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The role of positive emotion in harmful health behavior: Implications for theory and public health campaigns

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Meta-analyses have concluded that positive emotions do not reduce appetitive risk behaviors (risky behaviors that fulfill appetitive or craving states, such as smoking and excessive alcohol use). We propose that this conclusion is premature. Drawing on the Appraisal Tendency Framework and related theories of emotion and decision-making, we hypothesized that gratitude (a positive emotion) can decrease cigarette smoking, a leading cause of premature death globally. A series of multimethod studies provided evidence supporting our hypothesis (collective N = 34,222). Using nationally representative US samples and an international sample drawn from 87 countries, Studies 1 and 2 revealed that gratitude was inversely associated with likelihood of smoking, even after accounting for numerous covariates. Other positive emotions (e.g., compassion) lacked such consistent associations, as expected. Study 3, and its replication, provided further support for emotion specificity: Experimental induction of gratitude, unlike compassion or sadness, reduced cigarette craving compared to a neutral state. Study 4, and its replication, showed that inducing gratitude causally increased smoking cessation behavior, as evidenced by enrollment in a web-based cessation intervention. Self-reported gratitude mediated the effects in both experimental studies. Finally, Study 5 found that current antismoking messaging campaigns by the US Centers for Disease Control and Prevention primarily evoked sadness and compassion, but seldom gratitude. Together, our studies advance understanding of positive emotion effects on appetitive risk behaviors; they also offer practical implications for the design of public health campaigns.

emotion | smoking | public health | addictive behavior | public service announcements

Significance

This research provides unique insights into the relationship between positive emotions and appetitive risk behaviors, updating the meta-analytic finding that positive emotions serve no protective effects. Specifically, gratitude is proposed as a positive emotion capable of reducing cigarette smoking—a leading cause of preventable death globally. Correlational studies, including nationally representative US samples and an international sample from 87 countries, consistently indicate an association between gratitude and a reduced likelihood of smoking. Experimental studies further confirm gratitude's causal impact. Importantly, these findings reveal a missed opportunity in costly public health campaigns, which seldom evoke gratitude. By emphasizing gratitude's potential role in mitigating appetitive behaviors, this work opens broad avenues for intervention design in public health.

The field of emotion and decision-making has blossomed into a robust area of inquiry in recent decades, revealing reliable effects of emotions across many decision domains, including risk-taking and intertemporal choices (1–4). Yet, while theory and evidence highlight relations between positive affective states and health (e.g., refs. 5–7), multiple meta-analyses reveal that inducing positive (vs. neutral) affective states has no reliable causal effect on reducing appetitive risk behaviors (ARBs) or related cognitions (8–11). ARBs arise from craving states for hedonic rewards, including smoking, excessive alcohol use, risky sexual behavior, and unhealthy eating (9). This raises a provocative question: Are positive emotions, in fact, powerless to attenuate ARBs?

We contend that such a conclusion may be premature. A plausible explanation for the lack of observed causal effects in prior research is that most experimental studies on ARBs have concentrated on evoking broadly positive moods, paying minimal attention to specific positive emotions. Although one meta-analysis examined some specific positive emotions (amusement, contentment, excitement, happiness, hope, and pride), it found that amusement exacerbated rather than reduced indicators of ARBs, while other positive emotions had null effects (9). However, these studies may have inadvertently overlooked a crucial positive emotion that could attenuate ARBs. Specifically, gratitude might be especially capable of attenuating ARBs, as suggested by social-functional accounts of emotion (12–16) and the Appraisal Tendency Framework (ATF; 2, 17, 18). According to the ATF, each emotion evokes distinct implicit goals and predispositions, shaping appraisals of events in a manner consistent with the emotion's functional ends. These appraisals, though crafted to assist individuals in responding to the event that evoked an emotion, can persist beyond the immediate situation to influence decisions in subsequent, unrelated situations. For example, sadness, associated with appraisals of loss and self-focus, shapes subsequent implicit desires to seek rewards that replace loss and change circumstances—even in unrelated situations (19, 20–24). Such appraisals are not epiphenomenal. Research has shown that self-focused appraisals mediate the relationship between induced sadness and the volume of puffs consumed by people who smoke (21).

Gratitude, typically kindled by others' acts of kindness and generosity, is characterized by appraisals that are conceptually opposite to those of sadness. Rather than focusing on loss

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and the self, gratitude is associated with an enhanced sense of gain and focus on others (25–27). By inciting an implicit goal of acting in prosocial ways and fostering long-term cooperation, it enables individuals to forgo immediate gratification in favor of reciprocation and the establishment of durable, resourceful relationships (28). This paves the way for behaviors that build long-term social capital. We hypothesize that this combination of appraisals and goals along with the overall subjective experience of gratitude are critical to reducing appetitive craving. In contrast, other positive emotions, like happiness and compassion, do not elicit the same goals and appraisals (2, 27). While happiness is associated with an enhanced sense of gain, it does not reliably trigger focus on others. Similarly, while compassion has a high focus on others, it lacks a sense of gain. Thus, gratitude may be more likely than happiness or compassion to reduce appetitive craving. Indeed, trait gratitude, but not happiness, correlates with lower financial impatience (29). Furthermore, the induction of gratitude, unlike happiness, causally decreases financial impatience (28). Given the pivotal role of impatience for reward in ARBs (21, 30), we hypothesize that gratitude, but not all positive emotions, could diminish decisions and actions associated with ARBs. Notably, we do not argue that gratitude is the only positive emotion to produce such effects, as positive emotions are often not well differentiated (31–33).

The Present Research.

We chose to focus our research on a prime example of ARBs, cigarette smoking, based on three primary considerations. First, smoking remains a leading preventable cause of premature death in the United States and globally. Nearly one in eight US adults smokes, which results in an estimated 480,000 premature deaths in the United States each year (34, 35). Globally, projections indicate that tobacco use will result in a staggering one billion premature deaths by the end of this century (36). Second, the design of public antismoking campaigns, especially their emotional appeals, holds potential for further refinement. Emotionally evocative public service announcements have been a staple of many antismoking mass media campaigns since the early 1970s. These media-based strategies possess broad reach and are considered a cost-effective means of informing the public about health risks and promoting cessation (e.g., ref. 37). Yet, most smokers remain unchanged by these campaigns (38). Despite considerable government resources spent on these highly emotional advertisements—the US government spent $490 million on one antismoking campaign (38)—no empirically grounded theory of emotion has systematically guided their design. Finally, because common mechanisms underlie multiple forms of addictive behavior, smoking can serve as an excellent model for investigating other ARB outcomes (39, 40).

Research Overview. Invoking large-scale secondary data to test questions of generality, Studies 1 and 2 examined whether gratitude would correlate with population-level estimates of smoking behavior, using nationally representative US samples and a sample from 87 countries. Studies 3 to 5 used primary data to test questions about causality and finally examined the evidence–practice gap in current public health campaigns. Specifically, Study 3 and its replication sought to assess the causal effects of gratitude on craving to smoke. Study 4 (and its replication) went a step further to evaluate whether gratitude would influence actual behavior relevant to quitting smoking. Finally, having examined the effects of emotions and prepared to offer practical recommendations, Study 5 examined the potential gap between scientific evidence on the value of inducing gratitude and the emotions smokers experience when exposed to current antismoking messaging developed by the US Centers for Disease Control and Prevention (CDC). Collectively, these studies (N = 34,222) leveraged the unique advantages of field data, international samples, experimental designs, and an assessment of reactions to real-world antismoking public health communications.

Open Science Statement. In keeping with guidelines for open science (41), we preregistered all studies involving primary data collection (Studies 3 to 5) and posted all preregistrations, materials, data, and analysis code at https://osf.io/4zkwy/?view_only=759c7624f5c94adc85ec641588e14239. For each experiment, we sought to obtain 80% power for detecting small to medium effect sizes. Although we preregistered to use one-tailed tests for directional hypotheses in all experiments, we report two-tailed P-values to be conservative.

Study 1a

In Study 1a, we analyzed relevant data from the National Study of Youth and Religion research project, which included a nationally representative, longitudinal sample of young people in the United States (wave 3: N = 2,485, age range = 17 to 24 y, 2007 to 2008; wave 4: N = 2,003, age range = 20 to 32 y, 2012; see demographic details in *SI Appendix*, Table S1; other waves do not contain variables relevant to our hypothesis). It is important to examine this age group because most people start smoking regularly before their early 20s (42).

Results. Consistent with predictions, trait gratitude was significantly associated with a lower likelihood of smoking (in logistic regressions; here and below, all bs are standardized; b = −0.17, P < 0.001 in wave 3; b = −0.34, P < 0.001 in wave 4; combined-samples analyses b = −0.23, odds ratio = 0.80, P < 0.001). That is, for each one SD increase in trait gratitude, a person was approximately 20% less likely to smoke. Moreover, trait gratitude also inversely correlated with self-reported frequency of smoking (entire sample; in linear regressions; b = −0.08, P < 0.001 in wave 3; b = −0.15, P < 0.001 in wave 4; combined-samples analyses b = −0.11, P < 0.001). All these relationships held after controlling for age, gender, and/or sadness (*SI Appendix*, Tables S2 and S3).[†] Study 1b presents an opportunity to test the replicability and generality of effects.

Study 1b

In Study 1b, we aimed to test whether trait gratitude, as opposed to trait compassion, would be associated with a lower probability of smoking. As mentioned earlier, gratitude heightens appraisals of gain-focus, other-focus, and positivity, making it especially likely to reduce smoking. In contrast to gratitude, compassion—acknowledged as a positive emotion by both laypeople and experts (43, 44)—does not share the same set of appraisals of gratitude. Compassion typically arises from recognizing undeserved suffering, motivating individuals to alleviate others' suffering and protect the vulnerable (45). Despite its ability to heighten other-focus, compassion lacks a sense of gain and tends to be less positive than gratitude. Therefore, we did not expect compassion to reduce smoking.

We analyzed relevant datasets in the Midlife in the United States (MIDUS) surveys: MIDUS 2 (N = 4,963, 2004 to 2006), MIDUS 2

[*] In economic terms, smoking-related illness in the United States costs greater than $300 billion each year, including direct costs of medical care and lost wages due to illness (38).

[†] The survey measured only one positive emotion (gratitude) and one negative emotion—sadness, which was associated with lower gratitude (r = −0.16, P < 0.001 in wave 3 and r = −0.30, P < 0.001 in wave 4).

Biomarker (N = 1,255, 2004 to 2009), MIDUS 3 (N = 3,294, 2013 to 2014), MIDUS Refresher (N = 3,577, 2011 to 2014), and MIDUS Refresher Biomarker (N = 863, 2012 to 2016). The MIDUS 1 and MIDUS Refresher samples were nationally representative of the United States population aged mid-20s and older (see details in *Materials and Methods* and *SI Appendix*, Table S7).

Results. Consistent with hypotheses, trait gratitude was significantly associated with a lower likelihood of smoking, in all five datasets that measured gratitude (in logistic regressions; bs ranged from −0.40 to −0.19, Ps < 0.001; combined-samples analyses b = −0.26, odds ratio = 0.77, P < 0.001; *SI Appendix*, Table S8). For each one SD increase in trait gratitude, a person was approximately 23% less likely to smoke. Gratitude remained a statistically significant predictor in most cases even after controlling for demographics (age, gender, and socioeconomic status), general positive affect, and/or general negative affect (we examined covariates separately and jointly for robustness check; *SI Appendix*, Tables S9–S12). General positive affect was often significantly associated with a lower likelihood of smoking as well, consistent with the observation that positive emotions are not always well differentiated (*SI Appendix*, Tables S8, S9, S11, and S12). However, as hypothesized, trait compassion was not significantly associated with smoking status in any of the five waves (in logistic regressions; bs ranged from −0.12 to 0.04, Ps > 0.121; combined-samples analyses b = −0.01, odds ratio = 0.99, P = 0.743; *SI Appendix*, Table S8). These conclusions held after controlling for demographics, general positive affect, and/or general negative affect (*SI Appendix*, Tables S9–S12; see *SI Appendix*, Table S13 for the correlations among emotions).

Discussion. Using nationally representative samples that covered a wide age range, we identified robust associations between trait gratitude and a lower likelihood of smoking, even after controlling for demographic variables, positive affect, and negative affect, and even when the operationalization of the variables varied across different surveys.[‡] Moreover, gratitude predicted cessation among smokers 5 to 10 y later, although less consistently than in the cross-sectional analyses, which may be due to the fact that the measures varied over time (see details of longitudinal analyses in *SI Appendix*). In contrast, trait compassion did not significantly predict smoking at any point. Despite the consistent associations between gratitude and lower likelihood of smoking, Study 1 was limited to people in the United States and to having only compassion as a contrast positive emotion. Study 2 addresses these limitations.

Study 2

Study 2 tested whether the relationship between gratitude and smoking would generalize in an international sample and whether this relationship would be stronger for gratitude compared to several other positive emotions. We analyzed the dataset collected by Wang et al. (46), which included 21,644 participants from 87 countries/regions. Unlike in Study 1, however, this study assessed future intentions to use tobacco and other recreational drugs (using one, double-barreled question, which did not allow for distinguishing tobacco from other recreational drug intentions) at the individual level. Furthermore, this study analyzed tobacco use prevalence and cigarette retail sales volume at the country level (see details in *Materials and Methods*).

Results. At the individual level, current feelings of gratitude were associated with significantly lower intentions to use tobacco and other recreational drugs, even after controlling for demographics (age, gender, and education), negative affect, and/or other positive emotions measured (i.e., love, hope, inspiration, and serenity) (in multilevel models; bs ranged from −0.08 to −0.04, Ps < 0.001, N = 87 countries; Fig. 1*A*; *SI Appendix*, Tables S20 and S21). Among the five measured positive emotions, gratitude was the only one that consistently demonstrated significant relationships across various control variables and model specifications (*SI Appendix*, Tables S20 and S21). Furthermore, gratitude frequently exhibited the largest effect size numerically (though not always statistically significantly larger than that of other positive emotions).

At the country level, higher average levels of aggregated gratitude significantly predicted lower prevalence of tobacco use (in linear regressions; bs ranged from −0.57 to −0.31, Ps ≤ 0.010, N = 51 countries having available data; Fig. 1*B*) and lower retail volume of cigarette sales per capita (in linear regressions; bs ranged from −0.76 to −0.53, Ps < 0.001, N = 52 countries having available data; Fig. 1*C*), even after controlling for other specific positive emotions, negative affect, and/or log GDP per capita (*SI Appendix*, Tables S22 and S23). Among the five positive emotions measured, gratitude was the only one that consistently and significantly correlated with lower prevalence of tobacco use and retail volumes of cigarettes across different control variables (*SI Appendix*, Tables S22 and S23). Furthermore, gratitude frequently exhibited the largest effect size numerically (though not always statistically significantly larger than that of other positive emotions).

Discussion. Consistent with theories that take a granular approach to positive affect (e.g., ref. 48), Study 2 revealed that gratitude, unlike the other positive emotions we examined, was robustly associated with a lower prevalence of smoking at both the individual level and the country level in a cross-sectional global sample.[§] However, Studies 1 and 2 did not permit causal tests. It is quite possible that other factors, such as positive life events, could drive variations in both gratitude and smoking. Thus, the question persists: Does gratitude specifically, unlike positive affect more generally, exert a causal effect on smoking?

Study 3

In Study 3 (and its replication), we aimed to determine whether gratitude would causally decrease craving to smoke. We included compassion as a contrasting positive emotion and sadness as a contrasting negative emotion. Our hypothesis was that, relative to a neutral state, gratitude would reduce craving to smoke, while compassion would not reduce craving to smoke, and sadness would increase craving to smoke—consistent with previous findings on the influence of sadness (21). We recruited and randomly assigned adult smokers to one of four emotion-induction conditions: gratitude, compassion, sadness, or neutral (N = 546). Drawing from prior research (21), we used a two-part procedure for our emotion inductions, which involved watching a prevalidated video clip followed by a writing task. We measured craving to smoke before and after emotion induction using three self-report questions from the Brief Questionnaire on Smoking Urges

[‡]It is possible that gratitude indexes stronger social relationships and social support. After controlling for measures of social relationships and social support, however, gratitude continued to correlate significantly with smoking outcomes in 24 out of 27 cases (see details in *SI Appendix*). We thank an anonymous reviewer for this suggestion.

[§]Once again, it remains possible that gratitude indexes stronger social relationships and social support. After controlling for measures of perceived social connection, gratitude continued to correlate significantly with smoking outcomes (see details in *SI Appendix*). We thank an anonymous reviewer for this suggestion.

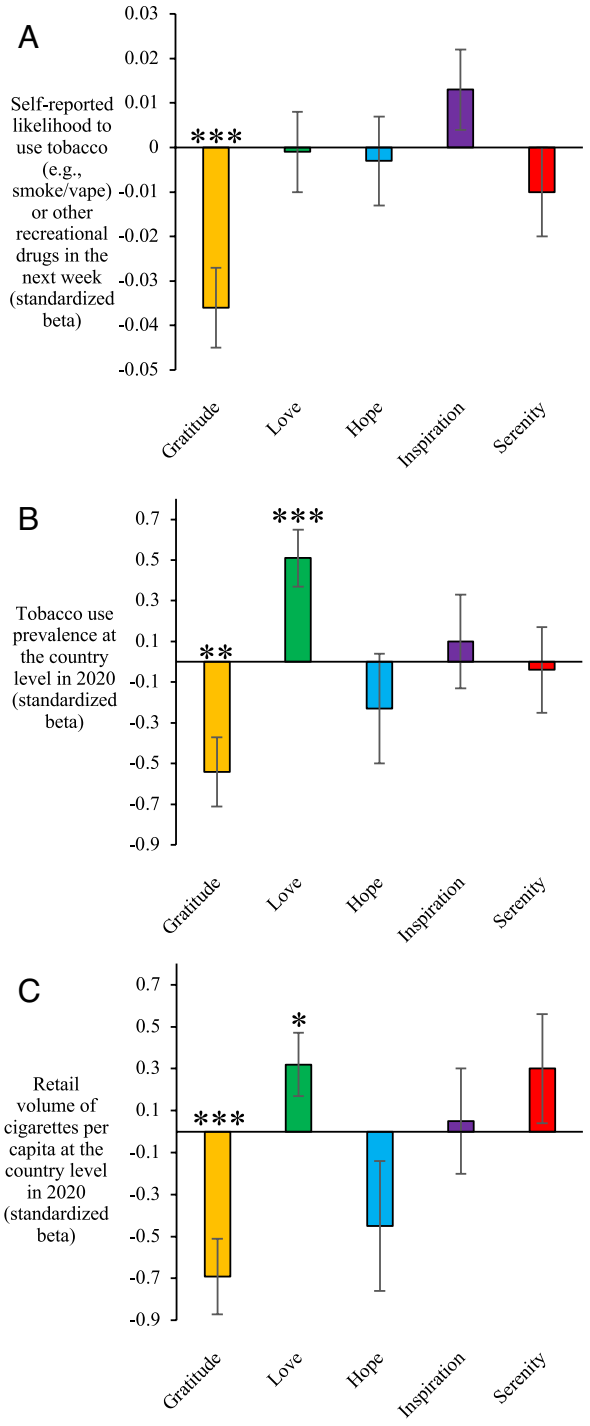

Fig. 1. Study 2: Among all five positive emotions measured, only gratitude consistently predicted reduced smoking. (*A*) At the individual level, gratitude significantly predicted lower behavioral intentions to use tobacco (e.g., smoke/vape) and other recreational drugs after controlling for age, gender, education, negative affect, and other positive emotions measured. (*B*) At the country level, gratitude significantly predicted lower prevalence of tobacco use after controlling for other positive emotions, negative affect, and log GDP per capita. (*C*) At the country level, gratitude significantly predicted lower retail volumes of cigarettes per capita after controlling for other positive emotions, negative affect, and log GDP per capita. Error bars represent 1 SE. To examine potential concerns of multicollinearity, we computed the variance inflation factor (VIF), which measures how much the variance of a regression coefficient is inflated due to multicollinearity in the model. A VIF value that exceeds 10 indicates a problematic amount of collinearity (47). We observed VIFs below 10 and thus concluded that the analyses included acceptable collinearity.

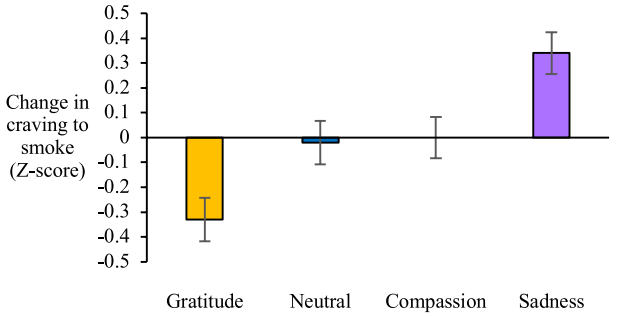

Fig. 2. Study 3: Gratitude significantly decreased cigarette cravings relative to all other conditions. Compassion did not significantly change cigarette cravings relative to a neutral state. Sadness significantly increased cigarette cravings relative to all other conditions. Error bars represent 1 SE. We report raw means and SDs in *SI Appendix*.

(49), which included questions about current craving to smoke (e.g., "I want a cigarette right now").

Results. In this and all following experiments, the emotion induction procedures were effective in eliciting specific, intense emotional responses based on our preregistered standard. We report full results in *SI Appendix*.

Next, we addressed our hypothesis regarding the differential causal effects of gratitude, compassion, and sadness on craving to smoke. We performed pairwise contrasts using *t* tests, with the dependent variable being pre–post change in craving following emotion induction. The results appear in Fig. 2. As predicted, gratitude significantly reduced craving to smoke compared to all other conditions (vs. neutral: $b = -0.31$, SE = 0.12, $t(542) = -2.48$, $P = 0.013$, $d = -0.37$, 95% CI = [−0.63, −0.12]; vs. compassion: $b = -0.33$, SE = 0.12, $t(542) = 2.72$, $P = 0.007$, $d = -0.33$, 95% CI = [−0.57, −0.09]; vs. sadness: $b = -0.67$, SE = 0.12, $t(542) = -5.46$, $P < 0.001$, $d = -0.61$, 95% CI = [−0.85, −0.36]). Consistent with our hypotheses, compassion did not significantly alter craving to smoke compared to a neutral state ($b = 0.02$, SE = 0.12, $t(542) = 0.20$, $P = 0.844$, $d = 0.03$, 95% CI = [−0.22, 0.28]). Replicating prior findings (21), sadness significantly increased craving to smoke compared to a neutral state ($b = 0.36$, SE = 0.12, $t(542) = 2.94$, $P = 0.003$, $d = 0.40$, 95% CI = [0.14, 0.67]). In an exploratory analysis aimed at determining whether emotions themselves, as opposed to unintentional characteristics of the emotion inductions, drove effects, we found that changes in self-reported gratitude before and after emotion induction significantly mediated the effect of gratitude (vs. neutral) on changes in craving ($b = -0.15$, 95% CI = [−0.29, −0.006], SE = 0.07, $z = -2.04$, $P = 0.041$, proportion = 0.43). Unexpectedly, change in self-reported happiness ($b = -0.07$, 95% CI = [−0.13, −0.004], SE = 0.03, $z = -2.08$, $P = 0.038$, proportion = 0.19) and compassion ($b = -0.25$, 95% CI = [−0.41, −0.08], SE = 0.09, $z = -2.92$, $P = 0.003$, proportion = 0.71) were also significant in mediation tests. Changes in other emotions were insignificant in mediation tests. Note that mediation tests may be significant for many reasons other than reflecting genuine mediators (50). For example, significant correlations among these positive emotions could contribute to this phenomenon. Nevertheless, the pattern aligns with the key conceptual hypothesis that changes in emotion per se drive the changes in craving. We discuss this pattern further in *General Discussion*.

Replication. Given the importance of the gratitude effect on craving to theory development and practical application, we tested whether significant differences between the gratitude and

neutral conditions would replicate in an independent sample of smokers. We conducted the preregistered replication study with the gratitude and neutral conditions (N = 194 after exclusion; for methodological details, see *SI Appendix*). Suggesting that gratitude reliably reduces craving, the replication study replicated the effect of gratitude (vs. neutral) on reducing craving to smoke (b = −0.40, SE = 0.15, t(192) = −2.79, P = 0.006, d = −0.40, 95% CI = [−0.69, −0.12]). The same pattern for mediation also replicated: The indirect effect was significant for changes in self-reported gratitude (b = −0.20, 95% CI = [−0.36, −0.03], SE = 0.09, z = −2.30, P = 0.022, proportion = 0.49) and happiness (b = −0.08, 95% CI = [−0.15, −0.001], SE = 0.04, z = −1.98, P = 0.048, proportion = 0.20). We did not measure compassion in this study and changes in other emotions were insignificant in mediation tests.

Because it is difficult to recruit a large number of smokers for research at any given time, we combined samples from the initial study with the replication study. This allowed us to conduct a better-powered analysis and more precise specification of potential effects, a strategy used in prior smoking research (21). Combined-sample analyses of Study 3 and its replication provided more precise estimates for the significant main effect of gratitude on reducing craving to smoke (b = −0.37, SE = 0.09, t(457) = −3.98, P < 0.001, d = −0.39, 95% CI = [−0.58, −0.20]) and the significant mediation effect via changes in self-reported gratitude (b = −0.17, 95% CI = [−0.28, −0.06], SE = 0.06, z = −3.12, P = 0.002, proportion = 0.47) and happiness (b = −0.07, 95% CI = [−0.12, −0.02], SE = 0.03, z = −2.91, P = 0.004, proportion = 0.20).

Discussion. Consistent with our predictions, gratitude, but not compassion, causally reduced craving to smoke. Sadness causally increased craving, replicating prior research (21). To investigate whether the benefits of gratitude might extend beyond self-reported outcomes, we next evaluated whether gratitude could influence behaviors associated with quitting smoking.

Study 4

Study 4 (and its replication) advanced two hypotheses. First, gratitude (vs. neutral) would increase smokers' likelihood of providing supportive advice on quitting to other smokers, given that gratitude has been shown to increase helping behavior toward others (51). Second, gratitude (vs. neutral) would increase self-reported intent to enroll in a smoking cessation program and, most importantly, actual enrollment in such a program. Our rationale was twofold. First, by reminding people of important social relations and values (12), gratitude may help smokers feel supported and less defensive (6, 52) when contemplating the prospect of joining a smoking cessation program. Second, by decreasing craving, gratitude may directly alter smokers' preferences (53) and indirectly trigger appraisals of satiety and increased preference for lasting long-term health benefits over short-term, but ultimately unsatisfying, rewards (28).

We recruited adult smokers who expressed at least minimal future intention to quit smoking (see *Materials and Methods* for details). We randomly assigned participants to either a gratitude- or a neutral-emotion induction condition (N = 169). The emotion inductions were the same as those used in Study 3. After the emotion induction, participants had the opportunity to provide advice to two people who smoke on strategies to quit. Next, we informed participants about a free, high-quality online smoking cessation program developed in collaboration with the Mayo Clinic, and allowed participants to make incentivized choices with lottery tickets to quantify their willingness to enroll in the program. At the end of the survey, we asked all participants who intended to enroll in the program to upload a screenshot of their registration within 1 wk to enter the lottery.

Fig. 3. Study 4: Gratitude significantly increased enrollment in a smoking cessation program relative to a neutral state. Error bars represent 1 SE.

Results. We found support for the most important of the proposed hypotheses: Gratitude (vs. neutral) significantly increased actual enrollment in the smoking cessation program ($M_{gratitude}$ = 40%, $M_{neutral}$ = 24%, odds ratio = 2.16, z = 2.28, P = 0.023, d = 0.43, 95% CI = [0.06, 0.80]; Fig. 3). Contrary to our predictions, gratitude (vs. neutral) did not significantly change the number of words of advice provided by participants in support of other smokers' quitting ($M_{gratitude}$ = 79.20, $M_{neutral}$ = 72.38, t(154.48) = 0.70, P = 0.483, d = 0.11, 95% CI = [−0.20, 0.41]). Nor did gratitude significantly change self-reported intent to enroll in a smoking cessation program compared with neutral, as indexed by the number of lottery tickets required to enroll ($M_{gratitude}$ = 3.77, $M_{neutral}$ = 3.63, t(164.91) = 0.26, P = 0.795, d = 0.04, 95% CI = [−0.26, 0.34]). That is, gratitude exerted the desired effect on actual behavior but not on the level of support offered to others or on self-reported intent to enroll; a pattern we address in *Discussion*.

Replication. Given the importance of the gratitude effect on actual enrollment for theory development and practical application, we ran a preregistered replication study with an identical design (N = 450 after exclusion; for methodological details, see *SI Appendix*). As in Study 3, we hoped to combine samples from the initial study with the replication study to achieve better statistical power and derive more precise specification of effects, per prior research (21). Results revealed that gratitude (vs. neutral) directionally but insignificantly increased actual enrollment in a smoking cessation program ($M_{gratitude}$ = 28%, $M_{neutral}$ = 22%, odds ratio = 1.36, z = 1.41, P = 0.158, d = 0.17, 95% CI = [−0.07, 0.41]). Importantly, the combined-sample analyses of Study 4 and its replication provide evidence for a significant causal effect of gratitude on increasing actual enrollment ($M_{gratitude}$ = 31%, $M_{neutral}$ = 23%, odds ratio = 1.55, z = 2.39, P = 0.017, d = 0.24, 95% CI = [0.04, 0.44])—a 35% increase in enrollment relative to the neutral condition.

Adding credence to the idea that the experience of gratitude accounted for the observed increase in enrollment, exploratory mediation analysis revealed that the magnitude of pre–post change in self-reported gratitude significantly mediated the effect of gratitude (vs. neutral) on increasing enrollment in a smoking cessation program (b = 0.11, 95% CI = [0.01, 0.21], SE = 0.05, z = 2.24, P = 0.025, proportion = 0.43). Other emotions did not significantly mediate the effect.

Discussion. Consistent with our prediction, we observed a causal, positive influence on a cessation-related behavior, as indexed by enrollment in a smoking cessation program. It is puzzling that gratitude exerted a causal effect on enrollment behavior, but not on the number of words or the self-reported intent to enroll. For the advice outcome, it may be that the number of words written was a poor indicator of the help provided. For the self-reported

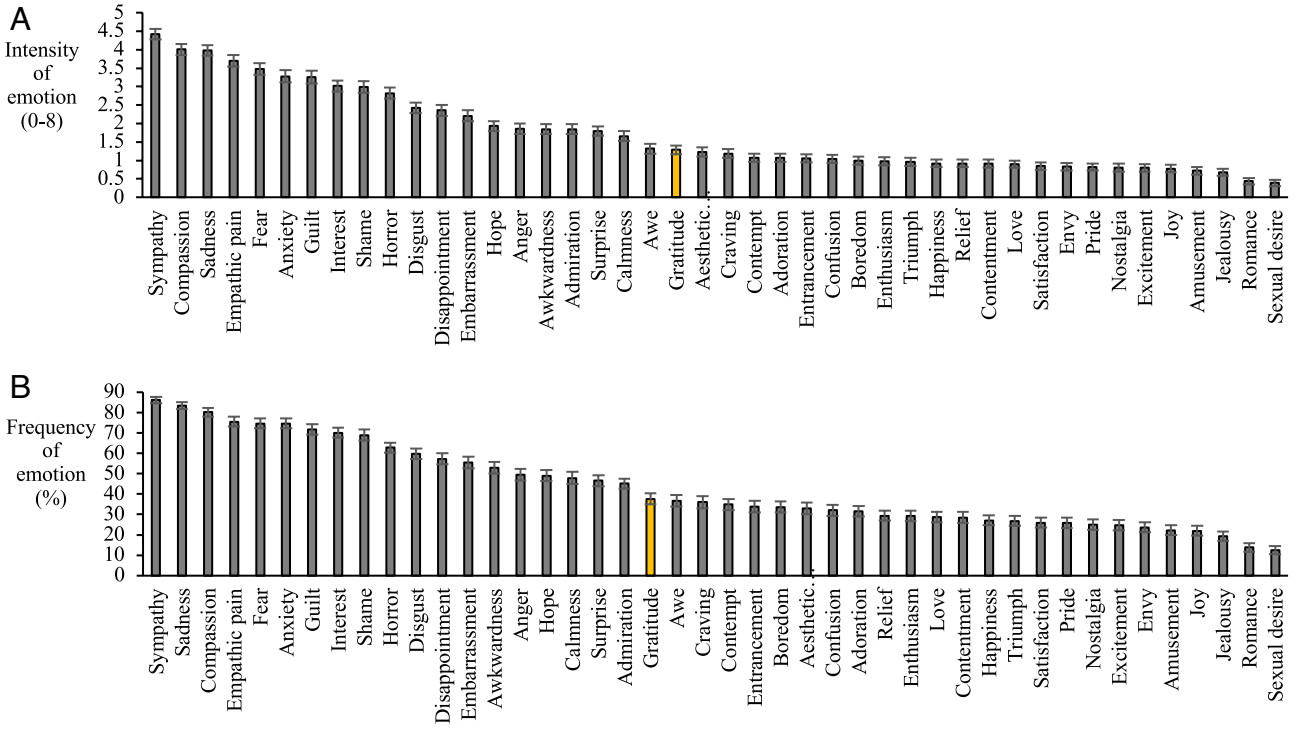

Fig. 4. Study 5: Among the 44 emotions reported by smokers when they watched the videos from the *Tips* campaign, gratitude ranked 21st in intensity (*A*) and 20th in frequency (*B*). Error bars represent 1 SE.

intent outcome, this finding might be explained by the large literature demonstrating gaps between behavioral intentions and actual behavior (54). Moreover, giving advice to others (a helping behavior) might have its own impact on the intention to quit, which could in turn impact the gratitude effect—a possibility that future research could explore.[¶] Overall, however, the findings on actual enrollment into the smoking cessation program reveal the potential for gratitude to promote positive change in appetitive risk behavior. Having observed that gratitude can create behavior change, we turned next to assessing the extent to which current mass-media antismoking campaigns might elicit gratitude.

Study 5

Study 5 aimed to characterize the broad range of emotions experienced by smokers in response to the largest publicly funded antismoking campaign currently in use: the CDC's state-of-the-art antismoking campaign, *Tips from Former Smokers ("Tips")*. *Tips* presents real people who describe in evocative ways the health harms smoking has caused them. As the first federally funded national tobacco education campaign in the United States, *Tips* was launched in 2012 and continues as of 2024. The campaign has cost $490 million and reached millions of people (38). We collected ratings for all 81 videos featured in the *Tips* campaign (at the time of this study) from 194 adult smokers. Each participant watched five randomly selected videos. Each video received evaluations from between 8 and 14 raters. After viewing each video, participants rated the intensity of 44 different emotions that they might have experienced while watching the video, rating them on a nine-point scale (where 0 meant "did not feel at all" and 8 represented "more strongly than ever"). Based on the results of the present studies and prior evidence (21), we hoped that the videos would evoke gratitude more than sadness. Based on prior reports about the *Tips* campaign, however, we preregistered the hypothesis that *Tips* would, on average, evoke gratitude less intensely and less frequently than sadness.

Results. Fig. 4 presents the intensity and frequency of the 44 emotions in decreasing order. The three most intense emotions experienced were sympathy, compassion, and sadness. The intensity of gratitude ranked 21st, with a mean rating less than half that of sadness and the most intensely experienced emotion, sympathy. The three most frequent emotions were sympathy, sadness, and compassion; the frequency of gratitude ranked 20th. Consistent with our hypothesis, gratitude was less intense ($t(193) = -18.39$, $P < 0.001$, $d = -1.32$, 95% CI = [−1.71, −1.13]) and less frequent ($\chi^2 = 39.06$, $P < 0.001$, odds ratio = 0.25) than sadness. In light of our prior findings on the relationship between smoking and compassion, sadness, and gratitude, increasing the frequency and intensity of gratitude-inducing content might allow campaigns such as *Tips* to have greater impact at reducing craving and encouraging cessation.

Discussion. We found that a major public health campaign primarily evoked sympathy, compassion, and sadness, but gratitude far less often. This analysis indicates that current best practices in antismoking communications could leverage the positive emotion of gratitude to yield greater impact.

General Discussion

Our findings underline the power of gratitude to attenuate a key appetitive risk behavior; they also suggest potential improvements for public messaging campaigns. Employing nationally representative US samples and an international sample from 87 countries, we found that gratitude predicted less smoking, even after controlling for numerous covariates; other positive emotions, such as compassion and hope, did not show such strong associations (Studies 1 and 2). In an experimental design (Study 3), results revealed that gratitude, unlike compassion or sadness, significantly

[¶]We thank an anonymous reviewer for this suggestion.

reduced craving to smoke, with self-reported gratitude (and happiness) mediating changes in craving. Further, induced gratitude causally increased smokers' actual quitting behavior, evidenced by enrollment in a cessation program, with self-reported gratitude (but not happiness) again serving as the mediator (Study 4). In contrast with this pattern of results, the state-of-the-art CDC antismoking campaign primarily evoked sadness and compassion among members of the target audience, and seldom gratitude (Study 5).

The coherence observed across multiple outcomes underscores the robustness of the findings with triangulating evidence. Rather than relying solely on a singular measure of smoking behavior (as an indicator of ARB), Studies 1 to 4 investigated multiple facets of engagement with and disengagement from smoking. These facets encompassed indices of current smoking behavior (Studies 1 and 2), behavioral intentions to smoke (Studies 2 and 3), and actions toward smoking cessation (Study 4). While using different operationalizations across studies may sacrifice depth on any particular index, the breadth of our approach offers significant advantages; it acknowledges the multifaceted nature of smoking behavior, allows for a comprehensive examination of its various dimensions, and avoids the risk of detecting a phenomenon that is method dependent. Moreover, although the psychological mechanisms underlying each outcome may vary, the consistent mediation by self-reported gratitude strengthens our overarching conclusions.

The present research contributes to theories of health decision-making from the intersecting fields of affective science, behavioral decision research, addiction science, public health, and communication. By demonstrating the powerful influence of gratitude on an ARB, our findings challenge the conclusion from meta-analyses that positive emotions do not causally reduce such behaviors (8–11). The findings also extend theories of emotion and decision-making by examining positive emotions and addictive behavior, building on previous research that focused predominantly on negative emotions (21), and answer a call to identify the influence of positive emotions on behavior change (55, 56). Moreover, the findings refine and extend several converging theories on the function of positive affect (e.g., refs. 5–8, 55, 57–60) by highlighting the importance of differentiating emotions and extending application into addictive substance use.

The present findings also provide practical implications, offering an empirical basis for developing more effective intervention strategies. Our research provides a solid empirical base and theoretical framework from which to enhance the effectiveness of intentionally emotional antismoking campaigns: a recognized pillar of tobacco control policy intervention. Such publicly funded campaigns must compete with an estimated $8 billion spent annually on advertising and promotion by cigarette manufacturers (61). Given the vast imbalance between corporate tobacco spending and public health spending, it is essential for public campaigns to make efficient use of their resources. Moreover, that such campaigns can now induce gratitude, a positive emotion that triggers cascading positive effects (7, 12, 57, 62), instead of inducing primarily negative emotions and cascading negative effects (9, 63, 64), should result in net policy improvement.

Limitations. While our study represents significant progress across multiple interdisciplinary lines, several aspects require further exploration. First, our theory extends to other ARBs; however, this study exclusively focused on smoking. Evidence that writing gratitude letters causally increases healthy eating (65) provides additional support for our theory. With that said, that study found that reduced negative affect, as opposed to gratitude or positive affect, was the significant mediator. Future research should investigate how and why gratitude might influence other forms of ARBs. Second, the present findings concerning gratitude are limited to gratitude that arises outside the context of smoking. Inducing gratitude within the context of antismoking campaigns could present challenges and may function differently when directly linked to smoking in antismoking campaigns. Different gratitude inductions may be needed at different time points for interventions to be successful, given affective adaptation (66). Third, the findings from Study 4 indicate that enrollment in a cessation program is a promising step toward long-term change but does not confirm enduring cessation. Therefore, future studies could investigate the long-term effects of gratitude induction. Fourth, future research could discern the potentially necessary vs. sufficient, contribution of the two key appraisal dimensions conceptualized in the foregoing studies (i.e., sense of gain and focus on others). Finally, we do not suggest that gratitude is the sole positive emotion capable of curbing ARBs. Other positive emotions, such as awe—which decreases impatience (67) and benefits physical health (68)—may also be viable candidates for further research.

Conclusion. Our research unveils the pivotal role of positive emotions, particularly gratitude, in shaping addictive risk behaviors. This significant departure from the conventional focus on negative emotions enriches our understanding of the emotional dynamics involved in addiction. Our research offers a more nuanced and empirically grounded foundation for designing effective intervention strategies at the population level.

Materials and Methods

Overview. The Committee for the Protection of Human Subjects at Harvard University reviewed and approved all experimental studies (IRB19-1917), with every participant providing their informed consent to participate. Space constraints necessitate the provision of additional details for materials, procedures, and preregistered exclusion criteria in *SI Appendix*.

Study 1a. We analyzed only the waves from the National Study of Youth and Religion (NSYR) that contained variables relevant to our hypothesis. Specifically, we included wave 3 (N = 2,485, 51% female; M age = 20.02, SD age = 1.45) and wave 4 (N = 2,003, 53% female; M age = 25.95, SD age = 1.47), as only these waves contained variables relevant to our hypothesis. The original NSYR telephone survey (69) employed a random-digit-dialing (RDD) method with in-house subject randomization to sample nationally representative households with youth aged 13 to 17, while oversampling Jewish households and providing a Spanish language version to enhance inclusivity. However, attrition rates of 26% in wave 3 and 41% in wave 4 reduced the sample's representativeness relative to census figures (for detailed information, see *SI Appendix*). We did not use weighting or modeling in any survey studies.

Trait gratitude was measured as the average of three items in both wave 3 and wave 4: "Long amounts of time can go by before you feel grateful to something or someone" (reverse coded), "You have so much in life to be thankful for," and "When you look at the world, you don't see much to be grateful for" (reverse coded) (α = 0.50 wave 3 and α = 0.62 wave 4, 70).[#] Participants answered on a four-point scale recoded from 1 (strongly disagree) to 4 (strongly agree). No other positive emotions were measured. For negative emotions, only sadness was measured. In wave 3, sadness was measured with a single item "How often do you feel very sad or depressed?" Participants answered on a five-point scale recoded from 1 (never) to 5 (always). In wave 4, sadness was measured with a single item: "Over the past 2 weeks, how often have you been bothered by

[#]The first item may require careful reading to realize its use of negation, and it is possible that some participants may have overlooked the negation, leading to low reliability. Indeed, we found that this item has lower correlations with other items in the scale (rs = 0.12 and 0.19) compared to the correlation between the other two items (r = 0.43) in wave 3. Reassuringly, when examining each of the three items of gratitude separately, all results remained significant or marginally significant, indicating that the relationships were not driven by a subset of items but were similar for each item.

feeling down, depressed, or hopeless?" Participants answered on a four-point scale recoded from 1 (not at all) to 4 (nearly every day).

Smoking status was measured differently in the two waves. In wave 3, participants were asked: "How often, if at all, do you smoke cigarettes?" Participants chose one of seven responses, from "never" (coded as 0) to "once a day or more" (coded as 6). In wave 4, participants were asked: "Have you used cigarettes at least a pack a month?" Participants chose one of four responses "No, never" (coded as 0), "Yes, once or a few times" (coded as 1), "Yes, regularly at some point in the past 5 years" (coded as 2), "Yes, regularly in the past 4 weeks" (coded as 3). The two measures positively correlated with each other across the two waves, $r = 0.69$, $t(1,748) = 39.37$, $P < 0.001$. For a robustness check, we also analyzed smoking status both as a dichotomous and as a continuous variable.

Study 1b. We analyzed only the waves from the Midlife in the United States project that contained variables relevant to our hypothesis. The original sample of MIDUS 1 (71) consisted of participants from four distinct groups: 1) a national RDD sample (49%); 2) siblings of individuals from the RDD sample (13%); 3) a national RDD sample comprising twin pairs (27%); and 4) additional samples from five US metropolitan areas (11%). Relative to MIDUS 1, the attrition rates were 30% in MIDUS 2, 82% in MIDUS 2 Biomarker, and 54% in MIDUS 3. Such attritions impacted the sample's representativeness, which we describe in *SI Appendix*. The original sample of MIDUS Refresher consisted of participants drawn from RDD and list frame (i.e., a list of phone number/address combinations) targeted to decadal age brackets (for detailed information on the sample, see *SI Appendix*). We reported detailed demographic information in *SI Appendix*, Table S7.

Gratitude was measured by a single item in MIDUS 2, 3, and Refresher: "On a daily basis, how often do you experience the following: A sense of deep appreciation." Participants answered on a four-point scale ranging from 1 (never) to 4 (often). Gratitude was measured as the average of two items in MIDUS 2 Biomarker and Refresher Biomarker: "I have so much in life to be thankful for" and "I am grateful to a wide variety of people" ($\alpha = 0.71$ in both waves) (70). Participants answered on a seven-point scale ranging from 1 (strongly disagree) to 7 (strongly agree). Compassion was measured as the average of four items in all waves (e.g., "I am moved when I hear of another person's hardship"; αs ranged from 0.44 to 0.50 across waves) (72). Participants answered on a seven-point scale ranging from 1 (strongly disagree) to 7 (strongly agree). Smoking status was a binary variable of whether the person currently smokes regularly (1) or not (0) in all datasets. For robustness checks, we examined the following control variables: gender, age, socioeconomic status (standardized average of education and log household income), general positive affect, and general negative affect. In MIDUS 2, 3, and Refresher, general positive affect was measured by 10 items (αs ranged from 0.93 to 0.94; "cheerful," "in good spirits," "extremely happy," "calm and peaceful," "satisfied," "full of life," "enthusiastic, "attentive," "proud," and "active") (73). In MIDUS 2 Biomarker and Refresher Biomarker, general positive affect was measured by 14 items ($\alpha = 0.93$ in both waves; "felt cheerful," "felt optimistic," "felt really happy," "was proud of myself," "felt like I was having a lot of fun," "felt like I had a lot of energy," "felt really up or lively," "looked forward with enjoyment," "had a lot of interesting things to do," "felt like I had accomplished a lot," "felt had a lot to look forward to," "felt hopeful about the future," "seemed to move quickly and easily," and "felt really good about myself") (74). In MIDUS 2, 3, and Refresher, general negative affect was measured by 14 items (αs range from 0.92 to 0.93) (73). In MIDUS 2 Biomarker and Refresher Biomarker, general negative affect ($\alpha = 0.83$ and 0.81, respectively) was proxied by the average of depressive (12 items) (74) and anxious (11 items) (74) symptoms.

Study 2. The Psychological Science Accelerator recruited participants via a combination of semirepresentative paneling (based primarily on sex and age) and convenience sampling by 186 member laboratories (for detailed information on the sample, see ref. 46). The final dataset included 21,644 participants from 87 countries/regions (63.41% female, 35.34% male, 0.45% other genders, 0.80% preferred not to say/missing response; M age = 31.91, SD age = 14.52; see *SI Appendix*, Table S11 for sample size per country/region). We examined the baseline emotions measured before experimental manipulation in the original study (conclusions hold for emotions measured after experimental manipulation). Each positive emotion was measured by a single item on a five-point scale ranging from 1 (not at all) to 5 (extremely) and from the modified Differential Emotions Scale (57). Gratitude was measured by asking, "To what extent do you feel grateful, appreciative, or thankful?" Hope was measured by asking, "To what extent do you feel hopeful, optimistic, or encouraged?" Love was measured by asking, "To what extent do you feel love, closeness, or trust?" Inspiration was measured by asking, "To what extent do you feel inspired, uplifted, or elevated?" Serenity was measured by asking, "To what extent do you feel serene, content, or peaceful?" Negative affect was the average of five items measuring fear, anger, sadness, stress, distrust ($\alpha = 0.83$). Intention to use tobacco and other recreational drugs was measured by asking, "During the next week, how likely is it that you will use too much tobacco (e.g., smoke/vape) or other recreational drugs?" (Although this item was measured after experimental manipulation, conditions did not differ significantly on this item; The survey did not ask whether participants are current smokers.) Participants answered on a seven-point scale ranging from 1 (extremely unlikely) to 7 (extremely likely). Given that 71.28% of the participants selected "extremely unlikely," we examined this outcome as both a dichotomous and a continuous variable in our analysis to ensure robustness. To account for the nested structure in our data (e.g., participant nested by country), we fit multilevel models with random by-country intercepts.

For country-level analysis, we calculated the average level of each emotion (without weighting by sample size) for countries with at least 30 participants and linked several national indicators. Specifically, we obtained prevalence of current tobacco use in 2020 from the World Health Organization (https://data.worldbank.org/indicator/SH.PRV.SMOK), which indicated the percentage of the population aged 15 y and over that currently use any tobacco product (smoked and/or smokeless tobacco) on a daily or nondaily basis ($N = 51$ countries had available data for analysis). We also obtained the retail volume of cigarettes in 2020 from the Passport database (https://www.euromonitor.com/our-expertise/passport) ($N = 52$ countries had available data for analysis). For control variable, we obtained GDP per capita from the World Bank (https://data.worldbank.org/indicator/NY.GDP.PCAP.CD). After graphically observing linear relationships, we applied linear regression models for the country-level analysis.

Study 3. We recruited 600 adult smokers via Amazon Mechanical Turk's CloudResearch high-quality pool. After applying preregistered exclusion criteria (https://aspredicted.org/R4K_KCN), our final sample consisted of 546 participants (51.47% male, 47.99% female, 0.55% other genders, mean age = 37.04, age range = 18 to 71 y). Given the final sample in each condition, sensitivity power analyses indicated that t tests under standard criteria (alpha = 0.05 and 80% power) could detect $d \geq 0.35$. Participants first reported their current emotional state on 20 items adapted from previous research on emotion and decision-making (21). Three items tapped gratitude (grateful, appreciative, and thankful), five tapped compassion (compassionate, sympathetic, moved, concerned, and touched), three tapped sadness (sad, blue, depressed), and three tapped neutrality (indifferent, neutral, unemotional). We also included several other filler emotion items (e.g., angry, happy). Next, participants rated the truthfulness of each of three statements about themselves on a 101-point scale ranging from 0 (not true of me at all right now) to 100 (extremely true of me right now). The three statements reflected immediate craving ("I crave a cigarette right now"; "I have an urge for a cigarette right now"; "All I want right now is a cigarette"; $\alpha = 0.96$) and came from the Brief Questionnaire on Smoking Urges (49).

After recording baseline levels of craving, we randomly assigned participants to one of four emotion conditions. We induced emotions by instructing participants to watch a prevalidated video clip and complete a writing task. Participants in the gratitude condition watched a short clip from the movie *Awakenings*, in which a man receives unexpected help from his colleagues; participants then wrote about a time they received help from another person. Participants in the compassion condition watched a clip showing children suffering from malnutrition and starvation (75); they then wrote about a time when they learned about another person's undeserved suffering and wished to help them. Participants in the sadness condition watched a short clip from the movie *Up* in which a man loses his life partner (21); they then wrote about a time they experienced significant loss. Finally, participants in the neutral condition watched a clip about wood furniture making and then wrote about where they spent their typical day. Immediately following the emotion induction, participants answered the same three craving items from earlier in the survey. After completing the craving measure, participants answered questions regarding the emotion manipulation check, exploratory items, and demographics.

Study 4. We recruited 200 adult smokers via Amazon Mechanical Turk's CloudResearch high-quality pool. The screening question required at least minimal future intention to quit, as reflected by a self-report rating of at least 1 (of a possible 0 to 10) on the Contemplation Ladder (a validated measure of readiness to consider smoking cessation) (76).[‖] After applying preregistered exclusions (https://aspredicted.org/83N_6BY) and excluding an additional 10 people who, prior to the study, already had accounts at the free smoking-cessation website representing our dependent variable (*BecomeAnEx*), we ended up with a final sample of 169 participants (56.80% male, 43.20% female, mean age = 38.98, age range = 20 to 77 y). We selected the *BecomeAnEx* program because it is an evidence-based intervention developed in collaboration with the Mayo Clinic Nicotine Dependence Center, in accordance with the US Public Health Service Clinical Practice Guidelines (77). Given the final sample in each condition, sensitivity power analyses indicated that *t* tests under standard criteria (alpha = 0.05 and 80% power) could detect $d \geq 0.45$.

The emotion inductions were the same as those used in Study 3. Participants were randomly assigned to either the gratitude or neutral condition. Immediately following the emotion induction, we introduced two smokers with texts and audio recordings (based on information collected from another study). One smoker asked how to avoid smoking when feeling bored or stressed. Another smoker asked what had helped the participant the most in terms of quitting. Participants then could answer the questions (giving advice) or skip to the next section. Next, we informed participants of a free online smoking cessation program, *BecomeAnEx,* and allowed them to make incentivized choices to quantify their willingness to enroll. Specifically, we asked participants whether they were willing to create an online account with the program within the next week in exchange for one lottery ticket for a $25 prize. If participants chose to enroll, we told them we would provide them with the link and steps to create an online account at the end of the survey. If participants initially chose not to enroll, the algorithm increased the number of lottery tickets offered (to 5, 10, 20, 40, 80, 160, and 320) and prompted them once more to consider enrollment. Therefore, the scale of willingness to enroll ranged from 0 (unwilling to enroll even with 320 lottery tickets) to 8 (willing to enroll for just one lottery ticket). Participants then continued to answer survey questions regarding the emotion manipulation check, exploratory items, and demographics. At the end of the survey, we asked participants who agreed to enroll in the online smoking cessation program to upload a screenshot of their registration within 1 wk to enter their tickets for the lottery prize. We then assigned a code of 1 for participants who uploaded a screenshot of their account within 1 wk of the survey, indicating actual enrollment, and a code of 0 for those who either did not upload a screenshot or opted not to enroll.

Study 5. We recruited 204 adult smokers via Amazon Mechanical Turk. After applying preregistered exclusions (https://aspredicted.org/EXX_YVK), we ended up with a final sample of 194 participants (47.94% male, 51.55% female, 0.52% other genders; mean age = 34.72, age range = 19 to 76 y). Each participant viewed five randomly selected videos from a comprehensive set of 81 videos available in the *Tips* campaign (as of the time we conducted this study). Between 8 and 14 raters assessed each video. By compiling items from three taxonomies of emotion (43, 78, 79), we generated a comprehensive list of 44 emotions, which we presented in random order. After watching each video, participants indicated how much they felt each of those 44 emotions while watching the video on a nine-point scale ranging from 0 (did not feel at all) to 8 (more strongly than ever). We assessed frequency as the percentage of scores greater than 0 on the nine-point scale.

Data, Materials, and Software Availability. Anonymized data have been deposited in OSF (https://osf.io/4zkwy/?view_only=759c7624f5c94adc85ec641588e14239) (80).

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[‖]In Study 3, where we did not have this screening question, only 1.83% of participants reported 0 on the Contemplation Ladder. Therefore, Study 4 included nearly 98% of potential participants and the findings should be generalizable to most smokers.

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1. D. Dukes *et al.*, The rise of affectivism. *Nat. Hum. Behav.* **5**, 816–820 (2021).
2. J. S. Lerner, Y. Li, P. Valdesolo, K. S. Kassam, Emotion and decision making. *Annu. Rev. Psychol.* **66**, 799–823 (2015).
3. G. F. Loewenstein, E. U. Weber, C. K. Hsee, N. Welch, Risk as feelings. *Psychol. Bull.* **127**, 267–286 (2001).
4. H. C. Lench, S. A. Flores, S. W. Bench, Discrete emotions predict changes in cognition, judgment, experience, behavior, and physiology: A meta-analysis of experimental emotion elicitations. *Psychol. Bull.* **137**, 834–855 (2011).
5. L. G. Aspinwall, Rethinking the role of positive affect in self-regulation. *Motiv. Emot.* **22**, 1–32 (1998).
6. B. L. Fredrickson, The role of positive emotions in positive psychology: The broaden-and-build theory of positive emotions. *Am. Psychol.* **56**, 218–226 (2001).
7. S. D. Pressman, B. N. Jenkins, J. T. Moskowitz, Positive affect and health: What do we know and where next should we go? *Annu. Rev. Psychol.* **70**, 627–650 (2019).
8. D. S. Cameron, E. J. Bertenshaw, P. Sheeran, The impact of positive affect on health cognitions and behaviours: A meta-analysis of the experimental evidence. *Health Psychol. Rev.* **9**, 345–365 (2015).
9. R. A. Ferrer *et al.*, The role of incidental affective states in appetitive risk behavior: A meta-analysis. *Health Psychol.* **39**, 1109–1124 (2020).
10. B. W. Heckman *et al.*, Influence of affective manipulations on cigarette craving: A meta-analysis. *Addiction* **108**, 2068–2078 (2013).
11. M. Um, R. Revilla, M. A. Cyders, A meta-analytic review of the effectiveness of mood inductions in eliciting emotion-based behavioral risk-taking and craving in the laboratory. *Emotion* **23**, 214–229 (2023).
12. S. B. Algoe, Find, remind, and bind: The functions of gratitude in everyday relationships. *Soc. Personal. Psychol. Compass* **6**, 455–469 (2012).
13. D. Keltner, J. J. Gross, Functional accounts of emotions. *Cogn. Emot.* **13**, 467–480 (1999).
14. D. Keltner, J. Haidt, Social functions of emotions at four levels of analysis. *Cogn. Emot.* **13**, 505–521 (1999).
15. P. M. Niedenthal, M. Brauer, Social functionality of human emotion. *Annu. Rev. Psychol.* **63**, 259–285 (2012).
16. M. N. Shiota, B. Campos, D. Keltner, M. J. Hertenstein, "Positive emotion and the regulation of interpersonal relationships" in *The Regulation of Emotion*, P. Philippot, R. S. Feldman, Eds. (Lawrence Erlbaum Associates Publishers, 2004), pp. 127–155.
17. J. S. Lerner, D. Keltner, Fear, anger, and risk. *J. Pers. Soc. Psychol.* **81**, 146–159 (2001).
18. J. S. Lerner, C. A. Dorison, J. Klusowski, "How do emotions affect decision making?" in *Emotion Theory – The Routledge Comprehensive Guide*, A. Scarantino, Ed. (Routledge, in press), **vol. 2**.
19. S. H. Chaudhury, N. Garg, "Heart strings and purse strings" revisited: A preregistered replication and extension. *J. Exp. Psychol. Gen.* **152**, 1873–1886 (2023).
20. C. E. Cryder, J. S. Lerner, J. J. Gross, R. E. Dahl, Misery is not miserly: Sad and self-focused individuals spend more. *Psychol. Sci.* **19**, 525–530 (2008).
21. C. A. Dorison *et al.*, Sadness, but not all negative emotions, heightens addictive substance use. *Proc. Natl. Acad. Sci. U.S.A.* **117**, 943–949 (2020).
22. N. Garg, L. A. Williams, J. S. Lerner, The misery-is-not-miserly effect revisited: Replication despite opportunities for compensatory consumption. *PLoS One* **13**, e0199433 (2018).
23. R. Raghunathan, M. T. Pham, All negative moods are not equal: Motivational influences of anxiety and sadness on decision making. *Organ. Behav. Hum. Decis. Process.* **79**, 56–77 (1999).
24. S. B. Shu, J. Peck, Psychological ownership and affective reaction: Emotional attachment process variables and the endowment effect. *J. Consum. Psychol.* **21**, 439–452 (2011).
25. D. E. Forster, E. J. Pedersen, M. E. McCullough, D. Lieberman, Evaluating benefits, costs, and social value as predictors of gratitude. *Psychol. Sci.* **33**, 538–549 (2022).
26. M. E. McCullough, S. D. Kilpatrick, R. A. Emmons, D. B. Larson, Is gratitude a moral affect? *Psychol. Bull.* **127**, 249–266 (2001).
27. C. A. Smith, E. M. W. Tong, P. C. Ellsworth, "The differentiation of positive emotional experience as viewed through the lens of appraisal theory" in *Handbook of Positive Emotions*, M. M. Tugade, M. N. Shiota, L. D. Kirby, Eds. (The Guilford Press, 2014), pp. 11–27.
28. D. DeSteno, Y. Li, L. Dickens, J. S. Lerner, Gratitude: A tool for reducing economic impatience. *Psychol. Sci.* **25**, 1262–1267 (2014).
29. L. Dickens, D. DeSteno, The grateful are patient: Heightened daily gratitude is associated with attenuated temporal discounting. *Emotion* **16**, 421–425 (2016).
30. W. K. Bickel, L. A. Marsch, Toward a behavioral economic understanding of drug dependence: Delay discounting processes. *Addiction* **96**, 73–86 (2001).
31. B. Campos, M. N. Shiota, D. Keltner, G. C. Gonzaga, J. L. Goetz, What is shared, what is different? Core relational themes and expressive displays of eight positive emotions *Cogn. Emot.* **27**, 37–52 (2013).
32. P. C. Ellsworth, C. A. Smith, Shades of joy: Patterns of appraisal differentiating pleasant emotions. *Cogn. Emot.* **2**, 301–331 (1988).
33. A. C. Weidman, J. L. Tracy, Picking up good vibrations: Uncovering the content of distinct positive emotion subjective experience. *Emotion* **20**, 1311–1331 (2020).
34. National Center for Chronic Disease Prevention and Health Promotion (US) Office on Smoking and Health, *The Health Consequences of Smoking–50 Years of Progress: A Report of the Surgeon General* (Centers for Disease Control and Prevention (US), 2014) (November 9, 2023).
35. M. E. Cornelius, Tobacco product use among adults – United States, 2021. *MMWR Morb. Mortal. Wkly. Rep.* **72**, 475–483 (2023).

36. M. B. Reitsma *et al.*, Spatial, temporal, and demographic patterns in prevalence of smoking tobacco use and attributable disease burden in 204 countries and territories, 1990–2019: A systematic analysis from the Global Burden of Disease Study 2019. *Lancet* **397**, 2337–2360 (2021).
37. S. Athey, K. Grabarz, M. Luca, N. Wernerfelt, Digital public health interventions at scale: The impact of social media advertising on beliefs and outcomes related to COVID vaccines. *Proc. Natl. Acad. Sci. U.S.A.* **120**, e2208110120 (2023).
38. S. S. Shrestha *et al.*, Cost effectiveness of the tips from former smokers® campaign–U.S., 2012–2018. *Am. J. Prev. Med.* **60**, 406–410 (2021).
39. G. F. Koob, N. D. Volkow, Neurocircuitry of addiction. *Neuropsychopharmacology* **35**, 217–238 (2010).
40. J. O. Prochaska, W. F. Velicer, The transtheoretical model of health behavior change. *Am. J. Health Promot.* **12**, 38–48 (1997).
41. J. P. Simmons, L. D. Nelson, U. Simonsohn, False-positive psychology: Undisclosed flexibility in data collection and analysis allows presenting anything as significant. *Psychol. Sci.* **22**, 1359–1366 (2011).
42. CDC, Youth and tobacco use. https://www.cdc.gov/tobacco/data_statistics/fact_sheets/youth_data/tobacco_use/index.htm. Accessed 18 August 2023.
43. D. Keltner, J. S. Lerner, "Emotion" in *Handbook of Social Psychology*, S. T. Fiske, D. T. Gilbert, G. Lindzey, Eds. (John Wiley & Sons Inc., ed. 5, 2010), **vol. 1**, pp. 317–352.
44. J. E. Stellar, A. Cohen, C. Oveis, D. Keltner, Affective and physiological responses to the suffering of others: Compassion and vagal activity. *J. Pers. Soc. Psychol.* **108**, 572–585 (2015).
45. J. L. Goetz, D. Keltner, E. Simon-Thomas, Compassion: An evolutionary analysis and empirical review. *Psychol. Bull.* **136**, 351–374 (2010).
46. K. Wang *et al.*, A multi-country test of brief reappraisal interventions on emotions during the COVID-19 pandemic. *Nat. Hum. Behav.* **5**, 1089–1110 (2021).
47. R. M. O'brien, A caution regarding rules of thumb for variance inflation factors. *Qual. Quant.* **41**, 673–690 (2007).
48. M. N. Shiota *et al.*, Beyond happiness: Building a science of discrete positive emotions. *Am. Psychol.* **72**, 617–643 (2017).
49. L. S. Cox, S. T. Tiffany, A. G. Christen, Evaluation of the brief questionnaire of smoking urges (QSU-brief) in laboratory and clinical settings. *Nicotine Tob. Res.* **3**, 7–16 (2001).
50. K. Fiedler, M. Schott, T. Meiser, What mediation analysis can (not) do. *J. Exp. Soc. Psychol.* **47**, 1231–1236 (2011).
51. L. K. Ma, R. J. Tunney, E. Ferguson, Does gratitude enhance prosociality?: A meta-analytic review. *Psychol. Bull.* **143**, 601–635 (2017).
52. T. Epton, P. R. Harris, R. Kane, G. M. van Koningsbruggen, P. Sheeran, The impact of self-affirmation on health-behavior change: A meta-analysis. *Health Psychol.* **34**, 187–196 (2015).
53. N. Schwarz, "Feelings as information: Informational and motivational functions of affective states" in *Handbook of Motivation and Cognition: Foundations of Social Behavior*, E. T. Higgins, R. M. Sorrentino, Eds. (The Guilford Press, 1990), **vol. 2**, pp. 527–561.
54. P. Sheeran, T. L. Webb, The intention–behavior gap. *Soc. Personal. Psychol. Compass* **10**, 503–518 (2016).
55. M. N. Shiota, E. K. Papies, S. D. Preston, D. A. Sauter, Positive affect and behavior change. *Curr. Opin. Behav. Sci.* **39**, 222–228 (2021).
56. M. N. Shiota, C. Vornlocher, L. Jia, Emotional mechanisms of behavior change: Existing techniques, best practices, and a new approach. *Policy Insights Behav. Brain Sci.* **10**, 201–211 (2023).
57. B. L. Fredrickson, "Positive emotions broaden and build" in *Advances in Experimental Social Psychology*, P. Devine, A. Plant, Eds. (Academic Press, 2013), pp. 1–53.
58. A. M. Isen, An influence of positive affect on decision making in complex situations: Theoretical issues with practical implications. *J. Consum. Psychol.* **11**, 75–85 (2001).
59. A. M. Isen, "Some ways in which positive affect influences decision making and problem solving" in *Handbook of Emotions*, M. Lewis, J. M. Haviland-Jones, L. F. Barrett, Eds. (The Guilford Press, ed. 3, 2008), pp. 548–573.
60. S. D. Pressman, S. Cohen, Does positive affect influence health? *Psychol. Bull.* **131**, 925–971 (2005).
61. CDC, Tobacco industry marketing. https://www.cdc.gov/tobacco/data_statistics/fact_sheets/tobacco_industry/marketing/index.htm. Accessed 18 August 2023.
62. A. M. Wood, J. J. Froh, A. W. A. Geraghty, Gratitude and well-being: A review and theoretical integration. *Clin. Psychol. Rev.* **30**, 890–905 (2010).
63. L. C. Gallo, K. A. Matthews, Understanding the association between socioeconomic status and physical health: Do negative emotions play a role? *Psychol. Bull.* **129**, 10–51 (2003).
64. A. A. Madison, M. R. Shrout, M. E. Renna, J. K. Kiecolt-Glaser, Psychological and behavioral predictors of vaccine efficacy: Considerations for COVID-19. *Perspect. Psychol. Sci.* **16**, 191–203 (2021).
65. M. M. Fritz, C. N. Armenta, L. C. Walsh, S. Lyubomirsky, Gratitude facilitates healthy eating behavior in adolescents and young adults. *J. Exp. Soc. Psychol.* **81**, 4–14 (2019).
66. T. D. Wilson, D. T. Gilbert, Explaining away: A model of affective adaptation. *Perspect. Psychol. Sci.* **3**, 370–386 (2008).
67. M. Rudd, K. D. Vohs, J. Aaker, Awe expands people's perception of time, alters decision making, and enhances well-being. *Psychol. Sci.* **23**, 1130–1136 (2012).
68. M. Monroy, D. Keltner, Awe as a pathway to mental and physical health. *Perspect. Psychol. Sci.* **18**, 309–320 (2023).
69. Youth and Religion, Research Design. https://youthandreligion.nd.edu/research-design/. Accessed 7 March 7, 2024.
70. M. E. McCullough, R. A. Emmons, J.-A. Tsang, The grateful disposition: A conceptual and empirical topography. *J. Pers. Soc. Psychol.* **82**, 112–127 (2002).
71. O. G. Brim *et al.*, Midlife in the United States (MIDUS 1), 1995-1996: Version 19 (1999), 10.3886/ICPSR02760.V19. Accessed 7 March, 2024.
72. Y. Uchida, S. Kitayama, Development and validation of a sympathy scale. *Jpn. J. Psychol.* **72**, 275–282 (2001).
73. D. K. Mroczek, C. M. Kolarz, The effect of age on positive and negative affect: A developmental perspective on happiness. *J. Pers. Soc. Psychol.* **75**, 1333–1349 (1998).
74. D. Watson *et al.*, Testing a tripartite model: I. Evaluating the convergent and discriminant validity of anxiety and depression symptom scales. *J. Abnorm. Psychol.* **104**, 3–14 (1995).
75. S. Côté *et al.*, Social power facilitates the effect of prosocial orientation on empathic accuracy. *J. Pers. Soc. Psychol.* **101**, 217–232 (2011).
76. L. Biener, D. B. Abrams, The Contemplation Ladder: Validation of a measure of readiness to consider smoking cessation. *Health Psychol.* **10**, 360–365 (1991).
77. A. L. Graham *et al.*, Improving adherence to smoking cessation treatment: Intervention effects in a web-based randomized trial. *Nicotine Tob. Res.* **19**, 324–332 (2017).
78. A. S. Cowen, D. Keltner, Self-report captures 27 distinct categories of emotion bridged by continuous gradients. *Proc. Natl. Acad. Sci. U.S.A.* **114**, E7900–E7909 (2017).
79. R. A. Ferrer, W. M. P. Klein, J. S. Lerner, V. F. Reyna, D. Keltner, "Emotions and health decision making" in *Behavioral Economics and Public Health*, C. A. Roberto, I. Kawachi, Eds. (Oxford University Press, 2015), pp. 101–132.
80. K. Wang, V. W. Rees, C. A. Dorison, I. Kawach, J. S. Lerner, Data from "The role of positive emotion in harmful health behavior: Implications for theory and public health campaigns". OSF. https://osf.io/4zkwy/?view_only=759c7624f5c94adc85ec641588e14239. Deposited 6 May 2024.