimism mediates the relation between stress and health behaviors and psychological health (Bretherton & McLean, 2014; Gill & Loh, 2010), this may constitute another fruitful area for investigation.

Conclusions

Happiness and optimistic explanatory style were not related to smoking status, smoker type, and cessation success. However, we found evidence that optimism and depression were related to cessation success. Also, we found that depression and optimism predicted cessation success in the same direction. The fact that the relation between optimism and cessation success was opposite to what we predicted suggests a need for further investigation to more fully understand the implications of this finding. Whether efforts to alter optimism will be useful for motivating ex-smokers to persist in quitting and lengthen the period of abstinence is unknown. Inclusion of larger and more diverse samples and more sophisticated statistical methods may enable future researchers to more convincingly establish the relation of happiness, optimism, and

other positive constructs (e.g., gratitude and hope) and how these concepts may improve upon traditional models of addiction.

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