HHS Public Access

Author manuscript

Health Psychol. Author manuscript; available in PMC 2021 December 01.

Published in final edited form as:

Health Psychol. 2020 December ; 39(12): 1109–1124. doi:10.1037/hea0001019.

The role of incidental affective states in appetitive risk behavior: A meta-analysis

Rebecca A. Ferrer,
National Cancer Institute

Jennifer M. Taber,
Kent State University

Paschal Sheeran,
University of North Carolina, Chapel Hill

Angela D. Bryan,
University of Colorado, Boulder

Linda D. Cameron,
University of California, Merced

Ellen Peters,
University of Oregon

Jennifer S. Lerner,
Harvard University

Emily Grenen,
ICF

William M. P. Klein
National Cancer Institute

Abstract

Objective: Appetitive risk behaviors (ARB), including tobacco use, alcohol consumption, consumption of calorie dense/nutrient-poor foods, and sexual risk behavior, contribute substantially to morbidity and mortality. Affective states that arise from a wide array of unrelated circumstances (i.e., incidental affect) may carry over to influence ARB. A meta-analysis is needed to systematically examine causal evidence for the role of incidental affect (including specific emotions) in influencing ARB.

Methods: Integrating effect sizes from 91 published and unpublished experimental studies that include both an incidental-affect induction and neutral-control condition (k=271 effect sizes; k=183 negative affect, k=78 positive affect), this meta-analysis examines how negative and positive affective states influenced ARB and related health cognitions (e.g., intentions, evaluations, craving, perceived control).

Results: Negative affective states reliably increased ARB, both in analyses where all negative affective states were analyzed (d = .29), as well as in stratified analyses of just negative mood (d = .30) and stress (d = .48). These effects were stronger among study populations coded as clinically at risk. Positive affective states generally did not influence ARB or related health cognitions, except in the presence of a craving cue. Design issues of extant literature largely precluded conclusions about the effects of specific positive and negative affective states.

Conclusion: Taken together, findings suggest the importance of strategies to attenuate negative affect incidental to ARB in order to facilitate healthier behavioral patterns, especially among clinically at-risk individuals.

Keywords

incidental affect; incidental emotion; appetitive risk behavior; health risk behavior; meta-analysis

People often engage in hedonically pleasing but unhealthy behavior to fulfill appetitive/craving states. *Appetitive risk behaviors* (ARB), including tobacco use, alcohol consumption, consumption of calorie dense/nutrient poor foods, and sexual risk behavior, contribute substantially to disease-related morbidity and mortality (Azfar-e-Alam Siddiqi & Hall, 2016; Gomes et al., 2018; Kanny et al., 2015; Ma et al., 2018; Micha et al., 2017; Scaglione et al., 2015). Despite these significant health risks, engagement in ARB is prevalent (Duffey & Popkin, 2011; Han & Powell, 2013; SAMHSA, 2015; Wang et al., 2018).

Health behavior theory often examines ARB through a social cognitive lens, examining determinants such as risk perception, attitudes, social norms, and self-efficacy, which can together predict a moderate amount of variance in these behaviors (Albarracin et al., 2001; Hausenblas, Carron, & Mack, 1997; McEachan et al., 2011; Sheeran et al., 2016; Sheeran & Taylor, 1999). However, behavior may be less driven by these social cognitive determinants when people are in an emotional state, compared to a neutral state (Nordgren, van der Pligt, & van Harreveld, 2008). Despite this being the case, affect is relatively understudied in the health behavior change literature (Conner et al., 2011; Ellis et al., 2016; Ferrer & Mendes, 2018; Lawton et al., 2009; Williams & Evans, 2014; Williams et al., 2018). The current meta-analysis examines whether affective states that are incidental to, and not elicited by, the ARB in question influence such behaviors.

Here, the term “affective state” refers to an overarching category of experiences, including specific emotions (i.e., discrete categories of affective states that are relatively fleeting and attributable to a specific cause), moods (i.e., general positive or negative affective states that are more “free-floating” rather than directly attributable to one specific cause), and stress (i.e., the experience of negative affect and physiological arousal as the result of specific life experiences, often related to social evaluation or life adversity) (see Cowen & Keltner, 2017; Keltner & Lerner, 2010). The present meta-analysis focuses specifically on affect that is elicited by sources unrelated (i.e., incidental) to the ARB that may follow them (Harle & Sanfey, 2007; Lerner et al., 2015; Loewenstein & Lerner, 2003), because the majority of theories on affect and ARB have highlighted the importance of this type of affect as opposed to integral affect (i.e., affect that is elicited by the ARB itself). For example, positive affect

elicited by (i.e., *integral* to) hedonically pleasing food might increase consumption of that food; however, job-related stress that is not elicited by hedonically pleasing food (i.e., is *incidental* to it) may also increase consumption.

Several theoretical perspectives and a growing body of evidence suggest that incidental emotion may be a particularly robust predictor of ARB (Cohn et al., 2009; DeSteno, Gross, & Kubzansky, 2013; Ferrer, Green, & Barrett, 2015; Ferrer, Klein, Lerner, Reyna, & Keltner, 2016; Fredrickson & Joiner, 2002; Magnan, Shorey Fennell, & Brady, 2017). Negative affect in general could increase ARB through several pathways. First, negative affect may increase reward sensitivity, and make appetitive stimuli even more enticing than if one were in a neutral state (Wagner et al., 2012; Wagner & Heatherton, 2014). Second, people experiencing negative affect may wish to escape those feelings and prioritize temporary mood-repair goals over other, longer-term goals (Baumeister & Heatherton, 1996; Metcalfe & Mischel, 1999). Thus, motivations to attenuate negative affect may lead people to engage in hedonically pleasing, appetitive behaviors (Adam & Epel, 2007; Canetti et al., 2002; Tice et al., 2001). Finally, negative affect can impair decision-making capacity, and working memory in particular (Johns et al., 2008; Schoofs et al., 2008), which can make it difficult to self-monitor ARB (e.g., to keep track of how much one has eaten or drunk).

Other theories suggest that not all negative affective states will have a similar influence on ARB, but rather that specific negative emotions may influence ARB depending on appraisals and action tendencies (Consedine & Moskowitz, 2007; Lerner & Keltner, 2000, 2001; Lerner et al., 2015). For example, the specific emotion of sadness—which arises from experiences of uncontrollable loss (Lazarus, 1991)—may trigger action tendencies (Frijda, 1986; Scherer, 1988) to mitigate or replace loss by acquiring and consuming hedonically pleasing goods (Cryder et al., 2008; Dorison, et al., 2020; Garg & Lerner, 2013; Lerner & Keltner, 2000; Lerner, Small & Loewenstein, 2004; Raghunathan & Pham, 1999; Zeelenberg, et al., 2008). Conversely, disgust, with appraisal themes of avoiding contamination (Rozin & Fallon, 1987; Rozin, Markwith, & Stoess, 1997; Lazarus, 1991) and action tendencies motivating avoidance (Frijda, 1986; Scherer, 1988), should reduce ARB (regardless of whether the behavior is hedonically pleasing) (Han et al., 2007; Han, Lerner, & Zeckhauser, 2012; Lerner et al., 2004).

Positive affect may also be implicated in engagement in ARB. Indeed, positive affect has been linked to better health outcomes (Consedine & Moskowitz, 2007; Pressman & Cohen, 2005), perhaps in part because it increases engagement in healthy behaviors and deters engagement in risky behaviors (Pressman & Cohen, 2005). Although positive affect is theoretically orthogonal to negative affect (as opposed to being a polar opposite) (Emmons & Diener, 1985; Lindquist et al., 2015), it may influence ARB through some of the same pathways posited for negative affect. Additionally, positive affect can improve self-regulation (Aspinwall, 1998; Tice, Baumeister, Shmueli, & Muraven, 2007), which is likely to improve health behavior, including ARB (Cameron & Leventhal, 2003). Positive affect can also enhance affect regulation resources and decrease reward salience (Cohn et al., 2009; Fredrickson & Joiner, 2002), which, in turn, may decrease the need to rely on hedonically pleasing but risky health behavior as a compensatory affect regulation strategy. Moreover, positive affect can facilitate greater engagement with longer-term goals (Clore & Huntsinger,

2007; Fishbach & Labroo, 2007; Orehek et al., 2011). Additionally, positive affect can improve decision making (Isen, 2008), by increasing sensitivity to positive and negative consequences (Carpenter, Peters, Vastfjall, & Isen, 2013), facilitating greater thought about future consequences (Isen & Reeve, 2005; Oettingen et al., 2005), and enhancing the ability to delay reward (DeSteno et al. 2014; Moore et al., 1976), and thereby deter hedonically pleasing but risky ARB (Daugherty & Brase, 2010). However, it is also possible that positive affect could increase risky behavior, given research that some individuals tend to engage in risky behavior when experiencing high levels of positive affect (Zapolsky et al., 2009).

Despite theoretical support for the link between positive affect and health behavior, one meta-analysis found that positive affect increases eating behavior (Cardi et al., 2015), and another found null effects of positive affect on health cognitions and behavior (Cameron et al., 2015). However, no meta-analytic inquiry examined the influence of positive affect on a comprehensive suite of ARB. Similarly, although there are grounds for thinking that specific positive emotions (e.g., pride, hope) may have particular influences on ARB (Consedine & Moskowitz, 2007; Shiota et al., 2017; Tugadeet al., 2004), no meta-analytic synthesis has been conducted on this research.

Gaining a better understanding of the role affect may play in ARB is crucial to developing effective interventions (DeSteno et al., 2013; Ferrer et al., 2015; Ferrer et al., 2016; Magnan et al., 2017). This meta-analysis synthesizes published and unpublished studies of the impact of incidental affect on a suite of outcomes related to ARB. It is also the first to focus specifically on studies that *experimentally manipulated* incidental positive and negative affect and tested effects on ARB. The meta-analysis sought to answer two primary research questions: (1) do positive and negative affective states influence ARB? and (2) Can specific positive and negative affective states be differentiated in their influence on ARB? Outcomes include self-reported and observed behavior, as well as health cognitions that precede or are associated with ARB, namely behavioral intentions and (implicit and explicit) attitudes and evaluations of ARB. The meta-analysis also examines whether conceptual factors were associated with effect-size magnitude: the extent to which the behavioral outcome was hedonically pleasing; whether the sample was considered “at risk” (e.g., high in tendency for emotional eating or drinking alcohol to cope with stress, eating disorder diagnosis, obesity status); and whether participants were in a craving state (e.g., fasting or smoking abstention). Finally, the meta-analysis examines whether a variety of participant and procedural characteristics influenced the magnitude of effect sizes.

Methods

This meta-analysis followed Preferred Reporting Items for Systematic Reviews and meta-analyses (PRISMA) guidelines for conducting and reporting meta-analyses (Moher et al., 2015). A review protocol was not registered.

Inclusion Criteria

Studies were included if they met the following criteria: 1) included experimental inductions of emotions, mood, or stress that were incidental (i.e., not normatively relevant) to the ARB; 2) contained at least one outcome related to the performance of an ARB (behavior,

intentions, craving/ hunger/ arousal, attitudes/ evaluations, implicit measures of attention/ evaluations, perceived behavioral control, information seeking); 3) included a neutral affect comparison condition in a between-subjects design; and 4) examined adults (i.e., over the age of 18). Studies were excluded if they: 1) examined outcomes related to ARB performed on behalf of someone else (e.g., proxy feeding); 2) targeted an affective state in a larger study design (e.g., a gratitude induction presented in the context of a larger randomized controlled trial designed to influence behavior in multiple ways); and 3) did not include necessary statistical information to calculate effect sizes and study authors were unreachable or unable to provide such information. All articles located in the search were published in English. Figure 1 contains a PRISMA diagram of the search process (Moher et al., 2009). The final database includes 91 published/unpublished studies (k= 271 independent effect sizes).

Search Strategy

The search was performed on November 15, 2018 and was updated on January 22, 2019, using the PsycInfo database. The same search was performed in PubMed, and no additional articles not indexed in PsycInfo were identified. Search terms are detailed in the supplementary online materials. Additionally, queries were sent to relevant listservs (Society for Personality and Social Psychology, Society for Experimental Social Psychology, Society for Judgment and Decision Making, and Social and Affective Neuroscience Society), as well as to individual authors known to publish studies investigating affective influences on ARB, to identify unpublished studies.

Coding and reliability

Each study was coded by two independent coders (JT, EG, RF; a post-masters-level government contractor; and a post-baccalaureate-level fellow). Coders were trained by the first and second authors (RF, JT). Inter-rater agreement was high (*Kappas* > .80). Discrepancies were resolved through discussion. The following variables were coded.

Conceptual factors.—The extent to which participants were considered “at risk” for engaging in an ARB was coded; participants coded as “at risk” were those: high in emotional eating, drinking alcohol to cope, restrained eating; dieting; with obesity; with eating disorders. The extent to which a behavior was hedonically pleasing was also coded, using a three-level variable (0=not hedonically pleasing, e.g., water or baby carrots; 1=somewhat hedonically pleasing, e.g., crackers; 2=very hedonically pleasing, e.g., M&Ms, cigarettes [among smokers], alcohol), because some affective science theory specifies effects for specific emotions on ARB only to the extent that the behavior is pleasing or rewarding. Whether there was an additional craving cue present (e.g., smell of buttered popcorn) was also coded.

Target affective state—Each test was coded with regard to the specific affective state targeted (with individual codes for negative mood, positive mood, and specific emotions of stress, fear, anger, sadness, happiness, etc.). Then, each test was also coded as targeting *negative affect* (a single code applied to all studies targeting negative mood, stress, fear, etc.) or *positive affect* (a single code applied to all studies targeting positive mood, happiness,

etc.). Because labeling of affective states by study authors was not always consistent (e.g., two studies using an identical induction were often coded as targeting two different affective states), the two lead authors (RF and JT) developed systematic coding rules for the affective state targeted based on induction procedures rather than the induction label in the original publication. For example, studies using the same sad video clip might state they targeted sadness or negative mood; the systematic coding rules categorized tests using this induction as sadness regardless of the label in the publication. To develop consensus on these rules, the lead authors reviewed 23 published and unpublished papers (39 inductions) within these categories. Then, these authors separately coded an additional 10 papers (21 inductions) (including inductions in categories described above, as well as all other induction types) to develop inter-rater reliability (*kappas* > .86). In 18.5% of instances, the induction was ambiguous (e.g., when a music or film clip or segment could not be identified) and the coders' (RF and JT) best judgment was used to code the target affective state. As a result, a separate code was developed for whether the target affective state was ambiguous or unambiguous to code. Additional details about the coding process for target affective state are included in the supplementary online materials.

Induction type.—Table 1 includes descriptions of the 10 types of inductions employed. These were coded as separate variables because some procedures used multiple inductions. The number of inductions used in each procedure was also coded.

Outcome characteristics.—Effect sizes were coded for the ARB examined (eating, alcohol consumption, smoking, sex, caffeine consumption, drug use). To assess potential bias, effect sizes were also coded to note the extent to which a behavior was public (0=privately performed or self-reported on paper-and-pencil or computer; 1=observed by an experimenter; 2=observed by an experimenter and other participants); and whether behavior was measured objectively (e.g., observation, weighing the amount of food consumed) or through self-report.

Procedural details.—Effect sizes were coded for whether participants were instructed to enter the study in a craving state (e.g., not eating or smoking for a certain number of hours). Coding also captured whether the study took place online or in person; whether there was an additional craving cue present (e.g., smell of buttered popcorn); and whether a message about the health risks of the ARB was presented before the outcome was assessed. To assess potential bias, coding indexed whether the publication specified that participants were randomized to affective induction condition; and whether procedures to blind participants to the study purpose and hypotheses were reported (e.g., using a cover story).

Sociodemographic characteristics.—The percentage of women in the sample was coded for each test. Participant race was coded as the percent of white individuals in the sample; a more nuanced coding of race and ethnicity was not undertaken because only a small number of studies reported participant race/ethnicity, and those that did were most likely to report the percent of participants who were white. The percent of individuals in the sample with some college education was also coded (studies enrolling students only were coded as 100%).

Outcomes and Effect Sizes

Effect sizes (Cohen's *d*, mean difference between the experimental condition and comparison condition divided by the pooled standard deviation) were calculated for each ARB, as well as for the induction checks, using Comprehensive Meta-Analysis (CMA) (Borenstein, Hedges, Higgins, & Rothstein, 2014). If means and *SD*s were not included in the publication, other statistical information (e.g., *t*- or *p*-values) was used to calculate *d* (Johnson & Eagly, 2000; Lipsey & Wilson, 2001). A positive effect size indicated an increase in the ARB (or related outcome) compared to the comparison condition, whereas a negative effect size indicated a decrease in ARB. To correct for bias due to sample size, effect sizes were weighted by the inverse of the variance of *d* (Hedges, 1981).

When an experiment included more than one neutral affect condition, the condition most closely resembling the experimental induction was selected as the comparison (e.g., a neutral autobiographical induction would be selected to compare to an autobiographical emotion induction instead of a neutral video induction if both neutral conditions were included). When a study included multiple treatments, the sample size was divided by the number of relevant conditions to avoid "double counting" participants (Borenstein et al., 2009). For example, if a study included fear, anger, and neutral inductions with n=100 in each condition, two effect sizes were calculated: fear (n=100) vs. neutral (n=50) and anger (n=100) vs. neutral (n=50).

Analysis strategy

The *Q* statistic was calculated to examine whether effect sizes were homogenous (i.e., whether all studies produced a statistically equitable effect size for the comparison of experimental condition to comparison condition on the target affective state manipulation check). Because heterogeneity in effect sizes was detected, and in order to generalize these findings, random-effects procedures were used throughout (Hedges & Vevea, 1998). All analyses were performed using CMA (Borenstein et al., 2014). First, main effects of inductions across studies were examined to determine the overall effect. Separate analyses were conducted on each outcome. Next, meta-regressions tested whether coded factors moderated effect sizes. Moderator analyses were undertaken only when there was significant heterogeneity of effect sizes (evaluated by a significant p-value for the Q statistic) and there were 15 or more effect sizes (i.e., $k \geq 15$). Within each sample of studies, and for each outcome, each coded factor was entered into a univariate meta-regression. Additionally, analyses examined whether the effect size for the induction check predicted the effect sizes for each outcome.

Results

Induction checks

Affect inductions were largely successful in inducing target affective state. Of the 17 affective states for which induction checks were reported, all but positive mood, hope, and contentment were significant (*d*s=0.29-3.11, *p*s<.013, Table 1).

Main effects analyses

Effect sizes for the impact of negative affective states appear in Table 3. Negative affective states (i.e., any induction targeting a negatively valenced affective state, including specific negative emotions, negative mood, and stress) increased engagement in ARB (k=120, d=0.29, *95%CI*=0.13, 0.45, p<.001) and craving (k=31, d=0.29, *95%CI*=0.00, 0.58, p=.049), but did not influence intentions, implicit or explicit evaluations, perceived behavioral control, or information seeking.

Experimentally-induced negative mood increased ARB (k=26, d=0.30, *95%CI*=0.04, 0.57, p=.023) and decreased perceived behavioral control (k=4, d=−0.81, *95%CI*=−1.27, −0.34, p=.001), but did not influence any other outcome. Stress increased ARB (k=43, d=0.48, *95%CI*=0.15, 0.80, p=.004), but did not influence any other outcome. Disgust decreased ARB (k=1, d=−0.42, *95%CI*=−0.80, −0.03, p=.034), intentions (k=1, d=−0.42, *95%CI*=−0.82, −0.02, p=.041), and craving (k=1, d=−0.34, *95%CI*=−0.57, −0.10, p=.005), but did not influence implicit or explicit attitudes; however, each effect size was generated based on only one test.

Effect sizes for positive affective states are in Table 5. Positive affective states (i.e., any induction targeting a positively valenced affective state, including specific positive emotions and positive mood) did not influence any outcome. Positive mood increased perceived behavioral control (k=1, d=0.54, *95%CI*=0.04, 0.57, p=.023), but did not influence other outcomes; however, only one study targeted positive mood and assessed perceived control. Amusement increased ARB intentions in two studies (d=0.98, *95%CI*=0.43, 1.53, p<.001) and decreased ARB information seeking in one study (k=1, d=−0.39, *95%CI*=−0.75, 0.03, p=.032). The other specific positive emotions did not influence any behavior or health cognition outcomes.

Meta-regression analyses

Complete findings for meta-regression analyses are reported in the supplementary online materials; only significant findings are discussed here. Main effects with at least one significant meta-analytic predictor for effect-size magnitude are noted with an asterisk in Tables 2 and 3.

Induction check effect sizes—Outcome effect sizes were not linearly predicted by the magnitude of the induction check effect size. However, for negative affective states, and for stress in particular, effects on ARB were predicted by the square of the induction check effect size (Figure S1 in supplementary online materials).

Conceptual factors—Negative affective states (i.e., any induction targeting a negatively valenced affective state, including specific negative emotions, negative mood, and stress) had a larger effect on ARB for participants coded as at risk compared to those not at risk (B=0.61, *95%CI*=0.27, 0.95, p<.001); stress also had greater effect sizes for ARB among at-risk participants (B=1.14, *95%CI*=0.45, 1.83, p=.001). Positive affective states (i.e., any induction targeting a positively valenced affective state, including specific positive emotions and positive mood) were more likely to decrease ARB when participants were

coded as at risk compared to those not at risk (*B*=−0.78, *95%CI*=−1.54, −0.02, *p*=.044). Unexpectedly, the effect of negative affective states on outcomes was smaller with more hedonically pleasing behaviors (*B*=−0.98, *95%CI*=−1.92, −0.04, *p*=.041). Similarly, stress had less effect on behavior when the behavior was coded as more hedonically pleasing (*B*=−1.03, *95%CI*=−1.86, −0.20, *p*=.015). Positive affect's effects on intention were larger when a craving cue, such as a hedonic smell, was present (*B*=0.88, *95%CI*=0.43, 1.34, *p*<.001). Of note, effects on behavior were not qualified by whether the outcome was observed or self-reported, whether the observed outcomes were public (e.g., observed by the experimenter or other participants) or private, or whether studies were conducted on the internet versus in person.

Induction type—The effect of stress (*B*=1.37, *95%CI*=0.48, 2.23, *p*=.002) and positive affect (*B*=0.97, *95%CI*=0.38, 1.56, *p*=.001) on ARB was larger for video inductions compared to other categories of induction.

Outcome characteristics—The effect of negative mood on behavior was larger for smoking studies (*B*=0.81, *95%CI*=0.06, 1.55, *p*=.033), compared to other ARBs. Positive affective states had larger effects on explicit evaluations (attitudes/evaluations/expectations) for studies examining sexual behavior (*B*=0.73, *95%CI*=0.28, 1.17, *p*=.001).

Sociodemographic Characteristics—The effect of stress on craving was larger in studies with older participants (*B*=0.16, *95%CI*=0.05, 0.27, *p*=.005). The effects of positive affective states on intention (*B*=−0.01, *95%CI*=−0.01, −0.00, *p*=.037) and attitudes (*B*=−0.01, *95%CI*=−0.02, −0.00, *p*=.015) were smaller when studies had a higher proportion of women. Positive affective states had larger effects on explicit evaluations (attitudes/ evaluations/ expectations) in studies with older participants (*B*=0.05, *95%CI*=0.01, 0.08, *p*=.005). The effect of amusement on behavior was higher when there were more women in the sample (*B*=0.03, *95%CI*=0.01, 0.05, *p*=.004), and was lower with younger participants (*B*=0.61, *95%CI*=0.27, 0.95, *p*<.001). Race and education did not predict effect sizes; however, these sample characteristics were inconsistently reported, and relevant meta-regressions were underpowered.

Publication bias

Publication bias analyses were conducted for affective state-outcome combinations with significant effect sizes and for which there were three or more comparisons contributing to the overall effect size. Forest plots and relevant analyses (see supplementary online materials) did not provide evidence for publication bias (Egger's coefficients = 0.69-1.44, *p*s > .162), with the single exception of perceived behavioral control (Egger's coefficient = −3.55, *p* = .046).

Discussion

This meta-analysis of 271 independent effect sizes (91 studies) examined whether positive and negative affective states influence appetitive risk behavior (ARB; e.g., tobacco use, alcohol consumption, consumption of calorie dense/nutrient poor foods, sexual risk behavior), and if so, whether the influence of specific positive and negative emotions could

be differentiated in their influence on ARB. Analyses indicated that incidental negative affective states increased engagement in ARB, an effect that was not qualified by objective vs. self-reported assessment. These effects emerged when all types of negative affect (negative emotions, negative mood, and stress) were examined together (k=120), as well as when analyses were stratified to focus on negative mood or stress independently. Conversely, no main effects emerged for positive affective states (k=41) on ARB or related cognitions, replicating a previous meta-analysis on the null effects of positive affect on health cognitions and behavior (Cameron et al., 2015).

Although specific emotion effects may exist, it was not possible to differentiate the effects of specific positive or specific negative emotions on ARB when aggregating studies due to limitations in the extant literature, even though relevant emotion inductions appeared to be successful in producing the target affective state. Indeed, with the exception of amusement (and single comparison analyses of disgust), no reliable significant effects of specific emotions on ARB were observed. Notably, there was substantial heterogeneity in effect sizes among specific emotion inductions that was not predicted by the moderators examined here, suggesting the possibility that other (unmeasured) factors may predict when specific emotions are most likely to influence ARB (e.g., Garg, 2019).

A number of moderators of effect sizes emerged. First, no outcomes were linearly predicted by the magnitude of the effect size for induction checks. However, for negative affective states and stress, a curvilinear association existed between the induction checks and behavior, such that at lower levels of negative affect and behavior, associations of affect induction check effect size and behavior effect size were null, but effects accumulated exponentially to the extent that the study-level induction check effect sizes were larger. However, this finding should be interpreted with caution given that effects only emerge when induction check effect sizes are exceptionally large.

Effects of negative affective states on ARB were stronger for participants coded as at risk (e.g., participants high in emotional eating or drinking to cope, who were dieting, or who had obesity) than for participants coded as not at risk. Relatedly, effects of negative mood on behavior were stronger in smoking studies, consistent with the notion that effects are stronger for at-risk individuals (because smoking is addictive, smokers are arguably at higher risk than those engaging in non-addictive behavior; Benowitz, 1988). This moderating effect has substantial clinical significance, as it suggests that negative affect may be a particularly important driver among “at-risk” populations and among smokers.

Whether an ARB was coded as hedonically pleasing also emerged as a moderator of the effects of certain types of negative affect, although the nature of this interaction was unexpected. For example, the effects of negative affective states on implicit evaluations of ARB were *weaker* when the outcome was coded as more hedonically pleasing. Similarly, the effects of stress on behavior were weaker when the outcome was coded as more hedonically pleasing. These findings are counterintuitive given expectations that negative affect would increase ARB due to increased reward salience, priority of mood regulation goals over longer-term goals, and reliance on rewarding behavior as an affect regulation strategy. It is possible that this finding reflects a mismatch between affective state and behavior (such that

individuals in negative affective states may not feel as though they would enjoy a rewarding behavior) or a match between affective state and behavior (such that negative affect makes people realize how unhealthy the ARB is and as such consumption is reduced; Kroese et al., 2011). It is also possible, however, that imprecision in coding whether an ARB outcome was hedonically pleasing at the study level, rather than the individual level, contributed to this unexpected finding. For example, although chocolate consumption would be coded as highly pleasing, people differ in how much they enjoy sweet, savory, or salty foods, as well as fruits and vegetables (Conner, Haddon, Pickering, & Booth, 1988). Similarly, among drinkers, there are individual differences in enjoyment of specific alcoholic drinks (Klatsky, Armstrong, & Kipp, 1990). As such, more primary research is necessary to explicitly examine whether the subjective hedonic pleasantness of a behavior moderates the effects of negative affective states.

Interestingly, despite no main effects of positive affective states on ARB or related health cognitions, positive affect was more likely to decrease ARB among at-risk individuals compared to those not at risk. Moreover, positive affect had greater impact on intentions when a craving cue (e.g., appetitive smell) was present at the time that intentions were assessed. This finding is consistent with research suggesting that the effects of positive emotion can be modulated by a currently activated goal (Fishbach & Labroo, 2007), in that the craving cue may have activated goals related to pursuing pleasure (as opposed to longer-term health goals), thus increasing the impact of positive affect.

Taken together, these findings have a number of clinical implications. First, they suggest that healthcare providers should consider a patient's incidental affective state, particularly when the affective state is negative, when providing counseling regarding the reduction of ARB. Second, they suggest that interventions designed to discourage ARB, particularly among at-risk populations, should include strategies that facilitate healthier ways to cope with negative affect or ways to disrupt the link between negative affect and behavior (Sheeran et al., 2018). Findings also have implications for the affective science theories that inform health behavior change interventions. For example, negative affect increased actual ARB but not intentions to engage in future ARB or ARB-related cognitions. These findings may be explained in terms of how negative affect reduces future-oriented thinking (e.g., Liu et al., 2013): negative affect may focus individuals on shorter-term solutions rather than longer-term intentions and health cognitions. These findings are also consistent with the notion that negative affect can directly stimulate action (Canetti et al., 2002; DeSteno et al., 2013; Garg & Lerner, 2013; Lerner et al., 2015), in addition to affecting action indirectly through expectations of how one will feel in the future (Baumeister, Vohs, Nathan DeWall, & Zhang, 2007), given that effects were stronger and more reliable for behavior than intentions. It is also possible that negative affective states did not increase intentions to engage in ARB because individuals anticipated that they would be able to repair future negative affect in other ways. Regardless of mechanism, this finding has clinical implications by warranting appetitive behavior interventions that focus affect regulation strategies that can be deployed *in situ* to manage the direct effects of incidental affect on cravings and behavior.

This meta-analysis has several limitations that should be acknowledged. First, limitations in the literature may make it difficult to differentiate between specific affective states,

underscoring that these analyses cannot be interpreted as evidence supporting valence versus discrete emotion theories. Second, there were ambiguities in coding specific affective states targeted by inductions; for example, an unknown proportion of the inductions coded as targeting negative mood may have targeted, or produced, a specific emotion. Third, it is possible that some specific affect inductions failed to achieve specificity. For example, one study included in analyses had a sadness induction that increased sadness, but also anger, compared to neutral emotion (Ferrer et al., 2017). As such, it is possible that lack of specificity may mask specific emotion effects. However, this possibility cannot be systematically examined in these data because the majority of studies included only an assessment of the target affective state, making specificity of inductions impossible to examine. Taken together, these limitations point to the importance of collective standards for precision in descriptions of affect inductions, the specific affect induced, and the measurement of (multiple types of) induced affect to allow for theory testing.

The present review is also limited by the fact there were too few studies to fully examine moderator effects except in analyses that grouped all positive and all negative affective states. For example, only four studies targeted fear and included a behavioral outcome, meaning analyses of the conditions under which fear may influence ARB were not possible. Additionally, because of limitations in the database, analyses were unable to systematically examine the effects of a homogeneous set of specific emotion inductions (e.g., autobiographical sadness inductions vs. music sadness inductions vs. autobiographical fear inductions vs. music fear inductions), as the cell size for some of these categories was too small. Finally, we were unable to examine whether the timing of the affect induction with respect to ARB outcome assessments moderated effect sizes, as few studies included an extended follow-up.

Notwithstanding these limitations, this meta-analysis synthesized a large number of studies, and demonstrated that negative affect leads to robust increases in ARB, particularly among populations at risk. The present review observed little influence of positive incidental affect on ARBs, with the exception of a significant effect on intentions when a craving cue was present. It is notable that inducing positive or negative affect generally did not influence cognitions or cravings; the largest effect size was observed here was for behavior and for negative affect inductions. Taken together, these findings point primarily to the importance of addressing negative affective states as a precursor of unhealthy ARB, particularly among clinically at-risk populations. Further studies that develop collective standards for affective science methods that identify potential mechanisms underlying the impact of negative affect on ARBs (e.g., increased reward sensitivity, heightened activation of the goal of mood repair, reduced cognitive capacity leading to reduced self-monitoring), and that afford standardized comparisons of specific emotion states, should be a priority in future research.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments:

We thank Emily Goettsche and Jennifer Scheideler for their contributions to the meta-analytic coding. We appreciate Arturo Durazo, Amber Koblitz, Daniel Ramen, and Christopher Wally, for contributions to the analyses reported here.

References:

Adam TC, & Epel ES (2007). Stress, eating and the reward system. Physiol Behav, 91(4, 449–458. [PubMed: 17543357]

Albarracin D, Johnson BT, Fishbein M, & Muellerleile PA (2001). Theories of reasoned action and planned behavior as models of condom use: a meta-analysis. Psychological Bulletin, 127(1), 142. [PubMed: 11271752]

Aspinwall LG (1998). Rethinking the role of positive affect in self-regulation. Motivation and Emotion, 22(1), 1–32.

Azfar-e-Alam Siddiqi HI, & Hall XH (2016). Population-based estimates of life expectancy after HIV diagnosis. United States 2008–2011. Journal of Acquired Immune Deficiency Syndrome, 72(2), 230.

Baumeister RF, & Heatherton TF (1996). Self-regulation failure: An overview. Psychological Inquiry, 7(1), 1–15.

Baumeister RF, Vohs KD, Nathan DeWall C, & Zhang L (2007). How emotion shapes behavior: Feedback, anticipation, and reflection, rather than direct causation. Personality and Social Psychology Review, 11(2), 167–203. [PubMed: 18453461]

Benowitz NL (1988). Pharmacologic aspects of cigarette smoking and nicotine addiction. New England Journal of Medicine, 319(20), 1318–1330.

Borenstein M, Cooper H, Hedges L, & Valentine J (2009). Effect sizes for continuous data. The Handbook of Research Synthesis Meta-analysis, 2, 221−235.

Borenstein M, Hedges L, Higgins J, & Rothstein H (2014). Comprehensive Meta-Analysis (CMA) software (Version 3.0). Englewood, NJ: Biostat. In.

Bradley MM, & Lang PJ (2007). The International Affective Digitized Sounds (; IADS-2): Affective ratings of sounds and instruction manual. University of Florida, Gainesville, FL, Tech. Rep. B-3.

Cameron DS, Bertenshaw EJ, & Sheeran P (2015). The impact of positive affect on health cognitions and behaviours: a meta-analysis of the experimental evidence. Health Psychol Rev, 9(3), 345–365. [PubMed: 27028049]

Cameron LD, & Leventhal H (2003). The self-regulation of health and illness behaviour: psychology press.

Canetti L, Bachar E, & Berry EM (2002). Food and emotion. Behavioural Processes, 60(2), 157–164. [PubMed: 12426067]

Cardi V, Leppanen J, & Treasure J (2015). The effects of negative and positive mood induction on eating behaviour: A meta-analysis of laboratory studies in the healthy population and eating and weight disorders. Neuroscience & Biobehavioral Reviews, 57, 299–309. [PubMed: 26299807]

Carpenter S, Peters E, Västfjäll D, & Isen AM (2013). Positive feelings facilitate working memory and complex decision making among older adults. Cognition & Emotion, 27(1), 184–192. [PubMed: 22764739]

Clore G, & Huntsinger JR (2007). How emotions inform judgment and regulate thought. Trends in Cognitive Sciences, 11(9), 393–399. [PubMed: 17698405]

Cohn MA, Fredrickson BL, Brown SL, Mikels JA, & Conway AM (2009). Happiness unpacked: positive emotions increase life satisfaction by building resilience. Emotion, 9(3), 361. [PubMed: 19485613]

Conner M, Rhodes RE, Morris B, McEachan R, Lawton RJP, & Health. (2011). Changing exercise through targeting affective or cognitive attitudes. 26(2), 133–149. [PubMed: 21318926]

Conner MT, Haddon AH, Pickering ES, & Booth DA (1988). Sweet tooth demonstrated: Individual differences in preference for both sweet foods and foods highly sweetened. Journal of Applied Psychology, 73(2), 275.

Consedine NS, & Moskowitz JT (2007). The role of discrete emotions in health outcomes: A critical review. Applied Preventive Psychology, 12(2), 59–75.

Cowen AS, & Keltner D (2017). Self-report captures 27 distinct categories of emotion bridged by continuous gradients. Proceedings of the National Academy of Sciences, 114(38), E7900–E7909.

Cryder CE, Lerner JS, Gross JJ, & Dahl RE (2008). Misery is not miserly: Sad and self-focused individuals spend more. Psychological science, 19(6), 525–530. [PubMed: 18578840]

Daugherty JR, & Brase GL (2010). Taking time to be healthy: Predicting health behaviors with delay discounting and time perspective. Personality and Individual Differences, 48(2), 202–207.

DeSteno D, Li Y, Dickens L, & Lerner JS (2014). Gratitude: A tool for reducing economic impatience. Psychological science, 25(6), 1262–1267. [PubMed: 24760144]

DeSteno D, Gross JJ, & Kubzansky L (2013). Affective science and health: The importance of emotion and emotion regulation. Health Psychology, 32(5), 474. [PubMed: 23646831]

Dorison CA, Wang K, Rees VW, Kawachi I, Ericson KM, & Lerner JS (2020). Sadness, but not all negative emotions, heightens addictive substance use. Proceedings of the National Academy of Sciences, 117(2), 943–949.

Duffey KJ, & Popkin BM (2011). Energy density, portion size, and eating occasions: contributions to increased energy intake in the United States, 1977–2006. PLoS Med, 8(6), e1001050. [PubMed: 21738451]

Ellis EM, Collins RL, Homish GG, Parks KA, & Kiviniemi MTJHP (2016). Perceived controllability of condom use shifts reliance on implicit versus explicit affect. 35(8), 842.

Emmons RA, & Diener E (1985). Personality correlates of subjective well-being. Personality and Social Psychology Bulletin, 11(1), 89–97.

Ferrer RA, Green PA, & Barrett LF (2015). Affective science and cancer control: Towards a mutually beneficial research agenda. Perspectives on Psychological Science, 10, 328–345. [PubMed: 25987511]

Ferrer RA, Klein WMP, Lerner JS, Reyna V, & Keltner D (2016). Emotions and health decison-making: Extending the Appraisal Tendency Framework to improve health and healthcare. In Roberto C & Kawachi I (Eds.), Behavioral Economics and Public Health (pp. 6). Cambridge, MA: Harvard University Press.

Ferrer RA, Maclay A, Litvak PM, & Lerner JS (2017). Revisiting the effects of anger on risk-taking: Empirical and meta-analytic evidence for differences between males and females. Journal of Behavioral Decision Making, 30(2), 516–526.

Ferrer RA, & Mendes WB (2018). Emotion, health decision making, and health behaviour. Psychology & Health.

Fishbach A, & Labroo AA (2007). Be better or be merry: How mood affects self-control. Journal of Personality and Social Psychology, 93(2), 158. [PubMed: 17645393]

Fredrickson BL, & Joiner T (2002). Positive emotions trigger upward spirals toward emotional well-being. Psychological Science, 13(2), 172–175. [PubMed: 11934003]

Frijda NH (1986). The emotions: Cambridge University Press.

Garg N (2019). Misery wants control: The roles of helplessness and choice in the sadness–consumption relationship. Australian Journal of Management, 44(3), 407–424.

Garg N, & Lerner JS (2013). Sadness and consumption. Journal of Consumer Psychology, 23(1), 106–113.

Gomes T, Tadrous M, Mamdani MM, Paterson JM, & Juurlink DN (2018). The burden of opioid-related mortality in the United States. JAMA Network Open, 1(2), e180217–e180217. [PubMed: 30646062]

Han E, & Powell LM (2013). Consumption patterns of sugar-sweetened beverages in the United States. Journal of the Academy of Nutrition and Dietetics, 113(1), 43–53. [PubMed: 23260723]

Han S, Lerner JS, & Keltner D (2007). Feelings and consumer decision making: The appraisal-tendency framework. Journal of Consumer Psychology, 17(3), 158–168. doi:10.1016/s1057-7408(07)70023-2

Han S, Lerner JS, & Zeckhauser R (2012). The disgust-promotes-disposal effect. Journal of Risk and Uncertainty, 44(2), 101–113. doi:10.1007/s11166-012-9139-3

Harle KM, & Sanfey AG (2007). Incidental sadness biases social economic decisions in the Ultimatum Game. Emotion, 7(4), 876–881. doi:10.1037/1528-3542.7.4.876 [PubMed: 18039057]

Hausenblas HA, Carron AV, & Mack DE (1997). Application of the theories of reasoned action and planned behavior to exercise behavior: A meta-analysis. Journal of Sport Exercise Psychology, 19(1), 36–51.

Hedges LV (1981). Distribution theory for Glass's estimator of effect size and related estimators. Journal of Educational Statistics, 6(2), 107–128.

Hedges LV, & Vevea JL (1998). Fixed-and random-effects models in meta-analysis. Psychological Methods, 3(4), 486.

Isen AM (2008). Some ways in which positive affect influences decision making and problem solving. Handbook of Emotions, 3, 548–573.

Isen AM, & Reeve J (2005). The influence of positive affect on intrinsic and extrinsic motivation: Facilitating enjoyment of play, responsible work behavior, and self-control. Motivation and Emotion, 29(4), 295–323.

Johns M, Inzlicht M, & Schmader T (2008). Stereotype threat and executive resource depletion: Examining the influence of emotion regulation. Journal of Experimental Psychology: General, 137(4), 691. [PubMed: 18999361]

Johnson BT, & Eagly AH (2000). Quantitative synthesis of social psychological research.

Kanny D, Brewer RD, Mesnick JB, Paulozzi LJ, Naimi TS, & Lu H (2015). Vital signs: alcohol poisoning deaths—United States, 2010–2012. Morbidity and Mortality Weekly Report, 63(53), 1238. [PubMed: 25577989]

Keltner D, & Lerner JS (2010). Emotion. In Fiske ST, Gilbert DT, & Lindzey G (Eds.), Handbook of social psychology (p. 317–352). John Wiley & Sons Inc.

Klatsky AL, Armstrong MA, & Kipp H (1990). Correlates of alcoholic beverage preference: traits of persons who choose wine, liquor or beer. British Journal of Addiction, 85(10), 1279–1289. [PubMed: 2265288]

Kroese FM, Evers C, & De Ridder DTD (2011). Tricky treats: Paradoxical effects of temptation strength on self-regulation processes. European Journal of Social Psychology, 31(3), 281–288.

Lawton R, Conner M, & McEachan R (2009). Desire or reason: predicting health behaviors from affective and cognitive attitudes. Health Psychology, 28(1), 56. [PubMed: 19210018]

Lazarus RS (1991). Progress on a cognitive-motivational-relational theory of emotion. American Psychologist, 46(8), 819–834. doi:10.1037/0003-066x.46.8.819

Lerner JS, & Keltner D (2000). Beyond valence: Toward a model of emotion-specific influences on judgement and choice. Cognition and Emotion, 14(4), 473–493. doi:10.1080/026999300402763

Lerner JS, & Keltner D (2001). Fear, anger, and risk. Journal of Personality and Social Psychology, 81(1), 146–159. doi:10.1037/0022-3514.81.1.146 [PubMed: 11474720]

Lerner JS, Li Y, Valdesolo P, & Kassam K (2015). Emotion and decision-making. Annual Review of Psychology, 66.

Lerner JS, Small DA, & Loewenstein G (2004). Heart strings and purse strings: Carryover effects of emotions on economic decisions. Psychological science, 15(5), 337–341. [PubMed: 15102144]

Lindquist KA, Satpute AB, Wager TD, Weber J, & Barrett LF (2015). The brain basis of positive and negative affect: evidence from a meta-analysis of the human neuroimaging literature. Cerebral Cortex, 26(5), 1910–1922. [PubMed: 25631056]

Lipsey MW, & Wilson DB (2001). Practical meta-analysis: SAGE publications, Inc.

Liu L, Feng T, Chen J, & Li H (2013). The value of emotion: how does episodic prospection modulate delay discounting?. PloS one, 8(11).

Loewenstein G, & Lerner JS (2003). The role of affect in decision making. In Davidson RJ, Scherer KR, & Goldsmith HH (Eds.), Handbook of affective sciences (pp. 619–642). New York, NY, US: Oxford University Press.

Ma J, Siegel RL, Jacobs EJ, & Jemal A (2018). Smoking-attributable Mortality by State in 2014, US. American Journal of Preventive Medicine, 54(5), 661–670. [PubMed: 29551325]

Magnan RE, Shorey Fennell BR, & Brady JM (2017). Health decision making and behavior: The role of affect-laden constructs. Social Personality Psychology Compass, 11(8), e12333.

McEachan RRC, Conner M, Taylor NJ, & Lawton RJ (2011). Prospective prediction of health-related behaviours with the theory of planned behaviour: A meta-analysis. Health Psychol Rev, 5(2), 97–144.

Metcalfe J, & Mischel W (1999). A hot/cool-system analysis of delay of gratification: dynamics of willpower. Psychological Review, 106(1), 3. [PubMed: 10197361]

Micha R, Peñalvo JL, Cudhea F, Imamura F, Rehm CD, & Mozaffarian D (2017). Association between dietary factors and mortality from heart disease, stroke, and type 2 diabetes in the United States. JAMA, 317(9), 912–924. [PubMed: 28267855]

Moher D, Liberati A, Tetzlaff J, & Altman DG (2009). Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. Annals of Internal Medicine, 151(4), 264–269. [PubMed: 19622511]

Moher D, Shamseer L, Clarke M, Ghersi D, Liberati A, Petticrew M, … Stewart LA (2015). Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. Systematic Reviews, 4(1), 1. [PubMed: 25554246]

Moore BS, Clyburn A, & Underwood B (1976). The role of affect in delay of gratification. Child Development, 273–276.

Nordgren LF, van der Pligt J, & van Harreveld F (2008). The instability of health cognitions: Visceral states influence self-efficacy and related health beliefs. . Health Psychology, 27(6), 722. [PubMed: 19025267]

Oettingen G, Mayer D, Thorpe JS, Janetzke H, & Lorenz S (2005). Turning fantasies about positive and negative futures into self-improvement goals. Motivation and Emotion, 29(4), 236–266.

Orehek E, Bessarabova E, Chen X, & Kruglanski AW (2011). Positive affect as informational feedback in goal pursuit. Motivation and Emotion, 35(1), 44–51. [PubMed: 21423342]

Pressman SD, & Cohen S (2005). Does positive affect influence health? Psychological Bulletin, 737(6), 925.

Raghunathan R, & Pham MT (1999). All negative moods are not equal: Motivational influences of anxiety and sadness on decision making. Organizational behavior and human decision processes, 79(1), 56–77. [PubMed: 10388609]

Rozin P, & Fallon AE (1987). A perspective on disgust. Psychological review, 94(1), 23. [PubMed: 3823304]

Rozin P, Markwith M, & Stoess C (1997). Moralization and becoming a vegetarian: The transformation of preferences into values and the recruitment of disgust. Psychological Science, 8(2), 67–73.

Scaglione S, Kliethermes S, Cao G, Shoham D, Durazo R, Luke A, & Volk ML (2015). The epidemiology of cirrhosis in the United States. Journal of Clinical Gastroenterology, 49(8), 690–696. [PubMed: 25291348]

Scherer KR (1988). Criteria for emotion-antecedent appraisal: A review. In Cognitive perspectives on emotion and motivation (pp. 89–126): Springer.

Schoofs D, Preuß D, & Wolf OT (2008). Psychosocial stress induces working memory impairments in an n-back paradigm. Psychoneuroendocrinology, 33(5), 643–653. [PubMed: 18359168]

Sheeran P, Maki A, Montanaro E, Avishai-Yitshak A, Bryan A, Klein WM, … Rothman AJ (2016). The impact of changing attitudes, norms, and self-efficacy on health-related intentions and behavior: a meta-analysis. Health Psychology, 35(11), 1178. [PubMed: 27280365]

Sheeran P, & Taylor S (1999). Predicting Intentions to Use Condoms: A Meta-Analysis and Comparison of the Theories of Reasoned Action and Planned Behavior 1. Journal of Applied Psychology, 29(8), 1624–1675.

Sheeran P, Webb TL, Gollwitzer PM, Oettingen G, Williams D, Rhodes R, & Conner M (2018). Self-regulation of affect-health behavior relations. In Williams DM, Rhodes RE, & Conner MT (Eds.), Affective determinants of health behavior (pp. 90–114): Oxford University Press.

Shiota MN, Campos B, Oveis C, Hertenstein MJ, Simon-Thomas E, & Keltner D (2017). Beyond happiness: Building a science of discrete positive emotions. American Psychologist, 72(7), 617.

Substance Abuse and Mental Health Services Administration (SAMHSA). (2015). 2015 National Survey on Drug Use and Health (NSDUH).

Available at: https://www.samhsa.gov/data/sites/default/files/NSDUH-DetTabs-2015/NSDUH-DetTabs-2015/NSDUH-DetTabs-2015.htm#tab2-41b.

Tice DM, Baumeister RF, Shmueli D, & Muraven M (2007). Restoring the self: Positive affect helps improve self-regulation following ego depletion. Journal of Experimental Social Psychology, 43(3), 379–384.

Tice DM, Bratslavsky E, & Baumeister RF (2001). Emotional distress regulation takes precedence over impulse control: If you feel bad, do it! Journal of Personality and Social Psychology, 80(1), 53. [PubMed: 11195891]

Tugade MM, Fredrickson BL, & Feldman Barrett L (2004). Psychological resilience and positive emotional granularity: Examining the benefits of positive emotions on coping and health. Journal of Personality, 72(6), 1161–1190. [PubMed: 15509280]

Wagner DD, Boswell RG, Kelley WM, & Heatherton TF (2012). Inducing negative affect increases the reward value of appetizing foods in dieters. Journal of Cognitive Neuroscience, 24(7), 1625–1633. [PubMed: 22524295]

Wagner DD, & Heatherton TE (2014). Emotion and self-regulation failure. In Gross JJ (Ed.), Handbook of emotion regulation 2nd Edition (pp. 613–628). New York: Guilford.

Wang TW, Asman K, Gentzke AS, Cullen KA, Holder-Hayes E, Reyes-Guzman C, … King BA (2018). Tobacco product use among adults—United States, 2017. Morbidity and Mortality Weekly Report, 67(44), 1225. [PubMed: 30408019]

Williams DM, & Evans DR (2014). Current emotion research in health behavior science. Emotion Review, 6(3), 277–287.

Williams DM, Rhodes RE, & Conner M (2018). Overview of affective determinants of health behavior. Affective determinants of health behavior, 1–18.

Zeelenberg M, Nelissen RM, Breugelmans SM, & Pieters R (2008). On emotion specificity in decision making: Why feeling is for doing. Judgment and Decision making, 3(1), 18.

Zapolski TC, Cyders MA, & Smith GT (2009). Positive urgency predicts illegal drug use and risky sexual behavior. Psychology of Addictive Behaviors, 23(2), 348 [PubMed: 19586152]

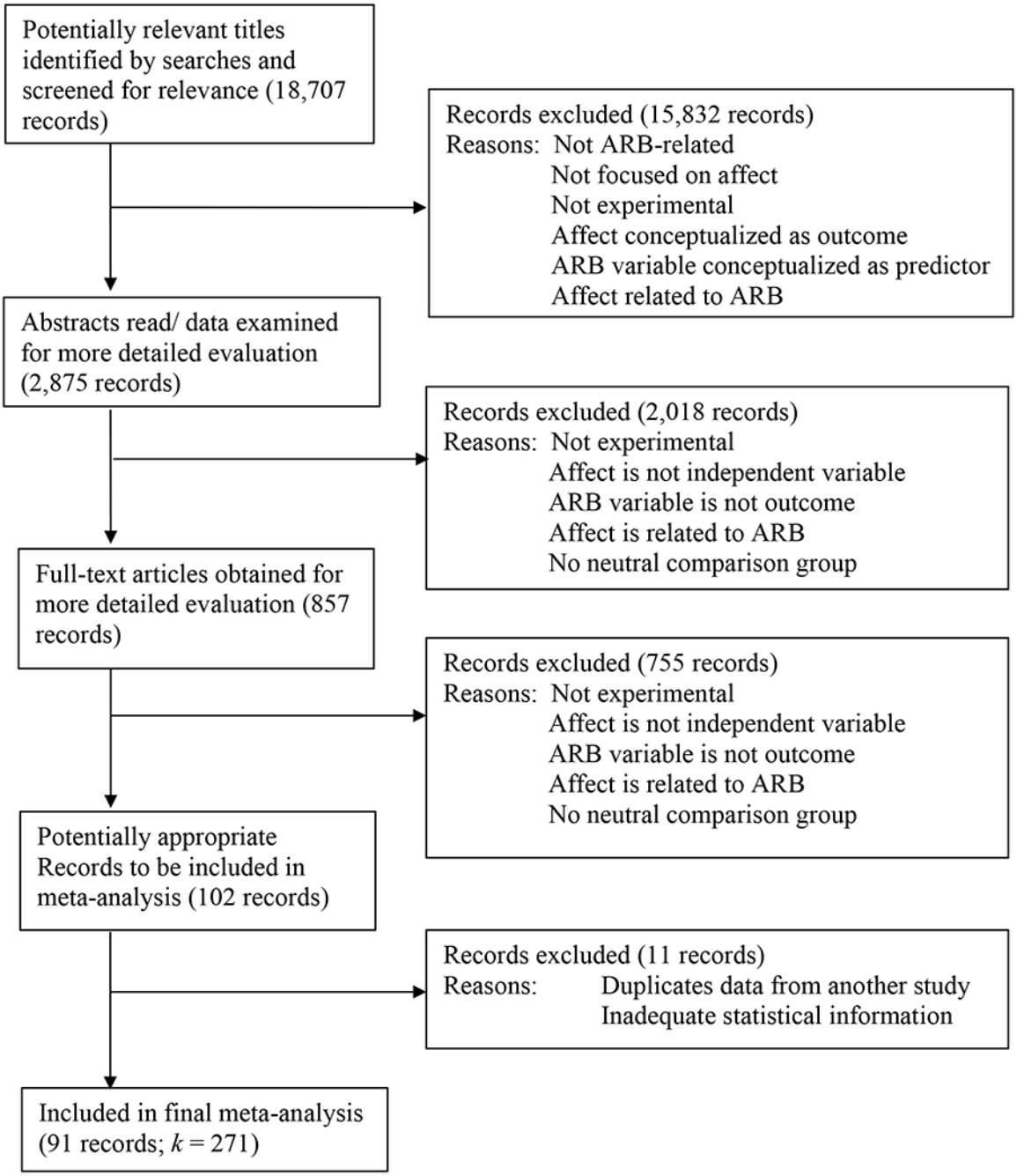

Figure 1. Flow of Information Through the Phases of the Review
Note: ARB = Appetitive Risk behavior

Table 1.

Meta-analysis predictors, moderators, and outcomes.

Predictors (Affective States)	Moderators	Outcomes
Negative affective states	**Induction factors**	Behavior
Negative mood	Induction check effect size	Intentions
Stress	Induction check effect size^2 (squared)	Craving
Anger	Presence of induction check	Attitudes/
Disgust	Ambiguous induction	evaluations
Fear	Induction type	Implicit evaluation/
Guilt	**Participant characteristics**	attention
Loneliness	Publication status	Perceived behavioral
Sadness	Mean age	control
Shame	Percent female	Information seeking
Positive affective states	Percent white	
Positive mood	Percent some college	
Amusement	Participant “at risk”	
Contentment	**Procedural details**	
Excitement	Craving state induced	
Happiness	Participant blinding specified	
Hope	Internet research	
Pride	Craving cue present	
Surprise	Presence of ARB health risk message	
	Outcome characteristics	
	Appetitive behavior	
	Hedonic outcome	
	ARB outcome observed vs. private	
	Self-reported outcome	

Table 2.

Description of inductions in included studies

Induction	Description
Autobiographical Recall	Participants are instructed to write in detail about an experience that made them feel a specified affective state. Such inductions often involve instructing participants to list 3-5 events that made them feel most emotional before choosing one about which to write.
Imagination	Participants are asked to vividly imagine themselves in affectively evocative situations, sometimes using guided imagery.
Fabricated situations	Participants are exposed to a fabricated situation to induce affect, such as being placed in a situation where they interact with an anger-inducing confederate (i.e., an actor).
Music	A piece of music designed to elicit the target affective state is played.
Picture	Previously validated (and often taken from standard databases (e.g., International Affective Pictures System) (Bradley & Lang, 2007) are presented.
Priming	Words and/ or pictures associated with an affective state are presented as supraliminal stimuli.
Reading	Participants are presented with, and asked to read to themselves, paragraphs of text with affectively laden content, such as newspaper articles, jokes, or portions of textbooks.
Trier Social Stress Test (presentation)	Participants are told that they will develop and give a presentation in an evaluative social situation.
Trier Social Stress Test (mathematics)	Participants are given difficult or impossible mathematical or reasoning tasks and provided negative social feedback as they attempt to solve the problems.
Velten	Participants are instructed to put themselves into a target mood state and to subsequently read a series of self-referent statements.
Film	Film clips, usually excerpted from a feature length film and often selected from a validated set of clips, are presented.

Table 3.

Induction check effect sizes

Affective State	k	d	95% CI	p	Q	p (Q)	I^2	Tau^2
Negative affect	115	0.91	0.86, 35.70	<.001	1059.88	<.001	89.24	0.63
Negative mood	27	1.12	0.89, 1.35	<.001	76.60	<.001	66.06	0.22
Stress	31	0.92	0.69, 1.16	<.001	93.86	<.001	63.04	0.28
Anger	6	0.72	0.31, 1.12	.001	33.52	<.001	85.08	0.20
Disgust	3	0.76	0.06, 0.29	.002	8.75	.013	77.14	0.13
Fear	6	3.11	1.70, 4.52	<.001	59.30	<.001	91.57	1.44
Guilt	3	0.69	0.43, 0.94	<.001	0.29	.865	0.00	0.00
Loneliness	-	-	-	-	-	-	-	-
Sadness	36	1.21	0.83, 1.59	<.001	703.58	<.001	92.03	1.22
Shame	5	1.26	0.67, 1.86	<.001	15.22	.004	73.71	0.29
Positive affect	50	0.62	0.40, 0.85	<.001	405.47	<.001	87.92	0.48
Positive mood	12	0.46	−0.25, 1.16	.201	130.08	<.001	91.54	1.36
Amusement	14	1.30	0.85, 1.75	<.001	67.91	<.001	80.86	0.46
Contentment	4	−0.13	−0.76, 0.51	.695	11.78	.008	74.53	0.30
Excitement	-	-	-	-	-	-	-	-
Happiness	13	0.43	0.10, 0.76	.011	81.75	<.001	85.32	0.29
Hope	2	−0.11	−0.30, 0.07	.239	0.04	.846	0.00	0.00
Pride	5	1.13	0.60, 1.66	<.001	12.60	.013	68.26	0.23
Surprise	2	0.29	0.06, 0.52	.013	0.44	.508	0.00	0.00

Table 4.

Impact of Negative Affect on Appetitive Risk Cognitions and Behavior

	k	d	95% CI	p	Q	p (Q)	I^2	Tau^2
Negative affective states (all)								
Behavior	**120**	***0.29**	**0.13, 0.45**	**<.001**	622.08	<.001	80.87	0.58
Intentions	25	*0.06	−0.04, 0.16	.208	29.22	.212	17.87	0.01
Craving	**31**	***0.29**	**0.00, 0.58**	**.049**	188.34	<.001	84.07	0.50
Attitudes/ evaluations/ expectancies	22	0.11	−0.02, 0.23	.085	27.33	.160	23.15	0.02
Implicit evaluations/ attention	16	0.05	−0.26, 0.36	.763	72.48	<.001	79.30	0.29
Perceived behavioral control	17	*−0.34	−0.73, 0.04	.076	118.13	<.001	86.46	0.52
Information seeking	5	−0.06	−0.44, 0.32	.757	5.10	.278	21.52	0.04
Negative mood								
Behavior	**26**	**0.30**	**0.04, 0.57**	**.023**	71.79	<.001	65.18	0.28
Intentions	2	0.03	−1.08, 1.14	.956	4.95	.026	79.80	0.51
Craving	1	0.58	−0.23, 1.40	.162	-	-	-	-
Attitudes/ evaluations/ expectancies	5	0.07	−0.15, 0.30	.529	4.01	.404	0.29	0.00
Implicit evaluations/ attention	5	0.01	−0.66, 0.69	.969	34.59	<.001	88.44	0.52
Perceived behavioral control	**4**	**−0.81**	**−1.27, −0.34**	**.001**	8.11	.044	63.00	0.14
Stress								
Behavior	**43**	***0.48**	**0.15, 0.80**	**.004**	269.07	<.001	84.39	0.93
Intentions	1	−0.03	−0.46, 0.40	.882	-	-	-	-
Craving	21	*0.24	−0.10, 0.58	.172	74.70	<.001	73.23	0.43
Attitudes/ evaluations/ expectancies	5	0.08	−0.19, 0.35	.549	6.47	.167	38.15	0.03
Implicit evaluations/ attention	4	0.29	−0.58, 1.15	.513	24.55	<.001	87.79	0.67
Perceived behavioral control	7	−0.13	−0.77, 0.52	.692	36.24	<.001	83.44	0.60
Anger								
Behavior	6	0.29	−0.00, 0.58	.051	2.43	.787	0.00	0.00
Intentions	5	0.10	−0.05, 0.25	.195	1.95	.745	0.00	0.00
Craving	1	−0.02	−0.52, 0.48	.940	-	-	-	-
Information seeking	2	0.20	−0.49, 0.90	.566	0.01	.923	0.00	0.00
Disgust								
Behavior	**1**	**−0.42**	**−0.80, −0.03**	**.034**	-	-	-	-
Intentions	**1**	**−0.42**	**−0.82, −0.02**	**.041**	-	-	-	-
Craving	**1**	**−0.34**	**−0.57, −0.10**	**.005**	-	-	-	-
Attitudes/ evaluations/ expectancies	1	0.19	−0.37, 0.75	.502	-	-	-	-
Implicit evaluations/ attention	1	−0.06	−0.61, 0.50	.833	-	-	-	-
Fear								
Behavior	4	0.44	−0.59, 1.47	.400	14.50	.002	79.31	0.87
Intentions	3	0.05	−0.12, 0.22	.556	0.32	.854	0.00	0.00
Guilt								
Behavior	1	0.58	−0.05, 1.20	.071				

	k	d	95% CI	p	Q	p (Q)	I^2	Tau^2
Intentions	2	0.08	−0.52, 0.26	.794	4.87	.027	79.45	0.15
Loneliness								
Behavior	3	0.47	−0.14, 1.09	.133	1.61	.447	0.00	0.00
Sadness								
Behavior	33	0.10	−0.06, 0.25	.211	60.66	.002	47.25	0.09
Intentions	7	0.16	−0.05, 0.37	.145	3.49	.745	0.00	0.00
Craving	7	0.53	−0.26, 1.33	.187	82.61	<.001	92.74	1.03
Attitudes/ evaluations/ expectancies	7	0.08	−0.11, 0.28	.405	9.07	.170	33.82	0.02
Implicit evaluations/ attention	4	0.02	−0.21, 0.25	.860	0.10	.992	0.00	0.00
Perceived behavioral control	6	−0.23	−0.98, 0.52	.548	56.06	<.001	91.08	0.79
Shame								
Behavior	7	−0.03	−1.81, 1.76	.978				
Intentions	4	0.07	−0.36, 0.49	.760	6.87	.083	55.13	0.10
Attitudes/ evaluations/ expectancies	5	0.25	−0.28, 0.78	.360	8.43	.077	52.56	0.18
Implicit evaluations/ attention	2	−0.38	−2.46, 1.70	.721	9.32	.002	89.28	2.01

Note: When an outcome is not listed under a particular affective state, this indicates that no studies targeting that affective state assessed that outcome. Significant overall effect sizes are bolded. Significant overall effect sizes are bolded. Asterisks indicate main effects with at least one significant moderator.

Table 5.

Impact of Positive Affect on Appetitive Risk Cognitions and Behavior

	k	d	95% CI	p	Q	p (Q)	I^2	Tau^2
Positive affective states (all)								
Behavior	41	*0.08	−0.22, 0.39	.592	264.78	<.001	84.89	0.78
Intentions	22	*0.08	−0.10, 0.25	.392	39.38	.009	46.68	0.08
Craving	5	0.41	−0.26, 1.08	.226	26.66	<.001	85.00	0.48
Attitudes/ evaluations/ expectancies	19	*−0.10	−0.27, 0.07	.238	30.43	.033	40.86	0.06
Implicit evaluations/ attention	12	0.02	−0.17, 0.21	.807	10.56	.480	0.00	0.00
Perceived behavioral control	3	0.30	−0.13, 0.73	.168	2.82	.244	29.01	0.05
Information seeking	5	0.09	−0.37, 0.56	.694	6.83	.145	41.46	0.11
Positive mood								
Behavior	13	0.24	−0.05, 0.52	.104	20.39	.040	46.05	0.11
Craving	2	0.75	−0.59, 2.08	.272	15.27	<.001	93.45	0.87
Attitudes/ evaluations/ expectancies	4	0.02	−0.28, 0.33	.879	1.23	.772	0.00	0.00
Implicit evaluations/ attention	7	−0.13	−0.38, 0.12	.308	2.36	.853	0.00	0.00
Perceived behavioral control	**1**	**0.54**	**0.13, 0.95**	**.009**	-	-	-	-
Amusement								
Behavior	15	*−0.05	−0.47, 0.37	.818	58.70	<.001	76.15	0.45
Intentions	**2**	**0.98**	**0.43, 1.53**	**<.001**	1.13	.288	11.47	0.02
Craving	2	0.42	−0.15, 1.00	.149	0.04	.846	0.00	0.00
Implicit evaluations/ attention	3	0.33	−0.00, 0.66	.052	1.33	.514	0.00	0.00
Information seeking	**1**	**−0.39**	**−0.75, 0.03**	**.032**	-	-	-	-
Contentment								
Behavior	1	0.23	−0.75, 1.22	.645	-	-	-	-
Intentions	2	−0.01	−0.43, 0.41	.961	0.00	.961	0.00	0.00
Craving	1	−0.25	−0.71, 0.21	.286	-	-	-	-
Attitudes/ evaluations/ expectancies	3	−0.23	−0.54, 0.09	.154	1.37	.503	0.00	0.00
Happiness								
Behavior	5	0.00	−0.42, 0.42	.995	6.41	.170	37.61	0.09
Intentions	12	0.02	−0.15, 0.19	.824	5.60	.899	0.00	0.00
Attitudes/ evaluations/ expectancies	10	−0.07	−0.37, 0.24	.674	21.15	.012	57.45	0.13
Implicit evaluations/ attention	2	−0.11	−0.95, 0.73	.802	1.75	.186	42.75	0.16
Information seeking	2	0.38	−0.31, 1.07	.277	0.09	.761	0.00	0.00
Hope								
Intentions	2	0.05	−0.26, 0.35	.773	0.78	.376	0.00	0.00
Attitudes/ evaluations/ expectancies	2	−0.08	−0.74, 0.59	.820	3.27	.057	72.43	0.17
Information seeking	2	0.38	−0.30, 1.07	.275	0.42	.518	0.00	0.00
Pride								
Behavior	7	0.39	−1.45, 2.23	.676	165.76	<.001	96.38	5.80
Intentions	6	0.04	−0.58, 0.66	.889	20.75	.001	75.90	0.45

	k	d	95% CI	p	Q	p (Q)	I^2	Tau^2
Attitudes/ evaluations/ expectancies	5	−0.20	−0.70, 0.30	.429	14.70	.005	72.78	0.22
Implicit evaluations/ attention	2	−0.11	−0.95, 0.73	.802	1.75	.186	42.75	0.16
Surprise								
Intentions	2	−0.09	−0.45, 0.26	.605	0.14	.712	0.00	0.00

Note: When an outcome is not listed under a particular affective state, this indicates that no studies targeting that affective state assessed that outcome. Significant overall effect sizes are bolded. Significant overall effect sizes are bolded. Asterisks indicate main effects with at least one significant moderator.