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## Suppression on Your Own Terms: Internally Generated Displays of Craving Suppression Predict Rebound Effects

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### Abstract

Research on emotion suppression has shown a rebound effect, in which expression of the targeted emotion increases following a suppression attempt. In prior investigations, participants have been explicitly instructed to suppress their responses, which has drawn the act of suppression into metaconsciousness. Yet emerging research emphasizes the importance of nonconscious approaches to emotion regulation. This study is the first in which a craving rebound effect was evaluated without simultaneously raising awareness about suppression. We aimed to link spontaneously occurring attempts to suppress cigarette craving to increased smoking motivation assessed immediately thereafter. Smokers ( $n = 66$ ) received a robust cued smoking-craving manipulation while their facial responses were videotaped and coded using the Facial Action Coding System. Following smoking-cue exposure, participants completed a behavioral choice task previously found to index smoking motivation. Participants evincing suppression-related facial expressions during cue exposure subsequently valued smoking more than did those not displaying these expressions, which suggests that internally generated suppression can exert powerful rebound effects.

### Keywords

suppression; emotion regulation; craving; facial expression; consciousness; drug/substance abuse; emotional control; emotions

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Understanding the role of suppression in emotion regulation has been of great interest to psychological theorists dating back to Freud. Contemporary researchers characterize suppression as attempting to temporarily prevent an experience from entering conscious thought (Wegner, 1994). In addition to illuminating basic features of motivation and cognition, research has identified numerous maladaptive consequences of suppression (John & Gross, 2004; Wegner, 2009).

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In nearly all research on emotion suppression, one of two study designs is employed; both designs suggest that suppression can be problematic. The first design draws associations between a self-reported tendency toward suppression and a range of outcome variables. For instance, this research shows that higher scores on suppression scales (indicative of more frequent thought suppression) are related to both experiencing and expressing less positive emotion and more negative emotion (Gross & John, 2003; Wegner & Zanakos, 1994), including increased frequency of suicide attempts (Najmi, Wegner, & Nock, 2007). Suppressors also report lower levels of life satisfaction, well-being, and self-esteem than nonsuppressors do (Sheldon, Ryan, Rawsthorne, & Ilardi, 1997).

In the second design, suppression is experimentally manipulated by instructing participants to suppress an emotional experience in the lab. Instructed suppression does not appear to effectively limit experience of the suppressed content while it is being suppressed. For example, while suppressing strong emotions, individuals showed electrodermal reactivity just as strongly as did people instructed to think about those thoughts (Gross, 1998; Wegner, Shortt, Blake, & Page, 1990). Indeed, some thought-suppression studies report immediate exacerbation effects, which suggests that craving suppression might elevate cravings (Salkovskis & Campbell, 1994; Wenzlaff & Wegner, 2000). Moreover, this research also reveals that suppressing a thought can lead to a subsequent increase (rebound) in the frequency of thinking about the previously suppressed thought (Wegner, Schneider, Carter, & White, 1987). This rebound phenomenon also pertains to suppression of emotion: Attempts to suppress emotions yield stronger subsequent responses to those emotions compared with when those emotions are not suppressed (Cioffi & Holloway, 1993; Pennebaker & Chew, 1985; Wegner & Gold, 1995).

One important research target for studying emotion suppression has been cigarette craving. Correlational studies indicate that suppression, compared with nonsuppression, is related to a longer smoking history and greater attentional bias to smoking cues (Fucito, Juliano, & Toll, 2010). Data also suggest that smokers frequently experience intrusive thoughts about smoking (especially when experiencing cravings), and in one study, all participants reported having tried to suppress these thoughts (Salkovskis & Reynolds, 1994). Experimental work has found that smokers told to suppress smoking-related thoughts for a week reported smoking more cigarettes in the following week than did both participants who expressed smoking thoughts and control subjects (Erskine, Georgiou, & Kvavilashvili, 2010), though subsequent work did not find that instructions to suppress smoking thoughts affected self-reported smoking desire (Erskine et al., 2012). In sum, past studies generally provide evidence for a smoking rebound following suppression.

The emerging literature on emotion suppression, including research on suppression of craving, documents rebound effects following suppression and holds promise for advancing understanding of emotion regulation. Nevertheless, this research has encountered two related methodological obstacles that have yet to be addressed. First, motivation to attempt suppression has been generated by experimenter instruction (though for a less direct approach, see Macrae, Bodenhausen, Milne, & Jetten, 1994). Participants are told, for example, to suppress thoughts of craving while viewing provocative images regardless of what they would normally do in that situation. This approach deemphasizes the role of

intrinsic motivation in suppression. Does one suppress emotions differently when one wants to suppress an uncomfortable experience compared with when one is told to suppress that experience irrespective of the motivation to do so? Second, explicitly instructing participants to suppress their emotions necessarily raises awareness that they are engaging in an effort to suppress them. These instructions shift the suppression attempt from experiential consciousness to metaconsciousness (see Schooler et al., 2011). This shift in consciousness induces self-monitoring, which is known to alter the behavior being monitored (Perlmutter, Noblin, & Hakami, 1983). Moreover, recent reviews indicate that a number of self-regulatory processes operate independently of conscious control (see Bargh & Williams, 2007).

In the current study, we aimed to evaluate naturally occurring (internally generated) efforts to suppress cravings without explicitly instructing participants to suppress them. We instructed nicotine-deprived heavy smokers to hold and look at a lit cigarette of their preferred brand without smoking it in order to create experimental conditions that would elicit efforts to suppress cigarette cravings. In addition, we sought to assess craving suppression unobtrusively so that the experience would not leak into metaconsciousness. To this end, we coded facial movements thought to be associated with suppression using the *Facial Action Coding System* (FACS; Ekman, Friesen, & Hagar, 2002). FACS is an anatomically based system derived from more than 7,000 muscle movements decomposed into action units (AUs) that describe all visible facial movements on a frame-by-frame basis. FACS, the most comprehensive facial coding system, provides unobtrusive assessment of facial expressions in real time. The faces of these heavy smokers while holding the cigarette were coded for suppression expressions to assess the relationship between internally motivated suppression and smoking motivation during and shortly after the attempt. Smoking motivation was assessed concurrently with facial coding of suppression using a measure of self-reported urge to smoke.

To assess potential rebound effects subsequent to suppression, we examined the monetary value that smokers placed on smoking using a behavioral choice measure we have used in prior studies (e.g., Sayette, Loewenstein, Griffin, & Black, 2008). Given prior contradictory findings, we made no prediction regarding the link between facial expressions thought to relate to suppressed emotion and cravings concurrent with the suppression displays. Most pertinent to the study, we hypothesized a rebound effect, such that participants expressing signs of suppressed emotion would subsequently value smoking a cigarette more than would individuals who did not register these facial movements.

## Method

### Participants

Sixty-six (male = 38, female = 28; age range = 21–35 years) nicotine-deprived heavy smokers not currently interested in quitting were recruited through advertisements in newspapers and radio programs as part of a larger study of heavy and light smokers (Sayette et al., 2003). These participants were from the two experimental groups in the parent study that experienced the strongest cravings to smoke. Participants in these conditions had to report smoking an average of 21 or more cigarettes per day for at least 24 continuous

months. To confirm abstinence, we required that smokers have carbon monoxide (CO) levels that did not exceed 16 ppm ( $M = 9.37$ ,  $SD = 4.18$ ). These participants were told they either would be able to smoke (nonsuppression group) or would not be able to smoke (suppression group) during the 2-hr experiment. The two groups did not differ in ethnic distribution, age, years of formal education, years of smoking, cigarettes smoked per day, and prior attempts to quit ( $ps > .21$ ). Because the two groups did not differ on these demographic variables or on the self-reported urge-to-smoke measure, the groups were combined in our analyses.

## Procedure

Eligible smokers attended a 2-hr laboratory session. They were instructed to refrain from smoking for at least 7 hr before the session and were told that breath samples would test whether they had abstained. Participants underwent a smoking-cue-exposure manipulation while seated in a comfortable chair behind a desk that faced a video camera. Participants were told that the camera and intercom facilitated communication and helped the investigator determine from a separate room whether instructions were understood throughout the study.

To confirm abstinence, we asked participants to report the last time they smoked, and we recorded their CO level. Participants next completed a baseline assessment, which included a rating of their urge to smoke. During cue exposure, participants were presented with a covered tray. They lifted the cover when instructed, revealing their pack of cigarettes, an ashtray, and a lighter. They removed one cigarette from the pack and lit it without putting it in their mouths. They then held the lit cigarette and looked at it. After 31 s, they rated their urge to smoke. They also completed a measure in which they estimated the magnitude of their urge to smoke (Sayette et al., 2000) relative to baseline levels (see the Supplemental Material available online).

Following cue exposure, all participants completed a behavioral choice task. Next, participants were told that they did not actually need to wait 5 min to smoke and could smoke at that time. Finally, participants completed a postexperimental form, were debriefed, and were paid \$45.

## Facial coding

For the present study, facial expressions during key intervals were coded by a FACS-certified coder (W. M. S.) during the 30 s of the smoking-cue exposure when participants held the lit cigarette. Particular AUs and AU combinations were classified as evincing efforts to suppress cravings (described hereafter as “suppression AUs”). On the basis of prior theory, we used AUs involving dampening and compression of the lips and tension in and around the lips to indicate suppression (e.g., Ekman, 1992, p. 124; C. M. Malatesta & Izard, 1984). AU 23 (lip tightener), AU 24 (lip pressor), AU 28 (lip suck), or AU 14 (dimpler) expressed by itself or in combination with any other AU represented an attempt at suppression (see Fig. 1). These movements have previously been linked to emotion suppression (e.g., Girard et al., in press; C. Z. Malatesta, Culver, Tesman, & Shepard, 1989; C. M. Malatesta, Jonas, Shepard, & Culver, 1992; Reed, Sayette, & Cohn, 2007). The Kappa

coefficient for the suppression AUs (.82) suggests that these expressions were coded reliably.

### Motivation to smoke

Participants who manifested AUs related to suppression during cigarette-cue exposure were compared with participants who did not on two measures indexing motivation to smoke.

**Behavioral choice task**—Participants chose between immediate access to a cigarette and delayed access with financial compensation. The amount of money required to delay smoking for an additional 5 min following cue exposure was predicted using the presence or absence of suppression AUs. A high monetary value was interpreted as strong motivation to smoke (Griffiths, Troisi, Silverman, & Mumford, 1993; Perkins, Epstein, Grobe, & Fonte, 1994). Because participants believed that their choice would result in actual monetary consequences and the desired behavior was immediately accessible, they were likely motivated to give a relatively accurate and thoughtful response (Sayette et al., 2008). Participants indicated the least amount of money they would accept to postpone smoking for 5 min. They also were informed that the experimenter had previously recorded an amount of money that represented the maximum that the laboratory would be willing to pay the participant for delaying smoking. If the value set by the participant were less than this previously set but undisclosed amount, they were told they would receive the amount they requested in return for delaying smoking. This monetary reward was included to bolster their belief that their responses would have real consequences and to encourage participants to report the smallest acceptable amount of money they required to delay smoking. The critical variable was the minimum amount of money they required to postpone smoking for 5 min (see Sayette et al., 2008, for details). Values were square-root-transformed to address a positive skew.

**Self-reported urge to smoke**—For both the present study and the larger study (Sayette et al., 2003), the critical urge rating was a composite score. This rating was the product of an absolute urge at baseline and the magnitude-estimation urge during cue exposure. The baseline urge was rated on a scale ranging from 0, *none at all*, to 100, *strongest urge I've ever had*. The magnitude-estimation urge was used to compare the current urge proportionately with the baseline urge, which was standardized to be a 10 (e.g., if craving doubled from baseline to cue exposure, they would report an urge of 20). This composite urge score addressed concerns with ceiling effects often found among nicotine-deprived heavy smokers (see Sayette et al., 2000, and the Supplemental Material). Composite urge scores were square-root-transformed to address a positive skew (see Sayette, Cohn, Wertz, Perrott, & Parrott, 2001).

## Results

### Characteristics of suppression AUs

A majority of participants ( $n = 41$ ) evinced at least one of the suppression-related AUs during the craving induction; therefore, these participants were grouped together as suppressors. Null regression coefficients in linear regression equations verified that

perceived smoking availability was unrelated to suppression-related AUs, behavioral choice, and composite urge score.

### Primary analyses

We used a pair of regression models to examine the association between occurrence of suppression AUs and the two measures of smoking motivation (composite urge score and behavioral choice). A dummy code categorized suppression AUs as present or absent. The regression model using suppression AUs to predict composite urge score during cue exposure did not reach significance ( $p = .52$ ), as both suppressors and nonsuppressors reported similar urges. Most pertinent to the present study and consistent with the rebound hypothesis, there was a significant link between suppression AU occurrence and smoking valuation on the behavioral choice task following cue exposure ( $R^2 = .086$ ,  $p = .017$ ). Participants evincing suppression-related AUs required twice as much money to further delay smoking by 5 min compared with participants who did not evince these AUs (see Fig. 2).

To examine the specificity of the observed association between suppression AUs and smoking valuation on the behavioral choice task, we also tested for relationships between performance on the behavioral choice task and a range of demographic and smoking-related variables in our data set: age, gender, years of smoking, cigarettes smoked per day, nicotine dependence (as indexed by time to first cigarette after waking), and desire to quit. Only dependence and cigarettes smoked per day were associated with smoking valuation. When controlling for these two variables, we found that the link between suppression AUs and smoking valuation remained significant ( $\beta = 0.27$ ,  $p < .02$ ; for additional details on these analyses, see the Supplemental Material).

### Discussion

In prior research on potential rebound effects associated with emotion suppression, participants have been instructed to suppress their experience, which may diverge from typical experiences when individuals suppress emotions of their own accord. In the present study, we found that participants spontaneously displaying facial movements thought to relate to suppression revealed a postsuppression rebound effect. Following the craving induction, suppressors needed twice as much money to further delay smoking as did those who did not express these AUs. These data reveal a significant increase in smoking motivation following a peak craving experience during which smokers expressed suppression AUs. Confidence in this finding is enhanced, as our behavioral choice task previously has proven to be our most sensitive measure of smoking motivation (e.g., Sayette et al., 2008; Sayette et al., 2003; see also Read & Loewenstein, 1999). This association—captured using a relatively unobtrusive facial coding system—also is notable, as presumably the attempts to suppress cravings were internally motivated. That is, these nicotine-deprived heavy smokers were never instructed to suppress their craving. Finally, this finding was not explained by other smoking-related or demographic variables.

Although a rebound effect with the behavioral choice task emerged after cue exposure, suppression AUs were unrelated to reported smoking motivation during cue exposure. These

data are consistent with past research also failing to link suppression to reduced concurrent experience of the suppressed content (e.g., Gross, 1998; Wegner et al., 1990). Although the time between the self-reported concurrent urge and the postsuppression behavioral choice task was fairly brief, we believe sufficient time had elapsed to allow for meaningful observations. One change between the two time intervals was the degree of control participants had over their smoking. During the concurrent smoking-urge assessment, smoking was prohibited (to facilitate suppression), whereas during the subsequent behavioral choice task, participants could smoke if they chose. (Fifty-two smokers expressed such an interest.) Further research is necessary to evaluate more precisely the time period (and other factors) most sensitive to rebound effects.

Although our findings are consistent with the position that the selected AUs indexed emotion suppression, the target of the suppression remains unclear. That is, being asked to suppress an act can result in similar rebound effects as not thinking of something (Polivy, Coleman, & Herman, 2005). Accordingly, these AUs may index effort to suppress the affect and cognitions associated with craving, or they may reflect difficulty suppressing the act of not smoking, or both. We speculate that the putative effort to suppress cravings observed in this study may reflect a multidimensional experience composed of cognitive, emotional, and behavioral elements. Such an approach is in accord with a model of craving in which procedural actions, as well as affective and cognitive information related to smoking, are accessed in parallel as part of an associated propositional network (Baker, Morse, & Sherman, 1987).

More generally, whereas displays of the selected facial expressions predicted enhanced smoking motivation, we stop short of arguing that there is perfect correspondence between our selected “suppression” AUs and the experience of suppression. As attractive as it is to assume that any expression can invariably reflect a specific underlying affective state, recent work suggests that expressions are best interpreted in context (see Barrett, Mesquita, & Gendron, 2011). We believe that in the present study, we created an ideal context for observing suppression, which increases our confidence that the selected expressions we observed while nicotine-deprived heavy smokers held a lit cigarette reflected suppression. In future studies, researchers might consider using a cued-review approach, in which smokers subsequently review their videos to report their prior affective experience. Although such a procedure has worked for other emotion studies (e.g., Rosenberg & Ekman, 1994), admittedly it remains unclear how well participants can recognize this suppression experience even with the benefit of video.

Related to this last point, we also cannot rule out that suppression expressions reflect an emotional state that has not reached metaawareness (Schooler et al., 2011). At this juncture, we are unaware of existing data to indicate whether any facial expression or emotion relationship can definitively discriminate between the presence of that emotional experience (or, in this case, emotion suppression) and the level of awareness of that experience. Future research is necessary to tackle this issue more directly, perhaps by focusing on the intensity or duration of the facial expression and employing real-time prompts (see Schooler et al., 2011). For instance, do briefer, less intense facial expressions of suppression, or any other emotional state, suggest that the experience has failed to reach metaconsciousness?

To our knowledge, this is the first study (though see Macrae et al., 1994) to evaluate naturally occurring craving suppression (indeed, the term “suppression” was never mentioned to participants), which reveals that such internally generated experiences predict subsequent motivation to smoke. These correlational data converge with prior experimental research that manipulated suppression to suggest that individuals who, for whatever reason, try to suppress their urges are likely to experience rebound effects. More generally, these data suggest a new direction for studying emotion suppression, in which suppression of affective experience is monitored without explicitly manipulating it or drawing the realization that one is suppressing emotion into metaconsciousness.

Using FACS, which though labor intensive is the most sophisticated system for coding visible facial movements, in tandem with an experimental approach likely to generate spontaneous and meaningful attempts at suppression (nicotine-deprived heavy smokers holding a lit cigarette without smoking) offers promise for observing internally generated “natural” displays of emotion suppression. Such an approach could be readily adapted to the study of a broad range of behaviors associated with emotion-regulation failure, including eating, gambling, and mood disorders. Conceptually, this research offers a new perspective in the emerging literature focused on nonconscious emotion regulation (see Bargh & Williams, 2007).

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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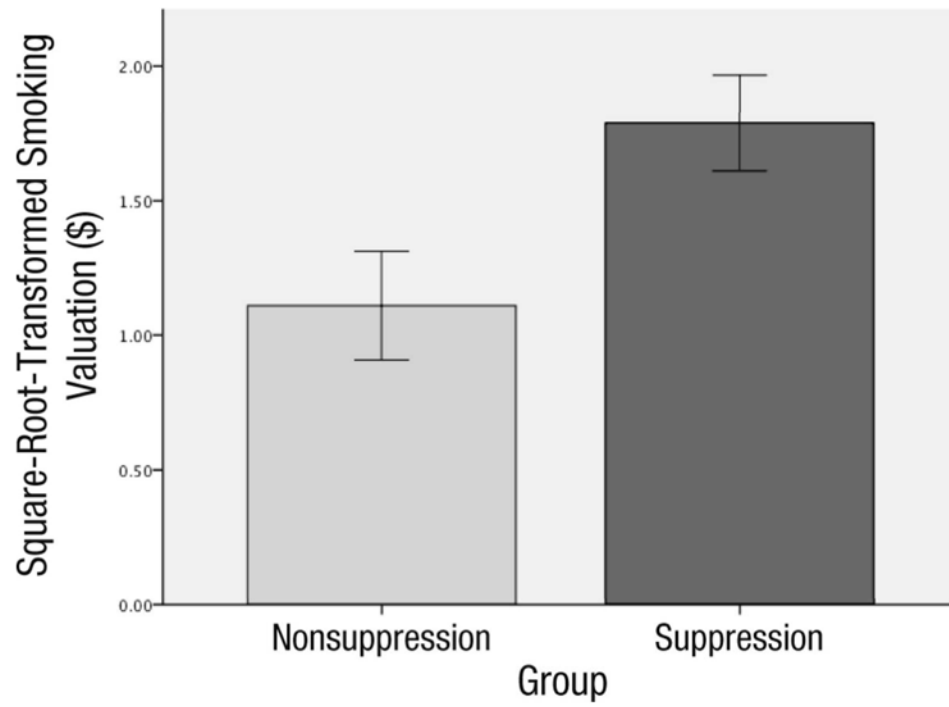
**Fig. 1.** Screenshot of a participant in the present study expressing a suppression-related facial movement.

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**Fig. 2.** Amount of money participants required to further delay smoking by 5 min as a function of group. Monetary values are square-root-transformed. Error bars show  $\pm 1 SE$ .