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Responding to Tobacco Craving: Experimental Test of Acceptance versus Suppression

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Abstract

Acceptance and Commitment Therapy (ACT) provides a theoretical rationale for “acceptance” of thoughts and feelings, and proscribes suppression, a more intuitive and commonly used coping strategy. Suppression is theorized to have negative consequences not applicable to acceptance, including depletion in self-control and ironic post-suppression rebound effects. However, it remains largely unknown whether these strategies differentially affect frequency of drug-related thoughts, craving intensity, drug use behavior, or other relevant outcomes. Adult smokers ($N = 162$) were randomly assigned to receive a brief laboratory-based coping intervention (acceptance or suppression) or were not given coping instructions (control group) and then were exposed to smoking cues. Results indicated that the suppression group was successful at suppressing thoughts of smoking, as they reported fewer thoughts of smoking than the other two groups. Also, both coping strategies were associated with benefit with respect to craving and affect. However, there were no group differences in depletion, nor did any rebound effects occur when coping was discontinued. Following the laboratory session, all participants attempted to quit or at least reduce their smoking for three days; the acceptance and suppression groups resumed use of their strategy. At 3-day follow-up, the acceptance and suppression groups reported greater self-efficacy for avoiding smoking when experiencing craving, compared to the control group. However, there were no group differences in number of cigarettes smoked during the three days. This study

provides support for the value of acceptance-based coping, but also suggests that more research is needed to differentiate its benefits compared to suppression.

Keywords

smoking; cigarettes; urge; cessation; coping

Strategies for coping with craving are key elements of psychological treatments for substance use disorders (SUDs). The current study compared acceptance-based to suppression-based coping for cigarette craving on laboratory outcomes including number of thoughts about smoking, craving and affect intensity, depletion in self-control, and rebound effects, and on outcomes over a 3-day follow-up of smoking frequency and self-efficacy for avoiding smoking.

Theoretical Underpinnings

Suppression is an intuitive strategy for coping with unwanted thoughts and feelings (e.g., thoughts and urges to smoke). However, when suppression is stopped, an ironic “rebound” effect may occur, such that the unwanted thoughts become even more frequent relative to a control group that did not suppress (Abramowitz, Tolin, & Street, 2001). Wegner (1994) theorized that this rebound effect is caused by an automatic monitoring process that continues to search for instances of the target thought for some time after the controlled, effortful operating process that generates alternative distracter thoughts is interrupted or terminated. The rebound effect was identified using a now well-established laboratory paradigm. This paradigm involves three brief (i.e., < 10 minutes) “thought-recording” periods during which participants record instances of a target thought (e.g., “white bears,” Wegner, Schneider, Carter, & White, 1987) using a handheld counter or another recording method (Abramowitz, Tolin, & Street, 2001). A control group is instructed to think about whatever they want during all three periods. A suppression group does the same for the first and third periods; however, during the second period, they are instead told to try to suppress the target thought as much as possible.

This paradigm was later used to examine the implications of suppression for clinical populations who may engage in suppression frequently (e.g., smokers trying to quit, Salkovskis & Reynolds, 1994). The concept of the rebound effect was expanded to include not only post-suppression increases in the target thought but also in affective states and behaviors (e.g., negative affect, Marcks & Woods, 2005; smoking, Erskine, Georgiou, & Kvavilashvili, 2010). For example, brief assessments of affect have been included between thought-recording periods (e.g., Marcks & Woods, 2005). Furthermore, a few studies have revealed that when the period of suppression is extended to days rather than minutes, which may have greater clinical applicability, suppression becomes difficult to sustain and the rebound effect occurs when individuals inevitably relax their suppression efforts (e.g., Trinder & Salkovskis, 1994).

The Ego Depletion Model of Self-Control (Muraven & Baumeister, 2000) provides a theoretical explanation for why thought suppression should be difficult to sustain over the

long-term. This model posits that all acts of self-control, of which thought suppression qualifies, consume a common resource analogous to a muscle. As such, one act of self-control should “deplete” this resource and impair performance on a subsequent task involving self-control. Therefore, suppression becomes difficult to sustain as depletion increases. Support for this model has been shown in numerous studies using a well-established two-task laboratory paradigm consisting of a brief period of thought suppression (a control group engages in an alternative task not involving thought suppression) followed by a second “self-control” task. Two studies relevant to addictive behaviors demonstrated that: (1) suppression of white bear thoughts undermined subsequent ability to limit alcohol intake (Muraven, Collins, & Nienhaus, 2002), and (2) suppression of thoughts and urges to drink an alcoholic beverage impaired subsequent performance on a handgrip squeezing task (Muraven & Shmueli, 2006).

Acceptance-Based Coping as an Alternative to Suppression

Acceptance and Commitment Therapy (ACT) specifically proscribes thought suppression. A primary goal of ACT is to enhance psychological flexibility by changing the *function* rather than the *content* of cognition via acceptance, “the active and aware embrace of those private events occasioned by one’s history without unnecessary attempts to change their frequency or form” (Hayes et al., 2006, p. 7), and cognitive defusion, observing thoughts “dispassionately” (p. 9) rather than engaging with them directly. In the context of smoking, use of these techniques may not reduce the frequency of thoughts about smoking *per se*, but may shorten the duration and intensity of cravings triggered by these thoughts and decrease the likelihood of *acting* on these thoughts by shifting one’s focus to control over behavior rather than thoughts. Therefore, acceptance-based coping is theorized to be less likely than suppression to cause depletion and rebound effects (Kavanagh, Andrade, & May, 2004). Reviews of ACT and other approaches that incorporate acceptance-based coping, such as mindfulness, suggest they are efficacious (Hofmann, Sawyer, Witt, & Oh, 2010; Powers, Zum Vörde Sive Vörding, & Emmelkamp, 2009), although the literature on smoking cessation is small (Brewer et al., 2011; Bricker, Mann, Marek, Liu, & Peterson, 2010; Davis, Fleming, Bonus, & Baker, 2007; Gifford et al., 2004; Hernandez-Lopez, Luciano, Bricker, Roales-Nieto, & Montesinos, 2009).

Recent laboratory studies have attempted to differentiate the acute effects of acceptance from suppression and other alternative coping strategies. Some studies have used the original thought suppression paradigm, with the addition of a third group instructed to use acceptance (e.g., Marcks & Woods, 2005). Others have not assessed thought frequency, but have found benefits of acceptance with respect to affect (e.g., anxiety in individuals with anxiety disorders, Campbell-Sills, Barlow, Brown, & Hofmann, 2006; Levitt, Brown, Orsillo, & Barlow, 2004). Two recent studies investigated acceptance-based coping in smokers. Bowen and Marlatt (2009) found no differences in craving or negative affect in the laboratory between a mindfulness-based coping group and a control group told to use coping strategies that had worked for them in the past. However, the mindfulness group smoked significantly fewer cigarettes during a 7-day follow-up period. Rogojanski, Vettese, and Antony (2011a) compared mindfulness to suppression. At 7-day follow-up, there were no

differences in craving or smoking frequency but the mindfulness group reported less negative affect and fewer depressive symptoms.

The Current Study

The current study also involved a laboratory session and brief follow-up, but differs from and builds upon the previous studies with smokers in several notable respects. First, we simultaneously compared acceptance and suppression against each other *and* a control group not given any coping instructions. Second, we evaluated not only affect and craving but also thought frequency and depletion using a combination of the thought suppression (i.e., three thought-recording periods, Abramowitz et al., 2001) and two-task depletion (Muraven & Baumeister, 2000) paradigms. During the second thought-recording period, which also served as the first task in the depletion paradigm, we predicted that participants in the suppression group would report fewer thoughts of smoking relative to the other groups. Immediately following this period, we predicted that both the acceptance and suppression groups would report decreased craving and negative affect relative to the control group, but that only the suppression group would show evidence of depletion. Finally, we hypothesized that after the third thought-recording period, only the suppression group would experience rebound effects in frequency of smoking thoughts, craving, affect, and motivation to smoke. After the laboratory session, all participants engaged in a “practice quit attempt” for 3 days; the acceptance and suppression groups resumed use of their assigned strategy. We predicted that suppression would be more difficult to sustain, such that the acceptance group would smoke the fewest cigarettes and report the greatest self-efficacy.

Method

Experimental Design and Overview

After completing baseline measures that included the first thought-recording period, participants were randomly assigned to view a brief presentation describing 1) acceptance, 2) suppression, or 3) a neutral magazine article (control group). Participants were then exposed to smoking cues to generate thoughts and urges to smoke. Cue exposure was followed by the second thought-recording period, during which the two coping groups employed their assigned strategy. Outcomes assessed immediately after this period (time 2 coping outcomes) included craving, affect, and performance on a handgrip squeezing task (i.e., depletion). Next, the third period of thought-recording occurred (same as baseline, coping discontinued). Immediately after this period, we assessed for rebound in craving, affect, and motivation to smoke (time 3 rebound outcomes). After the laboratory session, all participants tracked their smoking for 3 days as they attempted to quit (coping groups resumed use of their strategy throughout the 3 days). This study was approved by the Institutional Review Board of the University of South Florida.

Participants

Participants were 162 adult smokers (50% female) recruited from the community. Inclusion criteria were 18-65 years of age, smoking at least 10 cigarettes per day, and breath carbon

monoxide (CO) of at least 8 ppm. To ensure receptivity to learning coping strategies, they also had to report at least one previous quit attempt and an intention to quit within 6 months.

Measures

Fagerström Test for Nicotine Dependence (FTND) (Heatherton, Kozlowski, Frecker, & Fagerström, 1991). Participants completed this standard assessment of tobacco dependence.

Quizzes (adapted from Forman et al., 2007; Levitt et al., 2004) containing 6 multiple-choice items were administered to the coping groups after the presentation. Three items tested memory of the presentation content. One of these items was the same for both groups (“When I start to have a craving for a cigarette, I should...”) whereas the other two were specific to the acceptance (e.g., “The leaves on a stream and train examples can be helpful to...”) or suppression presentations (e.g., “What is biofeedback?”) (see descriptions of presentations below). The other 3 items assessed perceived understanding (“how well did you understand the information in the presentation?”), interest (“how interesting was the presentation?”), and expected usefulness (“How useful do you expect the instructions from the presentation will be for you during the upcoming task?”) on 5-point Likert scales. The control group was also administered a 6-item quiz; 4 items that tested memory of the article content and 2 Likert scale items (understanding, interest).

Manipulation check (adapted from Levitt et al., 2004). All participants, regardless of group assignment, rated the degree to which they used acceptance and suppression (3 items each) in the laboratory and during 3-day follow-up on 9-point scales from “never” to “all of the time.” Also, the coping groups rated the usefulness of their strategy on a 5-point scale.

Outcome measures – craving and affect—The primary measure of craving was the *Questionnaire of Smoking Urges-4 (QSU-4)*, which included 4 items taken from the original QSU (Tiffany & Drobes, 1991). Cronbach's alpha ranged from .82 to .94. Additionally, a *single-item (0-100) urge scale (1-Urge)* (Sayette, Martin, Wertz, Shiffman, & Perrott, 2001) was used. The *Magnitude Estimation of Urge (ME)* (Sayette et al., 2001), which is less susceptible to ceiling effects, was included as a secondary urge measure. Affect was assessed with the *Mood Form (MF)* (Diener & Emmons, 1984), which consists of 4 Positive Affect (PA) and 5 Negative Affect (NA) adjectives. Alphas in the current sample were .89-.93 for PA and .84-.89 for NA.

Other outcome measures—Participants recorded instances of *thoughts about smoking* (*thought-recording*) for three 3-minute periods using a handheld counter with its numbers obscured (Salkovskis & Reynolds, 1994; Marcks & Woods, 2005). *Depletion* was measured by the duration of time participants squeezed a *handgrip* device consisting of two handles connected by a spring. They squeezed as long as they could, until a pad of paper that was placed between the handles fell, signaling they had relaxed their grip (Muraven & Shmueli, 2006). *Motivation to smoke* was assessed by a *behavioral choice task (BCT)* in which a choice was offered between smoking immediately or delaying smoking until the study ended in exchange for monetary compensation up to an unspecified limit (adapted from Sayette et al., 2001). Participants stated their minimum acceptable amount to the nearest \$0.25. Finally, self-efficacy was evaluated with a single-item (0-100) rating of confidence that they

could quit for one year (1-SE) and the 20-item *Smoking: Self-Efficacy/Temptation Long Form (SET)* (Velicer, Diclemente, Rossi, & Prochaska, 1990) to assess confidence in avoiding smoking in Positive Affect/Social, Negative Affect, and Habitual/Craving Situations. Alphas for the SET were .90-.94.

Procedure

Recruitment and consent—Those who qualified and agreed to participate attended an individual 1.5 hour appointment. They were asked to abstain from smoking for the preceding 3 hours to increase craving and receptivity to the use of coping strategies. To encourage compliance, they were told they would complete a breath test that detects recent smoking. Upon arrival, after obtaining informed consent, the experimenter verified eligibility, administered the breath test (CO), and collected their cigarettes and lighter. If they reported smoking during the previous 3 hours, they waited until 3 hours had passed or were rescheduled.

Baseline measures – Time 1—Time 1 measures were completed in the following order: handgrip, demographics and smoking history, 1-SE, SET, MF, QSU-4, 1-Urge, thought-recording. The instructions for time 1 thought-recording were to think about anything they wanted, and to press the button once for each thought they had about smoking, if any.

Coping manipulation—Next, participants were randomly assigned to the acceptance, suppression, or control group. Randomization was stratified by gender; however no gender differences in primary outcomes were found. All groups viewed a 10-minute slide presentation. The coping groups' presentations explained the respective strategies (scripts adapted from Levitt et al., 2004 and Forman et al., 2007). The control group's presentation was based on a neutral magazine article (Levitt et al., 2004). To encourage attention, all participants were told that a quiz testing their memory for the presentation content would be administered afterward.

The acceptance presentation conveyed that suppression of smoking-related thoughts and cravings is not possible and is counterproductive. Nonjudgmental acceptance of craving, and a focus on controlling behavior rather than thoughts was encouraged. Concepts included willingness (i.e., to tolerate cravings as they arise) and cognitive defusion (i.e., “seeing themselves” having a craving at a psychological “distance”), illustrated via metaphors (e.g., leaves on a stream, train cars passing) commonly used in ACT. The overall message was, “be willing to have whatever your mind gives you. No matter how strong a craving is, you can let it be.” In contrast, the suppression presentation encouraged exertion of active, willful control over smoking-related thoughts by “pushing them away,” illustrated via examples of mental control such as biofeedback and walking on hot coals. The overall message was, “If thoughts or images about smoking pop into your head, immediately push them away and get them out of your mind. Just don't think about craving or smoking!”

The quiz was administered after the presentation. If more than one item was answered incorrectly, the experimenter reviewed the main ideas until she was confident the instructions were understood.

Cue exposure—After the quiz, the experimenter placed a covered tray in front of the participant, then left the room and administered instructions via intercom to remove the tray's cover, which revealed the participant's pack of cigarettes, lighter, and an ashtray. To maximize craving, participants were told they might have an opportunity to smoke (Juliano & Brandon, 1998). They were asked to light a cigarette without raising it to their mouth, and hold this lit cigarette while they viewed 12 images containing cigarettes (Carter et al., 2006) presented for 15 seconds each. The coping groups were instructed to use their strategy to cope with thoughts or cravings to smoke that arose. After the last image, they were told to extinguish their cigarette.

Coping outcomes - Time 2—After extinguishing their cigarette, participants completed the 1-Urge. Next, they completed the second thought-recording period. The coping groups were told to use their assigned strategy during this period, whereas the control group was given the time 1 instructions. After 3 minutes elapsed, participants completed coping outcome measures in the following order: QSU-4, ME, MF, depletion (handgrip), and manipulation check.

Rebound outcomes – Time 3—After the time 2 measures, participants completed the third thought-recording period. The purpose of this period was to assess for rebound in smoking thoughts; therefore, following the standard paradigm, all participants were given the time 1 instructions. The coping groups were explicitly instructed to discontinue use of their strategy: “This time, you're going to take a break from using your strategy. Ignore everything you heard in the presentation. This time, I want you to do the same thing you did the first time; that is, just think about anything you want and monitor your thoughts as they occur.” The suppression group was told: “you should not try to control your thoughts like you did before or use any other strategy.” The acceptance group was told: “you should not try to use the acceptance strategy like you did before or use any other strategy.” After 3 minutes elapsed, participants completed rebound outcome measures in the following order: QSU-4, ME, MF, and BCT.

Compensation and 3-day follow-up—Upon completion of all tasks described above, participants were compensated \$25 (\$20 plus \$5 for the BCT) and debriefed about the BCT (i.e., told the study was over and all would receive an extra \$5). All participants were asked to attempt to quit smoking immediately upon leaving the laboratory and continue their quit attempt for the rest of that day and the next two days (i.e., 3-day follow-up), framed as “practice” for their upcoming planned quit attempt. They were told that if they could not quit completely, they should still reduce their smoking as much as possible. They were given tally sheets to track all cigarettes smoked, including the exact time of the first cigarette they smoked after leaving. The coping groups were told to resume use of their coping strategy throughout the three days and were given a reminder card describing their strategy. All participants were instructed to complete follow-up questionnaires at the end of Day 3 and return them electronically or via mail: 1-SE, SET, manipulation check to assess use of acceptance and suppression during follow-up, and an open-ended item asking them to describe any additional coping strategies used. One reminder to complete the follow-up

questionnaires was sent via email or phone. Those who returned the follow-up questionnaires were mailed a \$5 gift card and entered into a raffle for a \$50 gift card.

Data Analysis Plan

Distributions of dependent variables (DVs) were screened for outliers and violations of parametric test assumptions. Chi-square tests and ANOVA were used to compare groups at baseline and on the manipulation checks. For primary analyses, ANCOVA was used with the baseline value of the DV included as a covariate (note: ANOVA was used when baseline values were unavailable, and baseline cigarettes per day was the covariate for total cigarettes smoked during follow-up). Significant *F* tests were followed-up by pairwise comparisons with Bonferroni correction to determine which groups differed (see Table 1).

Results

Participant Characteristics

The 162 participants (54 per group) had a mean age of 36.84 years, and were 77.7% Caucasian, 16.0% African-American, and 11.2% Hispanic. They smoked a mean of 20.10 cigarettes/day, had smoked for a mean of 18.53 years, and scored a mean of 5.33 on the FTND. They reported a median of 4 prior quit attempts, with their longest period of abstinence lasting a median of 90 days. No group differences were found on baseline variables (all *p*'s > .05).

Attrition at 3-Day Follow-Up—The proportion of participants who completed the follow-up questionnaires did not differ by group (68.5% in acceptance, 72.2% in suppression, 68.5% in control), $\chi^2(2, 162) = .23, p = .89$. Relative to attriters, completers were significantly older, $t(160) = 3.96, p < .001$, and had smoked for more years, $t(160) = 3.12, p = .002$, but did not differ on any other baseline variables (all *p*'s > .05). Regarding laboratory outcomes (time 2 and time 3), there were no significant differences in the pattern of results between completers and attriters. Two different methods were used to handle missing follow-up data: 1) pairwise deletion (i.e., analyzing data from retained participants only) and 2) baseline observation carried forward (BOCF, replacing missing follow-up values with baseline values for attriters). Results did not differ; therefore, all follow-up analyses are presented using pairwise deletion, which was used in previous similar studies (Bowen & Marlatt, 2009; Rogojanski, et al., 2011a).

Quiz

More participants in the acceptance (27.8%) group failed the quiz than in the suppression (1.9%) or control (7.4%) groups, $\chi^2(2, N = 162) = 18.60, p < .001$. Additionally, the acceptance group ($M = 3.94, SD = .71$) reported poorer understanding of the presentation than the suppression ($M = 4.48, SD = .72$) and control groups ($M = 4.48, SD = .75$), $F(2, 159) = 9.85, p < .001$. However, if participants who failed were excluded, there were no differences in the results of comparisons between acceptance and suppression, and only minor differences in results of comparisons involving one coping group vs. the control group. These differences did not change overall conclusions; therefore, we present results that include all participants. Also, there was no significant difference between the

acceptance ($M = 3.43$, $SD = .74$) and suppression ($M = 3.39$, $SD = .90$) groups in expected usefulness of their assigned strategy ($p = .82$).

Manipulation Check

Laboratory session—As expected, group differences were found in self-reported use of acceptance, $F(2, 159) = 13.76$, $p < .001$, and suppression, $F(2, 159) = 29.27$, $p < .001$. Post-hoc Tukey's HSD tests indicated that the acceptance group reported more use of acceptance ($M = 16.80$, $SD = 3.84$) than the suppression ($M = 12.81$, $SD = 4.75$) and control ($M = 13.37$, $SD = 4.18$) groups, both p 's $< .001$, and the suppression and control groups did not differ, $p = .78$. The suppression group ($M = 17.31$, $SD = 5.27$) reported more use of suppression than the control ($M = 12.17$, $SD = 5.83$) and acceptance ($M = 9.43$, $SD = 5.20$) groups, both p 's $< .001$. Additionally, the control group used suppression more than the acceptance group, $p = .03$. There was no significant difference between the acceptance ($M = 3.59$, $SD = .74$) and suppression ($M = 3.64$, $SD = .90$) groups in their rating of usefulness of their assigned strategy ($p = .76$).

Follow-up—As expected, group differences were found in self-reported use of acceptance during the 3-day follow-up period, $F(2, 108) = 14.40$, $p < .001$. Post-hoc Tukey's HSD tests indicated that the acceptance group reported more use of acceptance ($M = 15.05$, $SD = 4.63$) than the suppression ($M = 9.92$, $SD = 4.45$) and the control ($M = 10.57$, $SD = 4.36$) groups, both p 's $< .001$, who did not differ from each other, $p = .81$. However, no significant group differences were found in self-reported use of suppression, $F(2, 108) = 2.40$, $p = .10$. The means for use of suppression at follow-up vs. the laboratory session (acceptance $M = 10.11$ vs. 9.43 , suppression $M = 12.81$ vs. 17.31 , control $M = 11.03$ vs. 12.17) suggest that the suppression group spent proportionally less time suppressing during follow-up than in the laboratory. There was no significant difference between the acceptance ($M = 3.46$, $SD = 1.01$) and suppression ($M = 3.16$, $SD = .96$) groups in their rating of usefulness of their strategy during follow-up, $p = .21$.

Time 2 – Coping Outcomes

Craving—As predicted, the groups differed on all three craving measures: 1-Urge [$F(2, 154) = 5.13$, $p = .007$], QSU-4 [$F(2, 156) = 8.16$, $p < .001$], and ME [$F(2, 159) = 8.14$, $p < .001$]. Acceptance and suppression did not differ on any craving measure (p 's $.14 - 1.0$). Acceptance reported less intense craving than control on 1-Urge ($p = .009$) and ME ($p = .007$). Suppression reported marginally less intense craving on 1-Urge ($p = .05$), and less intense craving on QSU-4 ($p < .001$) and ME ($p < .001$) than control.

Affect—As predicted, the groups differed in PA [$F(2, 156) = 3.65$, $p = .03$] and NA [$F(2, 157) = 4.37$, $p = .01$]. Acceptance and suppression did not differ in PA or NA (p 's $.40 - 1.0$), but both reported marginally higher PA than control ($p = .08$ and $p = .05$, respectively). Acceptance reported lower NA than control ($p = .01$), but suppression and control did not differ ($p = .42$).

Thoughts About Smoking—Number of thoughts was log transformed at all three periods to improve significant skewness and kurtosis that remained even after a large outlier

was removed. As predicted, the groups differed in number of thoughts about smoking, $F(2, 157) = 18.16, p < .001$. The suppression group reported significantly fewer thoughts than the acceptance ($p < .001$) and control groups ($p < .001$). Acceptance and control did not differ in thoughts ($p = .54$).

Depletion (Handgrip)—The groups did not differ significantly in handgrip squeeze duration, $F(2, 157) = .88, p = .42$.

Time 3 – Rebound Outcomes

Results for craving were similar to time 2, and the groups did not differ in affect, thoughts about smoking, or BCT (all p 's $> .05$), indicating that no rebound effects occurred.

Three-Day Follow-Up

Latency to smoke and total cigarettes smoked—There were no group differences in latency to smoke after leaving the laboratory or total cigarettes smoked (all p 's $= 1.0$).

Self-efficacy—As hypothesized, the groups differed in self-efficacy for achieving a year of abstinence (1-SE) [$F(2, 80) = 3.73, p = .03$] and avoiding smoking in Habitual/Craving Situations (HCS) [$F(2, 101) = 4.92, p = .009$]. Acceptance and suppression did not differ on 1-SE or HCS (p 's $= .62$ – 1.0). Suppression reported greater self-efficacy than control on 1-SE ($p = .02$), and both acceptance ($p = .02$) and suppression ($p = .03$) reported greater self-efficacy than control on HCS. There were no group differences on other SET subscales (p 's $= .22$ – $.26$).

Additional coping strategies used—Responses to this open-ended question were classified into categories by two independent raters. Exploratory analyses were conducted to compare groups. Eating to cope was reported more frequently in the suppression group (by 23.1% of participants, versus 8.1% in acceptance and 5.4% in control), $\chi^2(2, 113) = 6.39, p = .04$.

Exploratory Moderation Analyses

Acceptance-based coping may differentially benefit individuals who struggle with cravings (Forman et al., 2007). We conducted exploratory moderation analyses to examine whether the effects of the coping manipulation on craving and affect were moderated by smoking rate (i.e., cigarettes per day) or level of nicotine dependence (i.e., FTND score), which may capture variability in tendency to struggle with craving. We predicted that acceptance would have greater benefit for heavier, more dependent smokers, and vice versa for suppression. General linear models were used with the primary measures of craving (QSU-4) and affect (MF state) at time 2 as the dependent variables, group as the independent variable, baseline (time 1) craving and affect as covariates, cigarettes per day or FTND as an additional covariate, and an interaction term between cigarettes per day or FTND and group. Planned contrasts were conducted to compare the slopes of the acceptance and suppression groups (i.e., to determine if the relationship between smoking rate or FTND and craving or affect differed by group).

Craving—There were no moderation effects of FTND on craving. However, smoking rate significantly moderated the effect of group (i.e., slopes for acceptance and suppression differed) on craving, $t(153) = 2.24, p = .03$. To determine the nature of this effect, a scatterplot with cigarettes per day on the x axis and QSU-4 (adjusted for time 1) on the y axis with the best-fitting line shown for each group was examined visually. Partially consistent with prediction, the lines indicated a positive relationship between smoking rate and QSU-4 in the suppression group, but no relationship in the acceptance group.

Affect—FTND moderated the effect of group on positive affect (PA) [$t(153) = -2.36, p = .02$] and negative affect (NA) [$t(154) = 2.95, p = .004$], and smoking rate also moderated the effect of group on NA [$t(154) = 2.12, p = .04$]. Best-fitting lines revealed a positive relationship between NA and smoking rate, and between NA and FTND, in the acceptance group, but no relationship in the suppression group. Furthermore, acceptance appeared to convey greater benefit than suppression (i.e., was associated with less NA) for lighter, less dependent smokers, but not for heavier, more dependent smokers. For PA, the scatterplot suggested no relationship between FTND and PA in the acceptance group, but a negative relationship in the suppression group. Additionally, suppression appeared to convey less benefit (i.e., was associated with lower PA) in more dependent smokers only.

Discussion

The primary goal of the current study was to compare the use of acceptance-based coping associated with Acceptance and Commitment Therapy (ACT) (Hayes et al., 2006) to suppression, an intuitive, commonly used coping strategy proscribed by ACT, for cigarette craving. Laboratory results indicated that as compared to a control group not given any coping instructions, both acceptance- and suppression-based coping were associated with some benefit with respect to craving intensity and affect. Although the suppression group was somewhat successful in suppressing thoughts of smoking, this did not leave them differentially depleted in self-control relative to the other groups. Also, neither coping group experienced rebound effects when coping was discontinued. Exploratory moderation analyses suggested that the effects of acceptance- and suppression-based coping on craving and affect may vary according to smoking rate and level of nicotine dependence. For example, the expected positive association between smoking rate and craving intensity in the suppression group was not evident in the acceptance group. At 3-day follow-up, the coping groups reported greater self-efficacy for avoiding smoking compared to the control group, but did not differ from each other, and there were no group differences in smoking frequency. However, the suppression group reported that they spent proportionally less time suppressing during follow-up than during the laboratory session, whereas the acceptance group's self-reported proportion of time spent engaging in acceptance-based coping was similar in both the laboratory and during follow-up. This result is consistent with theory and previous research that suggests suppression may be difficult to sustain over long-term periods. As a whole, the results of the current study suggest that, at least in the short-term, acceptance-based coping has some benefit for smokers who desire to quit. However, the theorized superiority of acceptance over suppression was not clearly supported.

Dunn, Billotti, Murphy, and Dalgleish (2009) note that although the current clinical “zeitgeist” favors acceptance-based coping, empirical findings on thought suppression and rebound effects are mixed. For example, a clear advantage for acceptance-based coping has not been found in laboratory studies investigating depression (Liverant, Brown, Barlow, & Roemer, 2008), felt emotion in a non-clinical population (Dunn, Billotti, Murphy, & Dalgleish, 2009), or increasing distress tolerance in smokers (Murray, 2007). Additionally, as previously mentioned, Rogojanski et al. (2011a) found no differences between acceptance and suppression-based coping with regard to smoking behavior or self-efficacy at a 7-day follow-up. However, the degree to which these laboratory findings generalize to clinical contexts with treatment-seeking individuals is not yet known. Additional research should evaluate the relationship between laboratory performance and treatment outcomes in treatment-seeking individuals.

Research suggests that willingness and capacity to exert self-control (i.e., to suppress) and resist depletion depends on practice (e.g., Muraven, 2010a; Muraven, 2010b) and motivation (Muraven & Slessareva, 2003). Given that all participants in the current study had tried to quit before, they were likely somewhat practiced in suppression of smoking thoughts. They were also likely to be at least somewhat motivated to learn and use coping strategies, as they intended to quit within six months. Therefore, the duration of suppression in the laboratory may have been too brief to produce depletion. However, our finding that the suppression group was more likely than the other groups to report that they coped with craving during follow-up by eating suggests that some depletion may have occurred during this longer period of suppression.

Our moderation analyses, which must be interpreted with caution, suggested that the effects of acceptance and suppression may vary by smoking rate and severity of nicotine dependence. If we assume that smoking rate and dependence capture variability in susceptibility to craving, our findings are somewhat consistent with Forman et al. (2007). More specifically, it appeared as though lighter and/or less dependent smokers derived greater benefit with regard to reducing craving from suppression relative to acceptance, but at the cost of greater negative affect. Perhaps because they likely experience fewer smoking-related intrusive thoughts and feelings, suppression is easier for lighter, less dependent smokers, but such successful suppression comes at the cost of increased negative affect (Marcks & Woods, 2005). It is also possible that additional, unmeasured, individual differences are exerting other moderating effects (Rogojanski, Vettese, & Antony, 2011b; Russell & Grealy, 2010).

Limitations

We must acknowledge several limitations of the current study. First, although our participants intended to quit within six months, most were not seeking treatment immediately, which may have limited their motivation to learn and use coping strategies (Perkins et al., 2008). Relatedly, while our procedures have been used in many previous studies, including studies with clinical populations or intended to have clinical relevance (Abramowitz et al., 2001; Muraven & Schmeuli, 2006), the clinical validity of the procedure we used to assess rebound is unknown and more research is needed to determine the

relevance of these paradigms to clinical contexts. Second, many of our measures were self-report, which are subject to demand, expectancy, and reactivity effects. For example, we cannot rule out the possibility that our manipulation check results are attributable to demand effects rather than actual differences in cognitive processes. Third, although we adapted scripts used successfully in previous studies (Forman et al., 2007; Levitt et al., 2004), the high failure for the acceptance quiz suggests that our script may not have fully captured the richness of ACT nor produced competence in implementing acceptance, which was a more novel strategy than suppression. However, results did not differ when analyses were limited to those who passed the quiz, and those who failed it received further instruction. We suspect that the failure rate on the acceptance quiz may reflect the difficulty of the quiz at least as much as participants' comprehension of the training. Fourth, we chose a follow-up period of 3 days to minimize participant burden and maximize retention, but longer follow-up periods may be necessary to detect effects (Bowen & Marlatt, 2009). Finally, our attrition rate at follow-up was 30%, a somewhat higher rate than the 10-20% in previous studies (Bowen & Marlatt, 2009; Rogojanski et al., 2011a). We did not send additional reminders beyond 3 days given the time-sensitive nature of the follow-up data. We attribute our attrition rate to the low compensation offered (\$5) relative to the effort involved, and a less personal assessment modality (online or mail) compared to the phone or face-to-face interviews used in the other studies.

Conclusion

The results of the current study lend additional legitimacy to acceptance as an alternative coping strategy, but suggest that more research is needed to differentiate the benefits of acceptance compared to suppression-based coping. We emphasize that this study was *not* a test of the complete ACT treatment, but rather evaluated a coping style advocated within ACT that is a theorized mechanism of action. Future research may benefit from longer, more intensive instructions and use of treatment-seeking participants. More generally, the current study addresses a primary criticism of the empirically-supported treatment (EST) movement—that it focuses on treatment *outcomes* at the expense of research on treatment *processes* (Orford, 2008). Nevertheless, the study also exemplifies the challenges and limitations associated with experimental research on treatment processes.

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Table 1

Covariate-Adjusted Means and Standard Errors for Primary Analyses

Outcome	Acceptance	Suppression	Control
Craving (Time 2)			
Single-item (0-100) ^{a,b}	64.35 (3.02)	66.99 (3.02)	77.31 (3.02)
QSU-4 ^b	21.91 (.73)	19.85 (.73)	24.05 (.74)
Magnitude Estimation ^{*a,b}	14.02 (10.95)	12.34 (9.04)	21.76 (17.34)
Affect (Time 2)			
Positive Affect ^b	12.59 (.41)	12.67 (.41)	11.26 (.42)
Negative Affect ^a	10.03 (.56)	11.22 (.56)	12.39 (.56)
Thoughts about smoking (Time 2) ^{**b,c}	5.72 (.80)	3.40 (.80)	8.90 (.80)
Thoughts about smoking (Time 3) ^{**}	10.06 (2.08)	9.04 (2.09)	5.87 (2.07)
Behavioral choice (\$) (Time 3) [*]	7.22 (9.00)	8.69 (9.91)	9.22 (10.34)
Latency to smoke (minutes) [*]	28.11 (50.79)	23.58 (34.92)	28.17 (61.10)
Total cigarettes smoked (3 days)	39.03 (2.82)	41.49 (2.70)	39.33 (2.84)
Self-Efficacy			
One-year confidence (0-100) ^b	45.06 (4.54)	53.23 (4.46)	36.21 (4.35)
Habitual/Craving Situations ^{a,b}	19.85 (.74)	19.65 (.75)	16.87 (.75)
Positive Affect/Social Situations	16.92 (.69)	16.37 (.73)	15.34 (.69)
Negative Affect Situations	12.62 (.69)	13.31 (.69)	11.61 (.70)

Note: QSU-4 = Questionnaire of Smoking Urges-4.

* Not covariate-adjusted; no baseline value (standard deviation in parentheses).

** Thoughts data were log transformed for analysis but untransformed covariate-adjusted means are shown.

^a Significant difference between acceptance and control, $p = .05$.

^b Significant difference between suppression and control, $p = .05$.

^c Significant difference between acceptance and suppression, $p = .05$.