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## Effects of moral frames within vaping prevention messages on current smokers' support for electronic cigarettes regulations

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### Abstract

Given the rise of communication campaigns to prevent and reduce the use of electronic nicotine delivery systems among minors nationwide, it is important to examine whether certain preventive messages will spill over to affect current adult smokers' support and compliance with vaping regulations. Drawing upon the Moral Foundations Theory, the current study experimentally examined the effects of moral frames on current adult smokers' support for vape-free policies and marketing restrictions. An online sample of current smokers ( $N=630$ ) were randomly assigned to a 3 (vaping-prevention moral frames: care, purity, non-moral control) x 2 (priming of anti-smoking messages: yes or no) between-subject survey experiment. Compared with non-moral framed messages, smokers exposed to both care and purity framed messages were more likely to support vape-free policies in public places. Such effects were stronger for smokers with the higher pre-treatment endorsement of the purity value, driven less by anger or disgust but more by smokers' updating of both self-oriented and secondhand harm perceptions. Moral frames, especially those appealing to care and purity moral values, are thus promising messaging strategies for vaping prevention communication campaigns in terms of increasing current smokers' support for vape-free policies. Results also help improve our understanding of the moral roots of health policy opinions and the potential of deploying moral framing to improve message design for health campaigns.

### Keywords

Moral frames; Moral Foundation Theory; vape-free policy support; electronic nicotine delivery systems; communication campaigns

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Declaration of interest statement

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Introduction

Controversies remain whether adopting electronic nicotine delivery systems (ENDS), such as electronic cigarettes or e-cigarettes (also known as vaping products), could encourage smoking cessation among adult smokers (CDC, 2020). Recent meta-analyses of randomized controlled trials, however, suggest that e-cigarettes may be superior to nicotine replacement therapies and non-nicotine placebos for cessation especially among intensive users (Zhang et al., 2021; Chan et al., 2021). Although e-cigarettes might help improve cessation for adult smokers, they still pose health risks to non-smokers. The Centers for Disease Control and Prevention (CDC) alerted the public for the harm of vaping after a national outbreak of vaping product use-associated lung injury (EVALI) between 2019 and 2020 (CDC, 2020). More concerning is the rapidly increasing use of e-cigarettes among young people that put them at risk of nicotine addiction and other health risks (FDA, 2020). To prevent the initiation of e-cigarette use among children and adolescents, one promising strategy is to garner public support and implement vaping regulations such as vape-free policies and marketing restrictions. Vaping in public places may re-glamorize smoking due to the similarity between vaping and smoking (Tan, Bigman & Sanders-Jackson, 2015), and adolescents are susceptible to normative influences regarding e-cigarette use (Duong & Liu, 2019; Vogel et al., 2018). Therefore, implementing vape-free policies in public arenas and restricting marketing e-cigarettes to youth are likely to reduce minors' exposure to vaping behaviors and deter the development of pro-vaping norms, facilitating vaping prevention efforts as a result. Since current smokers, especially those already using e-cigarettes or interested in trying such vaping products, will be the relevant group to whom such vape-free policies would apply, it is important to understand messaging strategies that can increase current smokers' support for such regulations.

Strategic deployment of message frames in communication health campaigns can be effective in improving audiences' health-related attitudes and behaviors (Shen, 2011; Fishbein & Cappella, 2006). Message attributes such as gain and loss frames (Nan, 2012), emotional appeals (Nabi, 2003), numbers (Yang et al., 2020) and normative appeals (Pechmann, & Knight, 2002), can influence individual responses towards health messages. Although motivating desirable health behavioral changes is often the golden goal for communication-based health interventions, spillover effects on policy opinions can be beneficial for social good and are worth considering as well (Cho & Salmon, 2007). A growing body of research revealed that moral considerations often form the basis for policy opinions (Ju & You, 2020; Haidt, 2012; Prinz, 2007); however, few studies have examined how frames appealing to morality in tobacco control messaging may affect health policy opinions. A handful of previous studies found that perceived personal responsibilities for health-promotion endeavors are often rooted in moral values (Guttman & Ressler, 2001; Wang & Yang, 2021), and portrayals of vaping even within promotional e-cigarette advertisements can increase smokers' support for vape-free policies particularly among those with higher endorsement of the care/harm moral value (Yang et al., 2018). That said, more research is needed to directly test the spillover effects of moral frames deployed within tobacco control messaging on vaping policy opinions and examine underlying psychological mechanisms. This study aims to address this gap.

## Moral Foundations and Moral Frames

In health message design, different conceptualizations and operationalizations of message framing exist. In this study, we focus on emphasis framing that selectively highlight certain aspects of a health issue (e.g., vaping) via deploying semantic foci at different levels ranging from subtle words to narrative structures (O'Keefe & Nan, 2012). A message is effective when selected semantic elements resonate with the cognitive schemas already existing in message recipients' minds (McLeod & Shah, 2014; Scheufele, 1999), because frame-schemas matching facilitates relevant information processing (McGuire, 1972; Wan, 2008). Moral framing is a subtype of emphasis message framing and deploys semantic elements that appeal to deeply seated moral foundations, which refer to the six fundamental dimensions structuring the complex space of human morality (Graham et al., 2011; Haidt, 2012; Iyer et al., 2012). According to the moral foundations theory (MFT), the six moral foundations include care/harm, fairness/cheating, loyalty/betrayal, authority/subversion, sanctity/degradation and liberty/oppression (Graham et al., 2011; Haidt, 2012; Iyer et al., 2012).

In previous research, moral framing based on MFT is demonstrated effective in shaping policy support, partially because individuals use moral values to make normative judgements—that is whether a position is *right* or *wrong* (Haidt, 2012; Prinz, 2007). One observational study found that between-person differences in the endorsement of one or several MFT dimensions can uniquely explain variances in opinions towards controversial sociocultural issues beyond standard predictors (Koleva et al., 2012). Strategically selected moral frames that appeal to the moral values highly endorsed by liberals versus conservatives, respectively, enhanced sustainable behaviors and pro-environmental opinions across partisan divides (Kidwell, Farmer & Hardesty, 2013). Advocacy statements framed in conservative-endorsed moral values such as the purity/degradation foundation increased conservatives' support for that policy, whereas liberals were in favor of arguments framed in liberal-endorsed moral values such as the care/harm foundation (Feinberg & Willer, 2015). This burgeoning literature on the persuasiveness of moral frames increased our confidence in finding a similar pattern in the case of tobacco control messages.

Among the six moral foundations, the care/harm foundation reflects human's adaptive normalization of the communal responsibilities to protect the offspring and the vulnerable. In tobacco control research, considerations about secondhand smoking are often associated with the care/harm foundation (Katz, 1997; Borland et al., 2006). We expected a similar connection between the care/harm foundation and concerns for secondhand harms from vaping. A recent study found that individuals' endorsement of the care/harm foundation strengthened the effects of visual vaping cues within e-cigarette video advertisements, albeit in the direction of increasing smokers' support for vape-free policies (Yang et al., 2018).

Apart from the care/harm foundation, the purity/degradation foundation should also be considered as another contributor to forming health policy opinions. The purity/degradation foundation reflects abhorrence for disgusting objects such as pathogens and rotten food, and this moral domain gradually expanded from physical hygiene to include spiritual and psychological cleanliness (Graham, et al., 2018). Given this foundation's evolutionary root

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in protecting individuals from diseases, it is not surprising that the purity value is empirically related to health-related attitudes and opinions, such as predicting vaccine hesitancy (Amin et al., 2017). In the context of vape-free policies, the e-cigarette aerosol contains toxic chemicals (Margham et al., 2016). Vaping in public places may evoke purity concerns, such as the repulsion against inhaling “disgusting” chemicals from another e-cigarette user. Although both the care/harm and the purity/degradation foundations may play a role in shaping opinions towards vaping restrictions, no previous research has sought to empirically tease out the respective influences of message frames appealing to these moral values. Our study fills this gap by experimentally testing the respective causal impacts of the care versus purity moral frames in vaping prevention messaging on current smokers’ policy opinions. Given the lack of prior research on other MFT dimensions related to health behaviors, we focus on care and purity in the current study.

**H1a–b:** Compared with smokers randomized to receive no non-moral vaping preventive messages, those randomized to vaping prevention messages deploying care moral frames will report: (a) more support for vape-free policies; and (b) more support for vape-marketing restrictions.

**H2a–b:** Compared with smokers randomized to receive no non-moral vaping preventive messages, those randomized to vaping prevention messages deploying purity moral frames will report: (a) more support for vape-free policies; and (b) more support for vape-marketing restrictions.

Given that part of the reason why moral frames could be effective is due to the frame-schema matching, the effects of moral frames in vaping preventive messages are likely to be moderated by individuals’ prior endorsement of the corresponding moral foundation. This matching effect has been documented in previous research testing pro-environmentalism messages (Feinberg et al., 2015; Kidwell et al., 2013; Wolsko et al., 2016) and more recently in the context of e-cigarette advertisements (Yang et al., 2018). Smokers with greater endorsement of the care/harm foundation may find the corresponding care frames more effective due to their preexisting cognitive schemas. We expect a similar matching effect where purity frames will produce more policy support among those with higher endorsement of the purity/degradation foundation.

**H3a–b:** The more current smokers endorse the care/harm foundation, exposure to vaping preventive messages deploying care frames (versus the no-message control) will produce more support for (a) vape-free policies and (b) for vape-marketing restrictions.

**H4a–b:** The more current smokers endorse the purity/degradation foundation, exposure to vaping preventive messages deploying purity frames (versus the no-message control) will produce more support for (a) vape-free policies and (b) for vape-marketing restrictions.

To better understand the cognitive and emotional mechanisms when smokers process moral frames, this current study tested four potential mediators based on previous research: secondhand harms perceptions, self-harms perceptions, anger, and disgust. Secondhand harm perceptions concern how one’s own vaping behavior might harm others whereas

self-harm beliefs concern perceived harms on one's own health. Previous studies found that perceived less harm of e-cigarettes in general related to increased e-cigarette use (Amrock et al., 2015), yet without differentiating the differences between perceived harms to oneself versus others. Anger and disgust are also examined to explore whether such emotional responses would mediate the effects of moral frames on policy opinions. These two emotions often empirically co-occur in response to moral violations and have both been established to affect moral opinion formation (Cameron et al., 2015; Horberg et al., 2011; Gray & Wegner, 2011; Rozin et al., 2008).

**H5a-d:** When modeled as multiple mediators, (a) perceived harms of secondhand vaping, (b) perceived chemical damage, (c) anger, and (d) disgust will respectively mediate the effects of purity as well as care frames on smokers' support for vaping regulations.

## Method

### Research design

This study employed a 3 (vaping-prevention moral frames: care, purity, non-moral frame control) x 2 (priming of anti-smoking messages: yes or no) between-subject factorial design. The original design also included a no-message control condition, which was not central to the analyses reported here and was hence omitted from further analyses. Participants were randomized to view vaping prevention flyers with messages that deployed either care, purity, or non-moral frames. In addition to vaping prevention messages, approximately half of all participants were also randomized to view six pictorial anti-smoking messages prior to the e-cigarette flyer. These anti-smoking messages were presented as warning labels and were programmed to use the same type of moral frames as the ensuing vaping prevention messages. A supplementary analysis was conducted to explore whether exposure to anti-smoking messages employing the same moral appeals might moderate the effects of the followed-up anti-vaping messages. The interaction effects crossing the factor of anti-smoking exposure (yes vs. no) with vaping-prevention moral frames (care/purity vs. control) were non-significant (see Table S1 in the appendix). Therefore, the factor of anti-smoking message priming was dropped and collapsed in following analyses. The study protocol was approved by the Institutional Review Board (IRB).

### Message Stimuli Development and Validation

Two types of message stimuli were used in this study: textual anti-vaping messages (TAVMs) and pictorial anti-smoking messages (PASMs). Message stimuli were selected based on crowdsourced moral foundation scores provided by a separate sample of adult current smokers (see Supplementary Materials for details). In this message rating pilot study, each of the TAVMs ( $N=122$ ) and PASMs ( $N=90$ ) in the original pool was evaluated by at least 25 randomly selected raters. A set of the six strongest instances of moral frames per foundation were selected. The full set of selected stimuli used in the current study can be found in Supplementary Materials Table S4 (for examples, see Table 1 below). The original pool of TAVMs and PAVMs were available upon request to the corresponding author.

**Textual anti-vaping messages (TAVMs) development.**—A textual anti-vaping message that deploys moral appeals makes a moral argument linking consequences of e-cigarette vaping to moral foundations through two components based on previous research on moral frames (Feinberg & Willer, 2015; Kidwell et al., 2013; Wolsko et al., 2016): 1) a normative claim reinforcing the importance of the targeted moral foundation (e.g., “Caring for children is the parents’ primary responsibility.”), and 2) a consequence-based argument (O’Keefe & Salmon, 2013) where either avoiding vaping is claimed to indicate compliance with the targeted moral foundation (e.g., “Avoiding vaping around your vulnerable children is the best protection for their well-being.”) or continuing to vape is claimed to indicate violation of the targeted moral foundation (e.g., “Vaping around children represents a potential danger that may damage their health, a deviation from being a caring parent”). A consequence-based argument could present a claim on factual consequence with or without explicitly mentioning abstract moral values. However, message recipients may still choose to interpret such factual consequences in moral terms. Because distinguishing which type of TAVM represents a stronger form of moral appeals goes beyond the purpose of the current study, we chose to keep both types of consequence-based arguments and rely upon crowdsourcing to scale these messages along moral dimensions. All textual stimuli were developed by extracting and revising segments of passages from e-cigarette news coverage and opinion pieces identified through manual online search, and factual claims included both revised excerpts from news pieces as well as quoted statements issued by credible scientific organizations (e.g., American Heart Association). For details on stimuli development for pictorial anti-smoking messages (PASMs), see Supplementary Materials.

**Non-moral control messages development.**—Non-moral framed messages were developed to control for valence (anti-tobacco), topic, and participant attention. General control TAVMs included statements emphasizing health risks and safety concerns posed by e-cigarettes on users themselves, while minimizing references with any of the specific themes related to moral foundations. Similarly, general control PASMs portrayed potential harms on smokers themselves and urged them to quit. Importantly, in control messages, no specific references to secondhand harms and the “disgusting” aspects of chemical constituents were made.

## Participants

Adult current smokers were recruited from Survey Savvy International (now Dynata), a marketing and survey company that maintains a large national online panel in Fall 2018. To be eligible, participants must be adults who have smoked at least 100 cigarettes in their lifetime and currently smoke cigarettes “every day” or “some days”. In total, 630 current smokers were included. In the analytical sample, most smokers had a smoker living in their house or as acquaintances/friends (92.9%), have tried e-cigarettes in the past (71.3%). Around 29.4% of recruited current smokers had never heard about or tried e-cigarettes, while 35% tried but not in the past 30 days. Another 36% of the sample used e-cigarettes at least once in the past 30 days, of whom 36% were current vapers who used e-cigarettes every day or some days.

As for demographics, about 10% of the smoker sample were between 18–24 years old, and the majority were 45 years old and above (66.3%). A slightly more than half of the sample were female (52.7%). Most had completed some college-level education or more (81.3%), had no children (83.7%), were non-Hispanic (83.3%), predominantly white (71.0%), and had household income below \$50,000 (53.8%). Slightly more smokers self-identified as Democratic (35.7%) than Republican (31.6%) and other (32.7%).

## Measures

Means and standard deviations of all variables, as well as their full correlation matrix, can be found in the Supplementary Materials (see Table S2 and Table S3 in the appendix).

**Care and purity moral values.**—Measures for these two moral values were taken from the Moral Foundations Questionnaire (Graham et al., 2011). Each moral value was measured using 6 items and the first three were moral judgements and the other three were moral relevancy questions. For the care value, the moral judgement asked three questions about respondents' agreement or disagreement on a six-point Likert-type scale (1 = *strongly disagree* and 6 = *strongly agree*): 1) compassion for those who are suffering is the most crucial virtue, 2) one of the worst things a person could do is hurt a defenseless animal, and 3) it can never be right to kill a human being. The moral relevance of care value was also asked by three questions on a six-point Likert-type scale (1 = *not at all relevant—this consideration has nothing to do with my judgments of right and wrong* and 6 = *extremely relevant—this is one of the most important factors when I judge right and wrong*). Smokers were asked “When you decide whether something is right or wrong, to what extent are the following considerations relevant to your thinking” for items “Whether or not someone suffered emotionally”, “Whether or not someone cared for someone weak or vulnerable”, and “Whether or not someone was cruel” (Cronbach's for care value = 0.79,  $M = 4.54$ ,  $SD = 0.99$ ). For the purity value, the three relevance considerations are “Whether or not someone violated standards of purity and decency”, “Whether or not someone did something disgusting”, and “Whether or not someone acted in a way that God would approve of” (Cronbach's for purity value = 0.81,  $M = 3.8$ ,  $SD = 1.10$ ). The purity moral judgement were measured on “People should not do things that are disgusting, even if no one is harmed”, “I would call some acts wrong on the grounds that they are unnatural”, and “Chastity is an important and valuable virtue.” (Cronbach's for purity value = 0.81,  $M = 3.80$ ,  $SD = 1.10$ ).

### Perceived harms of secondhand vaping.

Two questions were asked on a five-point Likert-type scale (1 = *not at all* and 5 = *very much*) beginning with “If you were to start vaping e-cigarettes every day, to what extent do you agree or disagree with the following statements?” on two statements: 1) “My exhaling vapor from e-cigarettes would be harmful to the health of people around me.”; and 2) “I would be concerned that vapor from my e-cigarettes could affect the health of people around me.” (Pearson correlation = 0.89,  $M = 3.38$ ,  $SD = 1.37$ ).

### Perceived harms of vaping on self.

Two questions were asked on a five-point Likert-type scale (1 = *not at all* and 5 = *very much*) beginning with “If you were to start vaping e-cigarettes every day, to what extent

do you agree or disagree with the following statements?" on two statements: 1) "I would be exposed to harmful ingredients"; and 2) "I would be inhaling toxic chemicals." (Pearson correlation = 0.86, M = 3.61, SD = 1.28)

### **Anger and disgust.**

After exposure to the message stimuli, participants were asked to what degree (*1 = not at all* and *5 = very much*) they felt *angry, mad, furious and pissed off*, a four-item scale to represent angry emotion (Cronbach's alpha = 0.95, M = 1.69, SD = 1.04). The same five-point Likert-type scale was applied to another four items, disgusted, sickened, nauseated, and grossed out to measure disgusted feelings (Cronbach's alpha = 0.94, M = 1.88, SD = 1.15)

### **Policy support for vaping regulation.**

Subjects were asked on a five-point Likert-type scale (*1 = strongly disagree* and *5 strongly agree*) for their opinions about two policies. The first policy was about vaping-free and the second was about vaping-marketing restrictions. For opinions about vaping free, respondents were asked to what extent they agree or disagree "Vaping e-cigarettes should be banned in places where smoking tobacco cigarettes is banned", "Vaping e-cigarettes should be banned from being used indoors in bars, casinos and clubs", "Vaping e-cigarettes should be banned from being used in public parks" and "Vaping e-cigarettes should be banned from being used indoors in restaurants". Scores from the four items were averaged for each participant (Cronbach's alpha = 0.91, M = 3.62, SD = 1.11). For opinions about vaping marketing, two statements were evaluated: "Marketing and advertising e-cigarettes to youth under 18 years should be banned", and "E-cigarette advertising should be banned in places where cigarette advertising is banned (e.g., television and radio)" (Cronbach's alpha = 0.71, M = 4.01, SD = 1.01). These two policy questions were validated in previous research (Tan et al., 2015). Higher values on the two questions mean more support for vaping restriction. Table 2 showed the mean of all outcomes in each experimental condition.

### **Statistical analyses**

A series of linear regression models with the ordinary least squares (OLS) estimator were fitted to examine the main effects of moral framing conditions as well as their interactions with moral values on the two policy outcomes. To address the interaction effects (H3a-b – H4a-b), we added the cross-product terms multiplying condition dummies with the care value and with the purity value, respectively, in two separate models. The indirect effects through anger, disgust, and harm perceptions (H5a-d) were tested in a path model (Hayes, 2017). Furthermore, Model 8 in Hayes' PROCESS macro was estimated using the statistical programming language *R* (Rosseel, 2012) to carry out moderated mediation analyses where pre-treatment moral values were allowed to moderate the effects of vaping prevention messages on mediators (i.e., the "a paths"). The four mediators were entered and estimated simultaneously allowing covariances with each other. Bootstrapping was used to estimate the indices for moderated mediation and the indirect effects through each mediator.

## Results

### Main effects of care and purity framing messages (H1a-b & H2a-b)

Estimated coefficients were reported in Table 3. Compared with no moral framed messages, current smokers exposed to both care and purity framed messages were more likely to support vape-free in public places. However, regarding support for marketing restriction, smokers were not influenced by moral frames. H1a and H2a were supported whereas H1b and H2b were not. These results were largely robust with or without covariates (see Table S8 in Supplementary Materials).

### Moderating effects of endorsing the care and purity values (H3a-b & H4a-b)

Regarding care value, the interaction effects between predisposed care value and care frames were only marginally significant for either policy opinion, although the coefficients were in the expected direction. H3a-b were not supported. Although not hypothesized, purity frames increased policy support to a greater extent for smokers with higher endorsement of the care value.

With that said, there was a significant moderation effect of purity moral values with matched moral frames (Table 3). OLS regressions showed that on average, for one unit's increase in participants' preexisting purity value endorsement, purity frames' power to improve support for vape-free policies was enhanced by 0.31, and for marketing restrictions by 0.24 on a 5-point scale. Interestingly, preexisting purity value also interacted with care frames, such that for current smokers with higher purity value endorsement, the effects of care frames were stronger in the direction to increase their support for both vaping-restriction policies. H3a-b were partially supported. H4a-b were fully supported by data. In summary, we found significant interactions between care values and purity frames, and similarly between purity values and both purity and care frames.

### Mediating roles of harm perceptions and emotions (H5a-d)

Figure 1 and Table 4 summarized the estimated indirect effect of harm perceptions (second and self-harm perceptions) and emotions (anger and disgust).<sup>1</sup> All mediators were allowed to covary with each other. For support for vape-free policies, we found that beliefs in secondhand harm and beliefs in self-harm positively mediated the effects of both the care and purity frames. We found a similar pattern supporting the indirect effects of these two harm perceptions related to the outcome of supporting marketing restrictions, again mediating the effects of both moral frames. By contrast, anger and disgust were not significant mediators except for one pathway: disgust mediated the effects of purity frame on support for vape-free policies. Figure 1 further decomposed the indirect effects into the constituting a-paths linking message frames conditions to mediators, and the b-paths linking mediators to policy outcomes.

Given that the effects of moral frames on policy opinions varied by pre-treatment endorsement of the care and purity moral values, we explored whether such moral values

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<sup>1</sup>Both purity and care value were median split into high versus low groups to estimate interaction effects.

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might have further moderated the indirect effects through harm perceptions and emotions, respectively. Following the specification in Model 8 in Hayes' (2015) PROCESS macro implemented in the statistical programming language *R*, we allowed care and purity moral values to moderate the effects of moral frames on each of the four mediators (i.e., interaction effects between moral frame conditions and moral values on the "a paths") while keeping the associations between mediators and the policy opinion outcomes intact (i.e., no moderation on the "b paths"). Among the estimated indices for moderated mediation pathways (see Table 5 for details) through bootstrapping (samples = 5000), only the indirect pathway linking purity frames to current smokers' support for vape-free policies through experienced disgust were significantly amplified by pre-treatment endorsement of either the care or purity moral value. In other words, for current smokers with higher endorsement of the care or purity moral value prior to message exposure, they experienced more disgust upon exposure to purity-framed vaping prevention messages, which in turn increased their likelihood to support vape-free policies. See Table 5 for detailed estimates for all estimated indices for moderated mediation analyses.

## Discussion

As regulators and public health professionals ramp up their efforts in rolling out vaping prevention campaigns targeting minors nationwide, it is important to understand how adult smokers react to such messages. This study showed experimentally that care and purity-based moral frames within anti-vaping messages can increase current smokers' support for vape-free policies but not for marketing restrictions. If implemented, vape-free policies would impact adult smokers given their potential interest in using e-cigarettes for smoking cessation. Given that e-cigarette aerosol still contains a host of harmful chemicals and particles (Layden et al., 2020), moral frames appealing to the care/harm foundation (e.g., secondhand harms) and the purity/degradation foundation (e.g., chemical constituents) are promising messaging strategies to garner support from adult current smokers for vape-free policies.

Winning current smokers' support is critical to reduce children and adolescents' exposure to adult vaping behaviors in indoor public spaces, hence facilitating vaping-prevention efforts among youth as a result. Our findings are consistent with previous research studying the moral roots of health behaviors, such as the linkage between the purity/degradation foundation and vaccine hesitancy (Amin et al., 2017), the general moralization of smoking over time in the US (Rozin & Singh, 1999), and more recently the relevance of the care/harm foundation to explain visual vaping cues' effects on vape-free policy support (Yang et al., 2018).

The non-significant main effects on support for marketing restriction suggests that moral frames' impacts on policy opinions might depend upon the closeness between the targeted policy domain and the frame's moral foundation. Whereas the issue of secondhand vaping is directly related to moral evaluations of how one's action of vaping could harm someone else vulnerable (care/harm) or threaten their bodily cleanliness with disgusting chemicals (purity/degradation), the issue of marketing restriction does not involve directly inflicting harm on the vulnerable and hence might not be morally salient enough for current smokers

with low endorsement of care and purity moral values. Our moderation analyses offered some preliminary evidence for this speculation. Purity frames produced more support for marketing restriction among smokers with higher endorsement of the purity value, and a similar pattern was observed for the issue of vape-free policies. Interestingly, care frames' effects to increase both types of policy support were also stronger among those with higher pre-existing purity value endorsement. In previous research, the purity/degradation moral foundation was strongly associated with vaccine hesitancy (Amin et al., 2017), and disgust manipulation produced more opposition to genetically modified food and smoking among participants with higher trait disgust sensitivity (Clifford & Wendell, 2015). Our findings are consistent with these studies highlighting the roles of purity concerns for health behaviors. Countering our hypotheses, the reinforcement effects between care frames and care value endorsement were only marginally significant, although the coefficients were in the expected directions for both policy outcomes; and care value showed amplification effects for purity frames instead. For vaping prevention campaigns designed to increase smokers' support for vaping regulations, this overall pattern of interactions suggests that purity-based moral frames are likely to be more effective for current smokers highly endorsing either the care or the purity value. For online campaigns, one promising way to identify such smokers is to utilize digital trace data, as current smokers with similar moral values may form a closely knitted online community—this speculation is consistent with the documented moral homophily effect (Dehghani et al., 2016). Also, expressed moral sentiment can be detected through natural language processing techniques (Hoover et al., 2020). Future health campaigns could consider delivering morally framed campaign messages to different online communities varying in their dominant moral values.

In addition, purity frames used in our study were not completely free from containing care elements (see Supplementary Materials Table S2), although purity frames indeed deployed considerably more purity-related semantic elements than the other two conditions based on our pilot message rating data. This might explain the observed interaction effects between care values and purity frames. Although this difficulty of eliminating care elements from purity frames is unlikely to alter our substantive conclusions emphasizing the effects of *both* care *and* purity frames over non-moral control messages, future research should seek alternative ways to further “purify” moral appeals and better isolate the effects of purity versus care frames.

Mediation analyses showed that both care and purity frames' impact on increased policy support were primarily channeled through perceived harms to self as well as to others. Although secondhand harm perceptions serve as the underpinning of the care/harm foundation, in the context of tobacco use, perceived harms to self reflects the purity/degradation foundation's concern with one's own bodily and spiritual purity that might be polluted by chemicals. Consistent with previous research highlighting the roles of harm perceptions in forming vape-free policy opinions (Mello et al., 2016; Yang et al., 2018), we found that anger and disgust played a much weaker mediating role than harm perceptions. These mediation analyses demonstrated that the moral frames tested in this study are not merely anger- or disgust-mongering; rather, their impacts on policy support were driven more by current smokers' reasoning and updating of harm perceptions.

One limitation of the present research is not having tested other moral foundations such as authority, loyalty and fairness. Moreover, the current study is under-powered to include vaping status as a potential moderator to test three-way interactions, though previous research found that college students' support for vape-free campus policy was related to vaping status and self-affirmation (Jun, Wen & Wu, 2020). Future research is encouraged to recruit a better-powered sample to test how existing e-cigarette use might further condition the reinforcement effects between moral values and moral frames, considering the rapid growth of vaping behaviors in past years (e.g., Tattan-Birch et al., 2023). We also did not examine the potential differential reactions to moral frames between current versus former smokers in terms of impacts on support for vaping regulations. Since former smokers have a higher chance of using vaping products for quitting, their reactions to vaping prevention messages, particularly those deploying moral frames, may be less favorable. We encourage future research to examine how smoking and vaping status may jointly moderate reception to morally framed vaping prevention messages. Lastly, it is important to examine to what degree moral frames might reduce current smokers' intentions to completely switch to e-cigarettes. Given that e-cigarettes represent a less harmful substitute to combustible cigarettes, gains in support for vaping regulations need to be weighed against the risk of deterring smokers from harm reduction. Policy appealing to strict restrictions such as sanctions for noncompliance may be perceived as a threat of freedom and induce psychological reactance (Kriss et al., 2022), or cause moral injury (Bayerle et al., 2022).

Despite the limitations, the current study contributes to the emerging body of research investigating the effects of moral frames on public opinions towards tobacco regulatory policies. We hope this study will provide insights to help practitioners better design care/purity framed messages in vaping prevention campaigns, considering the identified spillover effects to increase smokers' support for e-cigarette regulations.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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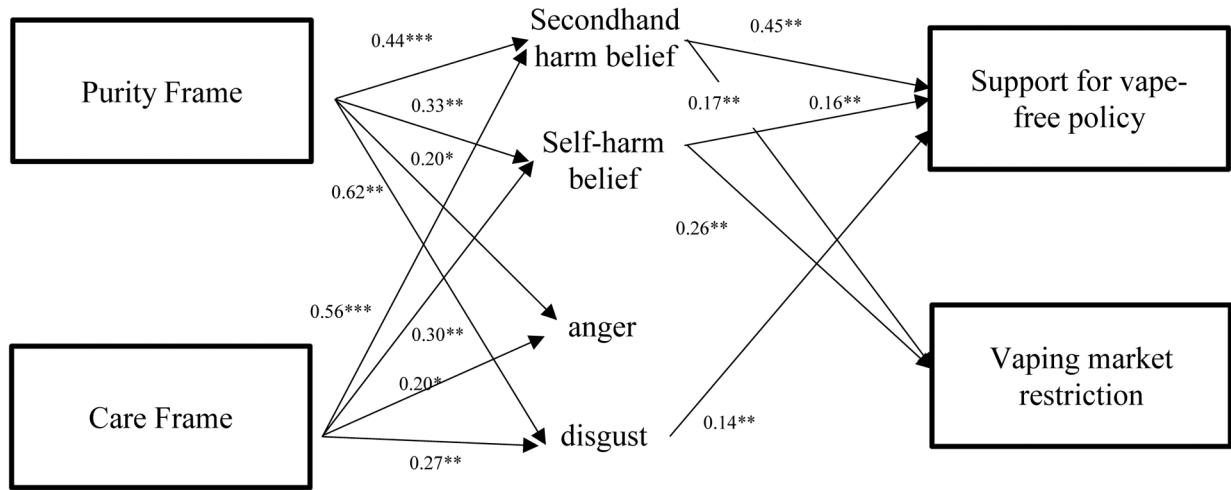
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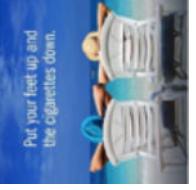
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**Figure 1.**

Mediation effects of cognition and emotion processing (only significant paths are presented)

## Examples of Message Stimuli

**Table 1:**

	Care	Purity	Control
Texts only	<p>"Researchers from Portland State University found that vapor from e-cigarettes can contain formaldehyde, a cancer-causing chemical. These vapors are released into the environment and can be inhaled by others, including children and pets."</p>	<p>"The aerosol from e-cigarettes is not harmless. It can contain harmful and potentially harmful chemicals, including nicotine, ultrafine particles that can be inhaled deep into the lungs; flavoring such as diacetyl, a chemical linked to a serious lung disease, volatile organic compounds such as benzene, which is found in car exhaust; and heavy metals, such as nickel, tin, and lead."</p>	<p>"The Food and Drug Administration (FDA) has joined other health experts to warn consumers about potential health risks associated with electronic cigarettes. "The FDA is concerned about the safety of these products and how they are marketed to the public," says Margaret A. Hamburg, M.D., commissioner of food and drugs."</p>
Texts + Graphs	<p>"When parents vape, their children may suffer from harmful ingredients in the vapor such as nicotine. It is parents' responsibility to care and protect their children against potential harm. Parents worried about the well-being of their children would think twice before vaping and should not expose their children to such preventable health risk."</p>	<p>"It is nauseating to think about the possibility of affecting the cleanliness of our body, by ingesting disgusting chemicals. Imagine putting the same chemicals found in antifreeze, in your body. It may seem exaggerated, but this is what people are exposing their body to when they use e-cigarettes. If someone care about keeping the body clean and healthy, then e-cigarettes would lead to just the opposite."</p> 	 <p>"A study published by scientists from the American University of Beirut and the Center for the Study of Tobacco Products found that all the e-liquids tested contained free-base nicotine, which is the strongest form of nicotine."</p> 

*Notes.* Each condition includes (a) six textual vaping prevention messages or (b) six textual vaping prevention messages plus six anti-smoking graphs. Participants were randomized to one of these six conditions.

Mean of Outcomes under Each Condition (N = 630)

	Care frame condition	Purity frame condition
<b>Mediators</b>		
Secondhand harm belief	3.40 (1.35)	3.23 (1.33)
Self-harm belief	3.56 (1.22)	3.55 (1.23)
Anger	1.83 (1.13)	1.82 (1.14)
Disgust	1.83 (1.11)	2.15 (1.27)
<b>Dependent Variables</b>		
Support for vape-free policy	3.51 (1.21)	3.52 (1.13)
Support for marketing restriction	3.98 (1.03)	3.92 (1.05)

Notes: Standard deviation is in the parentheses.

Table 2.

**Table 3:**

Main Effects of Moral Frame Conditions and Moderation Effects of the Care and Purity Moral Values (N = 630)

Independent Variables	Main effect	Support for vape-free policy		Outcome2: Support for marketing restriction	
		Moderator: purity value	Moderator: care value	Main effect	Moderator: purity value
Care frame vs control	0.22 * [0.00, 0.44]	-1.00 * [-1.83, -0.17]	-0.85 [-2.00, 0.30]	0.02 [-0.17, 0.21]	-0.94 ** [-1.66, -0.22] -0.82 † [-1.81, 0.18]
Purity frame vs control	0.49 * [0.03, 0.47]	-1.02 * [-1.84, -0.20]	.81 [-1.88, 0.25]	-0.01 [-1.00, 0.18]	-1.00 ** [-1.71, -0.28] -1.13 * [-2.05, -0.21]
Purity value	0.23 *** [0.12, 0.33]	0.02 [-0.13, 0.18]	0.22 *** [0.12, 0.33]	0.06 [-0.03, 0.15]	0.06 [-0.23, 0.03] 0.06 [-0.03, 0.15]
Care value	0.10 [-0.03, 0.22]	0.09 [-0.03, 0.21]	-0.06 [-0.24, 0.12]	0.22 *** [0.11, 0.32]	0.21 *** [0.11, 0.32] 0.07 [-0.09, 0.23]
Purity value*care frame		0.31 ** [0.12, 0.51]		0.23 *** [0.06, 0.40]	
Purity value*purity frame		0.30 ** [0.10, 0.49]		0.24 ** [0.07, 0.41]	
Care value*care frame			0.23 † [-0.01, 0.47]		0.18 † [-0.03, 0.38]
Care value*purity frame			0.23 * [0.003, 0.45]		0.24 * [0.05, 0.43]
Constant	1.937 *** [1.46, 2.41]	2.78 *** [2.12, 3.44]	2.66 *** [1.87, 3.46]	2.71 *** [2.30, 3.12]	3.36 *** [2.79, 3.94] 3.12 *** [2.70, 4.07]
R <sup>2</sup>	0.078	0.10	0.08	0.06	0.08 0.07
Residual Std. Error	1.14	0.10	1.14	0.98	0.98 0.98
F Statistic	13.15	11.01	9.63	10.32	8.66 7.96

Notes..

† p &lt; .10,

\* p &lt; .05,

\*\* p &lt; .005,

\*\*\* p &lt; .001.

95% confidence intervals are in the parentheses.

Results from alternative model specifications including other covariates are in Supplementary Materials Table S8.

## Indirect Effects through Harm Perceptions versus Emotions

**Table 4.**

Mediator	Outcome 1: Support for vape-free policy				Outcome 2: Support for marketing restriction			
	Purity frame (vs. non-moral control)	Care frame (vs. non-moral control)	Purity frame (vs. non-moral control)	Care frame (vs. non-moral control)	Purity frame (vs. non-moral control)	Care frame (vs. non-moral control)	Purity frame (vs. non-moral control)	Care frame (vs. non-moral control)
Secondhand harm belief	0.19 ** [0.07, 0.31]	0.24 *** [0.14, 0.37]	0.07 * [0.02, 0.13]	0.07 * [0.02, 0.16]	0.09 *** [0.03, 0.16]	0.09 *** [0.03, 0.16]	0.09 *** [0.03, 0.16]	0.09 *** [0.03, 0.16]
Self-harm belief	0.05 * [0.01, 0.11]	0.05 * [0.01, 0.10]	0.05 * [0.01, 0.10]	0.05 * [0.02, 0.16]	0.09 * [0.02, 0.16]	0.09 * [0.02, 0.16]	0.08 * [0.02, 0.15]	0.08 * [0.02, 0.15]
Anger	0.00 [-0.02, 0.03]	0.00 [-0.02, 0.03]	-0.00 [-0.02, 0.03]	-0.00 [-0.03, 0.03]	-0.00 [-0.03, 0.03]	-0.00 [-0.03, 0.03]	-0.00 [-0.03, 0.03]	-0.00 [-0.03, 0.03]
Disgust	0.09 * [0.03, 0.16]	0.04 [0.01, 0.09]	0.04 [0.01, 0.09]	0.03 [0.01, 0.11]	0.03 [0.01, 0.11]	0.03 [0.01, 0.11]	0.02 [0.01, 0.06]	0.02 [0.01, 0.06]

Notes.

\*  $p < .050$ ,\*\*  $p < .005$ ,\*\*\*  $p < .001$ . $p < .001$ . Confidence intervals are in the parentheses.

**Table 5.**

Estimated Indices for Moderated Mediation Effects

<i>Mediator</i>	Outcome 1: Support for vape-free policy				Outcome 2: Support for marketing restriction			
	Purity frame (vs. control)		Care frame (vs. control)		Purity frame (vs. control)		Care frame (vs. control)	
	Moderator = purity value	Moderator = care value	Moderator = purity value	Moderator = care value	Moderator = purity value	Moderator = care value	Moderator = purity value	Moderator = care value
Secondhand harm belief	0.05 [-0.03, 0.13]	0.02 [-0.07, 0.11]	0.05 [-0.03, 0.14]	0.07 [-0.02, 0.17]	0.02 [-0.01, 0.05]	0.01 [-0.03, 0.05]	0.02 [-0.01, 0.06]	0.03 [-0.01, 0.07]
Self-harm belief	0.01 [-0.02, 0.04]	0.01 [-0.02, 0.04]	0.02 [-0.01, 0.06]	0.02 [-0.02, 0.05]	0.01 [-0.04, 0.05]	0.01 [-0.04, 0.07]	0.03 [-0.01, 0.08]	0.03 [-0.03, 0.08]
Anger	0.00 [-0.01, 0.02]	0.00 [-0.01, 0.02]	0.00 [-0.01, 0.01]	0.00 [-0.01, 0.01]	0.00 [-0.01, 0.02]	0.00 [-0.01, 0.02]	-0.00 [-0.02, 0.01]	-0.00 [-0.01, 0.01]
Disgust	0.03 * [0.05, 0.07]	0.03 * [0.00, 0.07]	0.00 [-0.03, 0.02]	0.00 [-0.02, 0.04]	0.01 [-0.02, 0.04]	0.01 [-0.02, 0.04]	-0.00 [-0.02, 0.01]	0.00 [-0.01, 0.02]

Notes.

\* indicates significant moderated mediation effect. Confidence intervals (CIs) from bootstrapping (5000 resamples) are in the parentheses.