



## Cue-induced cigarette craving and mixed emotions: A role for positive affect in the craving process

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### HIGHLIGHTS

- ▶ Simultaneous positive and negative affect reported in response to cues
- ▶ Cigarette cues associated with higher mixed emotion than other cue types
- ▶ Pleasant cues elicit higher craving than neutral or unpleasant cues
- ▶ Mixed emotions to cigarette cues predict self-reported craving
- ▶ Results suggest a role for positive affect in the cue-reactivity craving process

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### ABSTRACT

Craving is an important component of nicotine addiction, and extant research has demonstrated a clear link between cue-induced craving and negative affect, with mixed results in the positive affect domain. The current study was designed to test the idea that cue-reactive craving might be associated with a mixed emotional process, or the simultaneous experience of positive and negative affect. Participants were 86 non-deprived regular smokers and tobacco chippers who provided simultaneous ratings of positive and negative affect during cue exposure to pleasant, unpleasant, neutral and cigarette cues. Results indicated that self-reported craving was elevated in response to cigarette cues compared to other valenced cue types and craving was higher to pleasant cues than either neutral or unpleasant cues. Mixed emotional responses were higher to cigarette cues than other cue types. In addition, mixed emotional responses to cigarette cues predicted craving even after controlling for smoker type, difficulties regulating negative emotion, baseline craving level and mixed emotional responses to neutral cues. As the first study to investigate mixed emotions and cigarette craving, our results highlight the importance of examining the relationship between cue-reactive craving and emotional response using models of emotion that allow for measurement of nuanced emotional experience. In addition, our findings suggest that positive affect processes may indeed play a role in craving among non-deprived smokers.

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### 1. Introduction

Craving for cigarettes, whether induced by withdrawal or in response to cues, has been clearly linked to affective processes (Tiffany, 2009). In the realm of cue-reactivity, a robust relationship has been demonstrated between negative affect and craving (Brandon, Wetter, & Baker, 1996; Carter & Tiffany, 2001; Drobles & Tiffany, 1997; Maude-Griffin & Tiffany, 1996; Taylor, Harris, Singleton, Moolchan, & Heishman, 2000). Despite these findings, the precise nature of the

relationship between craving and affect remains uncertain. Further examination of the affective processes associated with cue response may prove important, particularly if affective responses contribute to self-reported craving and/or behavioral outcomes.

#### 1.1. Craving and negative affect

The relationship between cue-reactive craving and negative affect is clearly established in the literature. A host of evidence suggests that negative affect manipulations, even without the addition of smoking cues, prompt increased craving levels (Maude-Griffin & Tiffany, 1996; Taylor et al., 2000). Negative affect predicts craving when measured prospectively (Brandon et al., 1996; Drobles & Tiffany, 1997), and negative states show robust correlations with craving (Carter & Tiffany, 2001; Lee et al., 2007; Singleton, Anderson, & Heishman,

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2003). Moreover, presentation of smoking cues tends to increase negative affect more than presentation of neutral cues (Conklin, Perkins, Robin, McClernon, & Salkeld, 2010; Doran, Cook, McChargue, Myers, & Spring, 2008).

### 1.2. Craving and positive affect

At first blush, it appears that positive affect typically either has no correlation to smoking urge (e.g. Drobles & Tiffany, 1997; Kassel et al., 2007), or is associated with decreased urge (Bailey, Goedeker, & Tiffany, 2010; Maude-Griffin & Tiffany, 1996; Taylor et al., 2000; Tiffany, 2009).

Theoretically, however, positive affect has been linked to urge. A recent model of impulsivity suggested that certain individuals are likely to act rashly (e.g. succumb to urges) when in a positive mood (Cyders & Smith, 2008; Cyders et al., 2007). In addition, Baker and colleagues (Baker, Morse, & Sherman, 1987) proposed a craving model with two separate urge pathways such that a positive-affect urge network may be activated by appetitive stimuli, particularly for non-deprived smokers. As an example, in a study comparing deprived and continuing smokers on craving and affect ratings over a 24-hour period, Zinser and colleagues (Zinser, Baker, Sherman, & Cannon, 1992) found a significant positive relationship between positive affect and craving for continuing smokers, whereas deprived smokers expressed concordant negative affect and craving (however, see Brandon et al., 1996 for contradictory findings).

Several of the studies that found a negative relationship between positive affect and craving have investigated the effect of positive mood, typically induced in a laboratory setting, on subsequent cue-reactive craving (Maude-Griffin & Tiffany, 1996; Taylor et al., 2000). Whether mood state influences reaction to cues is a different, albeit related, question than whether self-reported craving increases in response to valenced cues or if changes in affect follow from presentation of cigarette cues. Self-reported craving in response to valenced cues has received limited empirical attention in the realm of cue-reactivity, as the typical cue-reactivity study compares craving responses to cigarette cues with craving responses to neutral cues (Carter & Tiffany, 1999). However, recent work comparing craving responses to a full set of valenced cues (e.g., including both pleasant and unpleasant cue stimuli) found heightened craving in response to positive cues when compared to negative and neutral cues (Muñoz et al., 2010; Robinson et al., 2011). Moreover, in the realm of psychophysiology, startle eyeblink responses (where heightened responses are indicative of negative affect) are dampened to both cigarette and pleasant cues (Cui et al., 2012; Dempsey, Cohen, Hobson, & Randall, 2007). Overall, these studies suggest that smoking cues are appetitive.

Other recent work has examined changes in affect following the presentation of cigarette cues, with mixed results. One study found that generalized positive affect decreased and negative affect increased in response to cigarette cue exposure (Doran et al., 2008). Another study found that smoking cues are associated with higher excitement (a specific positive feeling), when compared to non-smoking cues (Conklin et al., 2010). A third recent study examining self-reported mood in response to valenced and cigarette cues found that positive mood was higher to cigarette and positive cues compared to neutral and unpleasant cues (Robinson et al., 2011). In sum, although there is burgeoning evidence that smoking cues are appetitive, and theoretical frameworks proposing a link between positive affect and craving, the remaining empirical research on the relation between positive affect and craving is mixed. Considering that a synonym often used for craving is “desire,” which has a positive connotation, the mixed evidence is an apparent conundrum. Research focused on positive affect and craving may benefit from considering alternative approaches and methodologies to determine if, when, and for whom positive affect relates to craving.

### 1.3. Comparing positive and negative affect

An additional piece of the puzzle is that positive and negative affect are rarely compared to one another. For example, in a study comparing affective responses to cues, positive affect was lower in response to an imagery exposure with urge content compared to an imagery script with neutral content (Drobles & Tiffany, 1997). However, ratings of positive affect across the entire study were considerably higher than ratings of negative affect, a point not raised by the authors, as they focused on comparisons of smoking to neutral cues rather than comparisons of negative and positive affect.

Examining changes in emotional response to cues is important, but comparison of levels of negative and positive affect may provide different—and potentially equally important—information. For example, Sayette and Hufford (1995) found that participants manifested more positively valenced facial expressions than negative during initial cue exposure, and that more positive urge characteristics were self-generated during cigarette cue exposure compared to neutral cues, a relationship not found for negative urge characteristics (Sayette & Hufford, 1997). This study suggests that comparison of negative and positive affect might highlight the role of positive affect in cue-reactivity which is often obscured in other study designs. Moreover, a comparison of emotional responses may elucidate the relative contributions of positive and negative affect, both together and separately, on craving responses.

### 1.4. Mixed emotions

Highlighting the role of positive affect in cue-reactivity is only important if positive affect influences craving and/or behavior. Considering the robust relationship between craving and negative affect, it may be that “pure” positive affect has little role in the craving process. However, there may be benefit in modeling simultaneous positive and negative affect, dubbed “mixed emotions” (Larsen & McGraw, 2011; Larsen, McGraw, & Cacioppo, 2001; Larsen, McGraw, Mellers, & Cacioppo, 2004; Larsen & Stastny, 2011). In basic emotion research, Larsen and colleagues have demonstrated that many people experience heightened positive *and* negative affect when confronted with a film that is both funny and tragic; when experiencing the celebration and fear associated with graduating from college; or when reacting to disappointing wins and relieving losses (Larsen, Norris, McGraw, Hawkey, & Cacioppo, 2009; Larsen et al., 2001; Larsen et al., 2004).

The concept of mixed emotions calls into question the assumption that positive and negative affect must be mutually exclusive, an assumption that is common in basic emotion research (e.g., Russell, 2003) as well as implicitly endorsed in many of the cue-reactivity studies reviewed above. If negative affect and positive affect are opposites, and mutually exclusive, when negative affect goes up, positive affect must, by definition, go down. However, if positive and negative affect are independent *and* modeled simultaneously, we can establish if cues elicit relatively pure emotional responses or if cue-reactivity may be associated with a mixed emotional response.

The idea that craving might involve both positive and negative affect processes is certainly not new (Baker et al., 1987; Breiner, Stritzke, & Lang, 1999; Kavanagh, Andrade, & May, 2005). However, to our knowledge, the association between craving and mixed emotion has not been explicitly tested. Nonetheless, several studies have yielded findings consistent with a mixed emotional perspective. Taylor et al. (2000) created a variety of imagery scripts that differed in valence and smoking urge, and examined how the scripts influenced positive affect, negative affect and craving. For positively valenced scripts, the inclusion of urge-related material decreased positive affect and increased negative affect compared to the no-urge scripts. However, for negatively valenced scripts, the inclusion of urge-related material resulted in lower negative affect and heightened positive affect compared to no-urge negative scripts. Thus, the addition of the urge component attenuated the effect of negative stimuli on self-reported

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