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E-cigarette advertising exposure and implicit attitudes among young adult non-smokers

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Abstract

Background—This study tested whether exposure to e-cigarette advertising affects the subliminal—spontaneous or automatic—attitudes towards e-cigarettes as a more pleasant or safer alternative to cigarettes among non-smoking young adults.

Methods—187 young adult (mean age = 21.9; SD = 4.1) current non-smokers who had never used an e-cigarette were randomly assigned to one of the 3 conditions that involved viewing magazine advertisements. Two of the 3 conditions were experimental conditions where thematically different [harm-reduction (“Health”) vs. social enhancement (“Social”) focused] e-cigarette ads were interspersed among ads of everyday objects. The third condition was the control condition in which participants viewed ads of everyday objects only. Participants provided data on explicit (e.g., harm perceptions) and implicit [e.g., Implicit Association Test (IAT), Affect Misattribution Procedure (AMP)] measures after viewing the ads.

Results—Relative to the Control condition, participants in the Social condition showed 2.8 times higher odds of being open to using an e-cigarette in the future. Participants in the Health condition showed significantly higher implicit attitudes towards e-cigarettes as a safer alternative to cigarettes than participants in the Control condition. E-cigarette stimuli elicited more positive spontaneous affective reactions among participants in the Social condition than participants in the Health condition.

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Contributors

PP designed the study, conducted the data analysis, and led the manuscript preparation. PF and TAH contributed to the development and implementation of the study protocol and helped prepare the manuscript. QC assisted in the development of the experimental content and procedure. LK and NM assisted with participant recruitment, data collection, and literature review. JBU reviewed the manuscript helped interpret the data. All authors approved the final manuscript.

Conflict of interest

No conflict declared.

Conclusions—E-cigarette ads may implicitly promote e-cigarettes as a reduced-harm cigarette alternative. Marketing of e-cigarette use as a way to enhance social life or self-image may encourage non-smoking young adults to try e-cigarettes. Findings may inform regulations on e-cigarette marketing.

Keywords

E-cigarette; Young adults; Advertising; Implicit attitudes

1. Introduction

1.1. E-cigarette use, e-cigarette marketing and young adults

E-cigarette use prevalence is increasing rapidly among youth and young adults. According to a recent Monitoring the Future (MTF) survey (Johnston et al., 2015), past-30-day e-cigarette use prevalence among high school students has surpassed the prevalence of past-30-day cigarette use. Among U.S. adults, young adults (18–24 year olds) show the highest prevalence of e-cigarette use (21%; Schoenborn and Gindi, 2015). Although e-cigarette use prevalence is concentrated mostly among current or former regular cigarette smokers, there are concerns that e-cigarette use is on the rise even among those youth and young adults who do not smoke tobacco (Wills et al., 2015; Primack et al., 2015). Among U.S. young adults, approximately 10% of never cigarette smokers report having tried an e-cigarette (Schoenborn and Gindi, 2015).

The role of tobacco product marketing in promoting tobacco use initiation is well-documented (National Cancer Institute, 2008). E-cigarette marketing appears to be expanding aggressively. For example, between 2011 and 2013, young adults' exposure to television e-cigarette ads increased by 321% (Duke et al., 2014). The e-cigarette marketing expenditures for 2013 represented more than twice the expenditures for 2012 (Kornfield et al., 2015). At present, e-cigarette marketing is not regulated. This is of concern because e-cigarette marketing is thought to be using tactics similar to those used by the tobacco industry to market cigarettes in the past (Grana and Ling, 2014). To date, limited empirical evidence exists as to whether e-cigarette advertising persuades young people to believe that e-cigarettes are less harmful than cigarettes or that e-cigarette use may enhance their social lives or self-image.

1.2. E-cigarette advertising and automatic attitudes towards e-cigarettes

In consumer psychology and social cognition research, the effects of spontaneous or automatic cognitive processes—presumed to function outside awareness or consciousness—on consumer decision-making are well recognized (Maison et al., 2001; Brunel et al., 2003). However, such processes have not received sufficient attention in research on tobacco product marketing. Past tobacco research has almost exclusively assessed marketing effects using self-report measures which capture variables that are “explicit” or within the reaches of awareness. Although valid and useful, such explicit processes may be just one of the two main ways that the effects of tobacco product marketing are mediated. Automatic processes are measured by using implicit instruments, which assess the implicit attitude or cognition

construct indirectly by having participants perform certain tasks or tests (e.g., word association, sentence completion; De Houwer, 2006).

Strategic use of implicit measures in research may help demonstrate how tobacco product marketing shapes automatic attitudes towards tobacco products among potential consumers, including current non-users of tobacco products. Such evidence may be especially important in regulating new tobacco products such as e-cigarettes which are currently unregulated. E-cigarette marketing appears to be using implicit, if not overt, tactics to attract young people or promote e-cigarettes as a safer alternative to cigarettes (Grana and Ling, 2014). Such implicit tactics may encourage spontaneous association of e-cigarettes with reduced risk attributes or enhanced social life or self-image.

Two implicit attitude measures commonly used in social attitudes research are the Implicit Association Test (IAT; (Greenwald et al., 1998) and the Affect Misattribution Procedure (AMP; Payne et al., 2005). For the current investigation the IAT was specifically adapted to assess the automatic preference for e-cigarettes as a safer or healthier alternative to cigarettes. The IAT is a categorization task which functions on the assumption that individuals are faster at categorizing those concepts together that are compatible to them spontaneously than those that are incompatible. The AMP was adapted to assess spontaneous affective reaction (e.g., pleasant vs. unpleasant) to e-cigarette and cigarette stimuli. The task works under the assumption that individuals are likely to subliminally misattribute the affect induced by a priming stimulus (e.g., image of an e-cigarette or cigarette) to another stimulus that is ambiguous in terms of affect (e.g., irregular shapes with no meaning).

1.3. The present study

This experimental study examined the subliminal impact of real-world print e-cigarette ads on currently non-smoking young adults. Four main hypotheses were tested: (1) participants exposed to Health ads (i.e., ads containing implicit or explicit reduced-harm or health-benefit messages) would score higher on the IAT than those exposed to Control or Social ads (i.e., ads containing implicit or explicit messages promoting e-cigarettes as a means to enhance one's social life or self-image); (2) for e-cigarette cues, participants in the Social condition would score higher on the AMP than those in the Health or the Control condition; (3) implicit attitude measures would be moderately correlated with explicit measures of attitudes, including openness to use e-cigarettes, indicating that they assess distinct yet related constructs; and (4) participants in the experimental conditions would show increased openness to using e-cigarettes in the future relative to those in the control condition.

The second hypothesis was based on the assumption that young adults would find Social ads more attractive than the Health ads because Social ads, by definition, would include images or words signifying pleasant lifestyle that are particularly attractive to young adults. Hypotheses concerning the effects of the experiment on explicit attitudes were not tested at the current phase of the study because such effects were assumed be very small, as the current experiment involved a relatively indirect exposure to e-cigarette ads and the sample included young adults who were non-smokers.

2. Material and methods

2.1. Participant recruitment

Participants (N = 187) were recruited on college campuses in the Hawaiian island of Oahu. The study was advertised at one 4-year and two 2-year colleges through the use of flyers, classroom presentations, and e-mail listservs. Interested students telephoned a research project staff who conducted the initial screening for participation eligibility over the telephone. Participants were invited to the study laboratory if they met the following inclusion criteria: they (1) were 18–29 years in age; (2) had never used an electronic cigarette; and (3) had smoked less than 100 cigarettes in their lifetime and none in the past year.

2.2. Design and data collection

An experimental design was employed. Participants were randomly assigned to one of the following three conditions where they viewed still ads on a laptop computer: “Health” condition (n = 63) in which participants viewed 6 real-world e-cigarette ads containing health-benefit or reduced-harm themes, interspersed randomly among 14 filler ads; “Social” condition (n = 63) in which participants viewed 6 real-world e-cigarette ads containing messages promoting e-cigarette use as a means of attaining better social life or self-image, interspersed randomly among 14 filler ads; and “Control” condition (n = 61) in which participants viewed 20 real-world ads of everyday items, 14 of which were the same filler ads as the other two conditions. Each ad was shown on screen for 30 s. In the experimental conditions, e-cigarette ads were mingled with ads of other products because in real life, people usually come across ads, especially still ads, in the course of observing several other things, including other images. Interspersing ads of interest among other ads is a common practice in communications and marketing research (e.g., Homer, 1990; Homer and Yoon, 1992).

The study involved a one-time lab visit. Participants provided written informed consent before commencing study participation. Age and smoking status were verified against government-issued ID and breath Carbon Monoxide test, respectively. Data were collected immediately after participants viewed the ads via laptop computers. Participants first completed the implicit measures and other performance tasks (e.g., neurocognitive tasks) and then responded to the self-report questionnaire. Each participant was provided a \$30 supermarket gift card in compensation for his or her time.

2.3. Ad selection

Experimental ads were selected following a series of iterative steps. First, over a period of 6 months (June–December, 2014), two research staff gathered a pool of e-cigarette ads from the internet, including social media sites such as Facebook and Instagram, and young-adult-oriented print magazines that have been known to publish e-cigarette ads (see American Legacy Foundation, 2014). Every issue of the following magazines published during the 6 month period was monitored: *Ok!*, *Star Magazine*, *Entertainment Weekly*, *US Weekly*, *Sports Illustrated*, *Men’s Journal* and *Rolling Stone*. A total of 40 e-cigarette ads were collected through this process. Next, each of the 40 ads was pretested. Seven young adults

(18–30 years old in age), of whom 3 were women and 4 men, were first asked to carefully look at each ad and quickly write down 5–10 messages that they thought the ads were using to attract customers. After this task was completed, the same 7 young adults were asked to classify each ad into one of the three categories: (1) “Health”: ads that mainly promoted e-cigarettes, implicitly or explicitly, with health-benefit or harm-reduction claims; (2) “Social”: ads that mainly promoted e-cigarettes, implicitly or explicitly, as products that lead to enhanced social life or self-image; (3) “Neither”: ads that may not be classified as either Health or Social.

The qualitative data provided by the participants during the first task were coded and each ad was rated by a research staff on Health and Social characteristics for each participant. Next, for each participant, the ads were classified as “health,” “social,” or “neither” based on the consistency of rating between first and second tasks. If the ratings were inconsistent, the ad for that participant was classified as “neither.” Subsequently, comparing data across participants, 12 ads were classified as “Health” and 22 as “Social.” There was a substantial inter-rater reliability (Fleiss’ Kappa = 0.62) across participants. The final ads to be included in the experiment were randomly selected: 6 out of the 12 for the Health condition, and 6 out of the 22 for the Social condition. The final ads represented brands such as Blu, Fin, MarkTen, and Vuse.

Control and filler ads were ads of everyday objects (e.g., toothpaste, oil, television, smartphone) selected from the same sources as the e-cigarette ads. Filler ads were 14 ads among which the 6 experimental ads in the Health and Social conditions were interspersed. Control ads were also ads of everyday objects but they were carefully matched with the experimental ads in terms of quality, visual appeal, and models’ demographic characteristics.

2.4. Measures

2.4.1. Demographics—Single item indicators were used to assess age, gender, family/household annual income, and personal annual income. Ethnicity was determined based on an item that was inclusive of ethnicities common in Hawaii (e.g., Japanese, Filipino, Native Hawaiian) (Kolonel et al., 2000). As in our previous research (Pokhrel et al., 2015; Herzog and Pokhrel, 2012), Japanese, Chinese, and Korean were combined into a single “Asian” category.

2.4.2. Explicit measures

2.4.2.1. E-cigarette harm perceptions: E-cigarette harm perceptions were assessed using 20 items (Pokhrel et al., 2015; Cronbach’s $\alpha = 0.95$), in terms of self-reported perceptions that e-cigarettes are less harmful than cigarettes. This measure represents three dimensions: perceptions that e-cigarettes are healthier (e.g., “E-cigarettes improve breathing and reduce coughing”), that e-cigarettes expose self and others to lower risks (e.g., “E-cigarettes provide a safer way to get nicotine”), and that e-cigarettes help quit smoking and control smoking addiction (e.g., “E-cigarettes are less addictive than cigarettes”). Participants rated each item on a 7-point scale ranging from “Strongly Disagree” to “Strongly Agree”.

2.4.2.2. E-cigarette use positive outcome expectancies: Participants rated statements about outcomes that might happen to them if they used e-cigarettes (Pokhrel et al., 2014). A list of 52 items were presented, which included, among others, items relevant to the 5 positive outcome expectancies of interest to this study: *Positive Social Expectancies* (11 items; Cronbach's $\alpha = 0.91$; e.g., "Look cool"), *Positive "Smoking" Experience Expectancies* (4 items; Cronbach's $\alpha = 0.79$; e.g., "Smoke with family members' approval"), *Affect Regulation Expectancies* (7 items; Cronbach's $\alpha = 0.91$; e.g., "Feel calm"), *Positive Sensory Expectancies* (3 items; Cronbach's $\alpha = 0.89$; e.g., "Have a good taste"), and *Reward Expectancies* (4 items; Cronbach's $\alpha = 0.69$; e.g., "Feel healthier"). The rating scale ranged from 0 (Unlikely) to 9 (Likely).

2.4.2.3. Openness to use e-cigarette: Openness to use e-cigarette was assessed based on responses to 4 intentions to use e-cigarette items (e.g., "Do you think that you will use an e-cigarette soon?"; Cronbach's $\alpha = 0.88$; Pokhrel et al., 2014; Pierce et al., 1996). Each item was rated on a 5-point response scale (1: "Definitely not", ..., 4: "Definitely yes", 5: "I don't know"). To create the openness to use e-cigarette variable, each item was dichotomized such that "Definitely not" was coded as "0" and any other response was coded as "1". Next, the 4 dichotomized items were summed and the composite variable ranged from 0 to 4. For ease of analysis and interpretation, the openness variable was dichotomized as 0 (i.e., "Definitely not" response across all 4 items) vs. 1 (one or more any other response but "Definitely not").

2.4.3. Implicit measures

2.4.3.1. Implicit association test (IAT): Consistent with the original IAT (Greenwald et al., 1998), the current IAT was also a dual categorization task in which participants were asked to quickly categorize a word or an image stimulus by pressing "e" or "i" letter on the computer keyboard. Participants saw four types of stimuli: e-cigarette pictures, cigarette pictures, positive words (i.e., words signifying good health), and negative words (i.e., words signifying poor health). Picture stimuli were 8 images of e-cigarettes and 8 matching images of cigarettes. Attribute stimuli were 8 positive words (e.g., healthy, safe, clean, strong) and 8 negative (e.g., unhealthy, risky, sick, weak).

The test involved 5 steps representing 7 blocks of trials. In the first step, participants performed 20 practice trials (Block 1) by matching positive and negative word stimuli, that appeared at the center of the screen, to labels (e.g., E-cigarette/Good and Cigarette/Bad, respectively) that appeared on upper left and right corners of the screen. The words appeared in a random order. The second step also involved 20 practice trials (Block 2) but the stimuli presented were pictures of cigarette and e-cigarette, which the participants matched to the labels. The third step included two blocks, of 20 and 40 trials each (Blocks 3 and 4), during which pictures and words were presented in random order, and participants were asked to categorize them ("e" key: "E-cigarette or Good"; "i" key: "Cigarette or Bad"). The fourth and fifth steps included 20 (Block 5) and 20 and 40 trials (Block 6 and 7), respectively, similar to the second and third steps except that the combination of E-cigarette/Cigarette pictures and Good/Bad attributes was reversed (e.g., "e" key: "Cigarette or Good; "i" key: "E-cigarette or Bad"). The IAT effect was assessed in terms of the "D" score (Greenwald et al., 2003), which essentially represented the difference in latencies between Block 4 and

Block 7. The IAT has been validated across disciplines, including substance abuse and marketing research, as a measure of implicit attitudes and as a robust predictor of behavior (Greenwald et al., 2009).

2.4.3.2. Affect Misattribution Procedure (AMP): The AMP developed by Payne et al. (2005) was adapted for e-cigarette and cigarette. Priming stimuli included the same 8 cigarette and 8 e-cigarette images used in IAT above. The targets to be evaluated as “Pleasant” or “Unpleasant” were 100 fractal images (i.e., ambiguous images with irregular shapes). An AMP trial involved presentation of an e-cigarette or cigarette image as a prime. The prime was presented for 75 ms, followed by a blank screen for 125 ms, which was followed by a target fractal image. The target was presented for 100 ms and was followed by a black-and-white visual mask which remained on the screen until a response was made. The mask was meant to limit perceptual processing and maximize the ambiguity of the target items. Participants were instructed to judge the pleasantness of the fractal images based on whether the fractal image was more or less pleasant than the average fractal image and to press one of two keys, “e” (pleasant) or “i” (unpleasant). Participants completed 100 trials. Recent research across disciplines as far-ranging as political science and addiction has consistently shown AMP to be a valid measure of implicit attitudes (Payne et al., 2007; Payne et al., 2008; Payne et al., 2010).

2.5. Data analysis

Data were analyzed using SAS statistical software (Version 9.3). The hypotheses regarding the differences in mean IAT across conditions were tested using one-way ANOVA. Because of the *a priori* nature of the hypotheses concerning the differences between Health and Control conditions, and between Health and Social conditions, the differences in means were tested for statistical significance using the planned contrast procedure (i.e., using CONTRAST statement in PROC GLM). Repeated-measures ANOVA compared the within-participant AMP scores for cigarette and e-cigarette stimuli (cues) and also between-participant AMP scores across conditions for each stimuli (i.e., cigarette and e-cigarette). If the ANOVA results were statistically significant, mean AMP scores were compared across conditions using the planned contrast procedure, separately for e-cigarette and cigarette cues. As a supplementary analysis, self-report measures of e-cigarette harm perceptions and positive outcome expectancies were also compared across conditions, using one-way ANOVA. Zero-order correlation and logistic regression analyses were run to determine the correlations between implicit and explicit attitudes, and between implicit attitudes and openness to use e-cigarette, respectively. The logistic regression analysis also tested the associations between experimental conditions (i.e., Health and Social) and openness to use e-cigarettes. For the latter analysis, experimental conditions were dummy-coded with Control group as the reference category. All logistic regression models were run adjusting for age, gender, income, ethnicity, and lifetime smoking status.

3. Results

3.1. Participants

Table 1 describes the characteristics of the participants. The mean age of the participants was 21.9 (SD = 4.1) and participants were ethnically diverse. None of the participants had ever used an e-cigarette and all participants were current non-smokers of cigarettes. Approximately 40% of the participants had experimented smoking cigarettes in the past, however. These experimenters had smoked fewer than 100 cigarettes in their lifetime and none in the last year. Participants did not differ significantly on demographic or smoking characteristics across the experimental conditions.

3.2. IAT score across conditions

Fig. 1 illustrates the mean IAT score levels across the Health, Social, and Control conditions. One-way ANOVA comparing the mean IAT scores across conditions indicated statistically significant differences [$F(2, 184) = 4.02, p = 0.02$]. Planned contrast analysis supported the hypothesis that participants in the Health condition would report significantly higher mean IAT score than those in the Control condition [$F(1) = 4.82, p = 0.03$]. However, the hypothesis that participants in the Health condition would report significantly higher mean IAT score than those in the Social condition was not supported [$F(1) = 2.36, p = 0.13$]. In addition, significant differences were not found across conditions on the explicit e-cigarette harm perceptions measure ($p > 0.10$).

3.3. AMP score across conditions

Fig. 2 compares the AMP scores across the Social, Health, and Control conditions, separately for e-cigarette and cigarette stimuli. Results from the repeated measures ANOVA showed a statistically significant stimulus effect [Wilk's Lambda = 0.84; $F(1, 184) = 34.8, p < 0.0001$] such that participants were significantly more likely to rate the target fractal images as more pleasant following an e-cigarette stimulus vs. a cigarette stimulus. The stimulus effect was similar across conditions; that is, the stimulus* condition interaction effect was not significant [Wilk's Lambda = 0.99; $F(2, 184) = 0.01, p = 0.99$]. However, significant between-subject differences were found across conditions on AMP scores for both e-cigarette and cigarette stimuli [$F(2, 184) = 3.31, p = 0.04$]. As seen in Fig. 2, the patterns of differences across conditions were similar for both cues. Planned contrast analysis indicated that the mean AMP score for e-cigarette stimulus did not differ significantly between Social and Control conditions [$F(1) = 0.44, p = 0.50$] but differed significantly between Social and Health conditions [$F(1) = 4.26, p = 0.04$]. Similarly, for cigarette stimulus, the AMP score did not differ between Social and Control conditions [$F(1) = 0.30, p = 0.58$] but differed significantly between Social and Health conditions [$F(1) = 4.23, p = 0.04$]. No significant differences were found across conditions on measures of positive e-cigarette outcome expectancies ($p > 0.10$).

3.4. Correlations between implicit and explicit attitude variables

Table 2 shows the zero-order correlations between study variables. As expected, the IAT and AMP (e-cigarette) scores showed a moderate but significant positive correlation. AMP

scores for e-cigarette and cigarette stimuli showed positive and significant correlation of a relatively high strength. Both the IAT and e-cigarette AMP were similarly correlated—moderately but significantly—with the explicit measure of e-cigarette harm perceptions, which assessed the perceptions that e-cigarettes are lower in harm than cigarettes. Neither the IAT nor AMP was correlated significantly with measures of positive outcome expectancies. Measures of positive outcome expectancies were strongly correlated with each other.

3.5. Associations between implicit attitudes and openness to use e-cigarette

Table 3 shows the results of the logistic regression analyses examining the relationships between experimental conditions, implicit attitude measures and openness to use e-cigarette. The first model (Model 1) that examined the association between experimental conditions and openness to e-cigarette use found, adjusting for the effects of lifetime cigarette smoking and demographic variables, that relative to the Control group, the Social group was 2.8 times more likely to report openness to use e-cigarette in the future. This association was statistically significant. The association between Health condition and openness to use e-cigarettes was only marginally significant.

The IAT was associated with openness to use e-cigarettes [OR = 2.96, 95% CI = 1.20–7.30] when entered in the model with Social and Health conditions (Model 2). Similarly, the AMP (e-cigarette) was associated with openness to use e-cigarette [OR = 3.89, 95% CI = 1.01–15.10] when entered in the model with Social and Health conditions (Model 3). When the explicit measure of harm perceptions was entered in Model 2, the IAT was no longer significantly associated with openness to use e-cigarette (Model 4). Similarly, when the harm perception measure was added to Model 3, the AMP was no longer significantly associated with openness to use e-cigarette (Model 5).

4. Discussion

This is the first study to show that exposure to e-cigarette advertising induces favorable automatic or spontaneous attitudes towards e-cigarettes among young adults who are current non-smokers of cigarettes and who have never used an e-cigarette. Given that young adults are heavily exposed to e-cigarette advertising, not only on TV but also at point-of-sale and in the print media, this is an important finding. The current data suggest that e-cigarette advertising with themes of social enhancement has stronger impact on positive automatic affective reaction towards e-cigarettes among non-smoking young adults than the advertising with harm-reduction or health-benefit messages. Moreover, according to the current data, social-themed ads may promote openness to try e-cigarette among non-smoking young adults.

Not all of our hypotheses were supported. The IAT scores did not differ significantly between Social and Health conditions as hypothesized. This could be because e-cigarette ads are likely to combine both health and social themes. Our approach to separate ads into health and social themes was based on the rating of ads on observed themes. Social ads were classified as such because social themes were more prominently noticed in these ads. Similarly, health ads were rated to contain health themes more prominently. However,

themes did tend to overlap across the two conditions. Thus the fact that social ads also contained health messages, albeit less saliently than social themes, may be the reason behind the non-significant difference in the IAT scores between Health and Social conditions.

We did not find Social and Control conditions to differ on the AMP scores, either for e-cigarette or cigarette stimulus. But, Social and Health conditions differed on AMP scores for both stimuli. Regardless of the study condition, participants' automatic affective reaction to e-cigarettes was significantly more positive compared with cigarettes. Across conditions, however, participants in the Health condition tended to automatically react more negatively to e-cigarette and cigarette ads than participants in the Social condition. It is possible that exposure to Health themed ads made the non-smoking young adults subliminally associate cigarettes and e-cigarettes with health risks. As a result participants in the Health condition may have shown lower positive affective reaction to both e-cigarettes and cigarettes relative to those in Social condition.

There were some variations in the associations between implicit and explicit measures. The IAT measure was developed as an implicit equivalent of the explicit harm perception measure. Hence, as expected, the IAT in this study showed a moderate, positive correlation with the harm perceptions measure. We expected AMP-e-cigarette to show a similar correlation with positive outcome expectancies, but this did not turn out to be the case. The lack of correlation is consistent with the finding that the Social condition did not score higher on the AMP than the Control condition.

The relationships between implicit measures and openness to use e-cigarettes deserve some discussion. Although the failure to find unique effects of implicit attitudes on openness to use, above and beyond explicit attitudes, may seem to suggest that implicit attitudes are poor predictors of the actual behavior, it should be noted that openness to use variable was assessed based on a measure of intentions. Intentions are, by definition, conscious. Hence, the fact that the explicit measure of harm perceptions was more strongly associated with openness to use e-cigarettes is not surprising. Future studies are needed to determine whether the implicit measures proposed in this study are predictive of the actual behavior. This study makes a case for the necessity of such studies.

4.1. Implications

The implications of the current findings for development of regulations on e-cigarettes appear to be straightforward. The findings add to the evidence base showing that e-cigarettes are promoted as safer alternatives to cigarettes. Furthermore, e-cigarettes are marketed with images and messages associating e-cigarette use with enhanced social life and/or self-image, gimmicks that are particularly attractive to youth and young adults (American Legacy Foundation, 2014). The current data may help development of regulations on e-cigarette marketing in ways that would prevent the use of unsubstantiated health-benefit or reduced-harm claims and that would control the aspects of marketing that are appealing to young people. A point that the current study highlights and which may be important in regard to the monitoring of e-cigarette marketing is the use of implicit marketing tactics and influences.

4.2. Limitations

There are limitations to this study. The study was based solely on young adults; the sample did not include adolescents. Similar experimental study among adolescents may yield different results, particularly in regard to explicit measures of attitudes. Because adolescents are likely to be more impressionable than young adults, e-cigarette ads may have stronger effects on explicit attitudes among adolescents than what we found in this study.

It should be noted that the e-cigarette ads we included in the current experiment pertained to mainstream (national-level) e-cigarette brands and did not include ads for local or regional products, including tank systems and mods. Hence, the implications of the current study do not apply to local or regional products. Lastly, the current sample included non-smokers only. Including parallel groups of current smokers and former smokers, would have enriched the knowledge about how e-cigarette advertising exposure operated across non-smokers, current smokers, and former smokers.

5. Conclusions

Implicit attitude measures such as the IAT and AMP may be a valid way to assess spontaneous or automatic attitudes towards e-cigarettes. Exposure to e-cigarette ads may impact young adults, implicitly if not explicitly, to form automatic attitudes towards e-cigarettes as safer, healthier alternatives to tobacco cigarettes. Exposure to e-cigarette ads with social enhancement messages may promote openness to use e-cigarette among young adult non-smokers who have never used an e-cigarette. Lastly, our data suggest that currently non-smoking young adults may be vulnerable to the influence of e-cigarette marketing and explicit measures of attitudes and beliefs may not be adequate to gauge such impact among this group of young adults.

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Fig. 1. Implicit association test "D" scores across conditions. Bars represent standard errors. Asterisk indicates a statistically significant difference between conditions based on the planned contrast procedure, $*p < 0.05$.

Fig. 2.
Affect Misattribution Procedure scores across conditions by cue type. ECIG = e-cigarette cue, CIG = cigarette cue. Bars represent standard errors. Asterisks indicate statistically significant differences between conditions based on the planned contrast procedure, $*p < 0.05$.

Table 1Participant characteristics ($N = 187$).

		“Health” ($n = 63$)	“Social” ($n = 63$)	Control ($n = 61$)	p – value
Mean Age (SD)		22.7 (4.7)	21.8 (3.9)	21.1 (3.5)	NS
Gender					
	Men	35%	34%	39%	NS
	Women	65%	66%	61%	
Parental income					NS
	\$0–39,999	26%	33%	29%	
	\$40K–79,999	27%	26%	25%	
	\$80K–119,999	26%	16%	22%	
	\$120K–159,999	10%	12%	10%	
	\$160K–199,999	6%	3%	5%	
	\$200K or over	5%	10%	9%	
Self-income					NS
	\$0–9999	81%	69%	69%	
	\$10K–19,000	11%	15%	15%	
	\$20K–29,999	4%	8%	5%	
	\$30K–39,999	2%	5%	2%	
	\$40K–49,999	2%	3%	5%	
	\$50 K or over	0%	0%	4%	
Ethnicity					NS
	Asian	32%	35%	36%	
	Filipino	16%	16%	8%	
	NH/PI	6%	5%	7%	
	White	30%	33%	37%	
	Other	16%	11%	11%	
Lifetime cigarette smoking					
	No	67%	52%	62%	NS
	Yes	33%	48%	38%	

Notes: SD – Standard Deviation; NS – Not statistically significant (at $p = 0.05$; 2-tailed).

Table 2

Zero-order correlations of implicit measures with explicit measures ($N = 187$).

	IAT	AMP e-cig	AMP cig	Harm Percept.	Positive Social exp.	Positive 'Smoking' exp.	Affect regulation exp.	Positive Sensory exp.	Reward exp.
IAT	1								
AMP E-Cig	0.20**	1							
AMP Cig	0.09	0.37***	1						
Harm Percept.	0.28***	0.27***	0.007	1					
Positive Social exp.	0.01	0.05	-0.05	0.13 [†]	1				
Positive 'Smoking' exp.	0.07	0.08	0.04	0.28***	0.61***	1			
Affect regulation exp.	-0.03	0.07	-0.07	0.27***	0.65***	0.60***	1		
Positive Sensory exp.	-0.03	-0.004	0.02	0.32***	0.45***	0.53***	0.56***	1	
Reward exp.	-0.01	-0.0005	0.05	0.09	0.52***	0.54***	0.41***	0.31***	1

Note. exp. = expectancies.

[†] $p < 0.10$.

** $p < 0.01$.

*** $p < 0.001$.

Table 3

Results from logistic regression analysis examining the associations between experimental conditions, explicit and implicit attitude measures, and openness to use e-cigarettes ($N = 187$).

Odds Ratio (95% Confidence Interval)					
	Model 1	Model 2	Model 3	Model 4	Model 5
Social	2.78 (1.18–6.56) [*]	2.96 (1.23–7.10) [*]	2.53 (1.10–5.82) [*]	3.08 (1.21–7.85) [*]	2.49 (1.03–6.01) [*]
Health	2.21 (0.93–5.25) [†]	1.98 (0.82–4.82)	2.49 (1.06–5.86) [*]	2.06 (0.82–5.18)	2.26 (0.93–5.51)
IAT		2.96 (1.20–7.30) [*]		2.13 (0.80–5.63)	
AMP E-Cig			3.89 (1.01–15.10) [*]		2.23 (0.54–9.30)
Harm Perceptions				1.86 (1.33–2.60) ^{***}	1.79 (1.31–2.43) ^{***}

Note. All models adjusted for age, gender, ethnicity, and lifetime smoking status.

[†] $p < 0.10$.
^{*} $p < 0.05$.
^{***} $p < 0.001$.