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ORIGINAL ARTICLE



Nonsmokers' Responses to Online E-Cigarette Commercials: Effects of Argument Quantity and Celebrity Endorsement Paper Resubmitted to Substance Use and Misuse

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ABSTRACT

Objectives: With mounting evidence on health risks caused by e-cigarette consumption, it is of great necessity to explore not only smokers' but also nonsmokers' responses to e-cigarette marketing messages, such as online commercials. Employing both psychophysiological and self-report measures, this study examined nonsmoking young adults' cognitive, emotional, and attitudinal reactions to two major message features used in e-cigarette commercials: argument quantity and endorsement type. **Method:** The experiment used a 2 (endorsement type: celebrity and average citizen) × 2 (argument quantity: low and high) × 2 (message repetition) within-subjects design. Continuous heart rate (indicative of attention) and skin conductance activity (indicative of emotional arousal) were measured during ads viewing. Self-reported ad liking and vaping urge were assessed immediately after participants finished watching each commercial. **Results:** Results showed that compared to high argument quantity, low argument quantity elicited more attention, evoked higher emotional arousal, and generated stronger ad liking and vaping urge. Additionally, compared to average-citizen endorsement, the presence of celebrity endorsement elicited higher attention and lower emotional arousal in nonsmoking young adults. There was a significant interaction effect of endorsement type and argument quantity on ad liking. **Conclusions:** For nonsmoking young adults, low argument quantity commercials might have the greatest impact in initiating vaping behavior, which has implications for regulatory policies regarding e-cigarette. Celebrity endorsement was effective in catching nonsmokers' attention but had limited effects on emotional involvement and product adoption. The implications of the findings were finally discussed in more details in the manuscript.

KEYWORDS

e-cigarette commercials; nonsmokers; celebrity endorsement; argument quantity; attention; physiology; social media

Advertising has played a critical role in the growing popularity of e-cigarettes (NASEM, 2018). E-cigarette manufacturers spent about \$658.5 million on e-cigarette promotion in 2018 alone (U.S. Federal Trade Commission, 2019). Adding fuel to the advertising frenzy is the power of social media which can reach audiences—actual and potential e-cigarette consumers—of a large scale (Vogel et al., 2021; Zheng et al., 2021). Social media campaigns and advertising have been crucial factors in driving e-cigarette sales. For example, JUUL, a market leader in the e-cigarette business, has been utilizing YouTube and Instagram to promote its products (Huang et al., 2019). It's estimated that over 300,000 commercial tweets circulated on social media daily (Dai et al., 2017).

Recent research has shown that exposure to e-cigarette-related marketing on social media is associated with e-cigarette use (Pokhrel et al., 2018; Zheng & Lin, 2021). As such, it is valuable to investigate the way e-cigarette advertising/marketing on social media influences viewers. Such an exploration is meaningful when grounded in the context

wherein the population of young adult e-cigarette users increased by 1.5 million from 2017 to 2018 (Center for Disease Control and Prevention, 2020; Willett et al., 2018). Furthermore, the tobacco naïve youth group is susceptible to the impact of commercial messages about e-cigarette (Chapman et al., 2019). The present study therefore focuses on nonsmokers—who have no or little experience with tobacco use—and explores their cognitive, emotional, and attitudinal responses to e-cigarette commercials on YouTube.

Past research has shown that both argument features and product endorsement play vital roles in the effectiveness of tobacco-related advertising. For example, messages featuring strong arguments as opposed to weak ones are more likely to sway smokers who are highly involved with the products (Lee et al., 2011; Lee & Cappella, 2013). Different than the aforementioned *argument quality*, *argument quantity*—referring to the number of arguments—is more likely to have a salient impact when audiences' involvement with the product or message is low (e.g., nonsmokers for smoking-related ads, Petty & Cacioppo, 1986). Celebrity endorsers, as

opposed to other types of endorsers, are more likely to affect nonsmokers because nonsmokers' low involvement may result in their concentration on peripheral cues, such as celebrity images rather than the products per se (Phua et al., 2018). Departing from this line of reasoning, the current study conceptualizes nonsmokers as a low-involvement group, whose responses and attitudes toward e-cigarettes are likely to succumb to the impact of both argument quantity and celebrity endorsement (cf. ELM, Petty & Cacioppo, 1986).

Argument quantity and message processing

Popular arguments in e-cigarette advertisements often make use of unsubstantiated claims and value-based appeals (Padon et al., 2017; Paek et al., 2014; Zhu et al., 2014). For instance, in Jenny McCarthy's TV commercial for the e-cigarette brand—Blu, she endorsed e-cigarettes as smart alternatives to combustible cigarettes by stating that e-cigarettes have “no carcinogens,” “no tobacco smoke,” “no ash,” and “no odor.” Voiceovers in these commercials often credit e-cigarette brands with claims appealing to audiences' beliefs or values, such as embracing freedom and valuing friendship (Padon et al., 2017). Although research has shown that various types of arguments affect people's attitudes toward e-cigarettes (e.g., Berry et al., 2017; Grana & Ling, 2014; Zhu et al., 2014), what remains unknown is whether and, if so, how argument quantity makes a difference in the impacts of e-cigarette commercials.

Using multiple arguments in e-cigarette commercials seems to be a common practice in the advertising industry. For instance, Zhu et al. (2014) found that among the 460 e-cigarette brands advertised on the Internet, a majority of them tended to use multiple arguments to emphasize the benefits of consuming e-cigarettes, such as being healthier, cheaper, and making people more attractive. According to the Limited Capacity Model of Motivated Mediated Message Processing (LC4MP, Lang, 2006), people have limited cognitive resources to process information. Specifically, the more information an ad introduces (including structural and content information), the more cognitive resources one needs to process the message (Lang et al., 2013). Given that most online e-cigarette commercials are short and straightforward, audiences may not need much cognitive resources to encode the information, especially when structural features of the message (e.g., camera changes and pacing) are not cognitively demanding (Lang et al., 2013). Lang et al. (2015) further explained that messages requiring more controlled, effortful, and less automatic processing, such as those featuring multiple (vs. single) arguments, tend to elicit much slower biological imperative responses and, thus, to be less arousing and memorable. Taken together, we propose that:

Hypothesis 1a (H1a): E-cigarette commercials with more arguments will elicit greater attention (indicated by heart rate deceleration).

Hypothesis 1b (H1b): E-cigarette commercials with more arguments will elicit a lower level of bodily arousal (indicated by decreased skin conductance level).

Celebrity endorsement and message processing

Research has shown that celebrity endorsement of e-cigarette brands on social media, especially when the celebrity is the ideal self of audiences, evokes more favorable attitudes toward the ads/products and elicits higher smoking intentions (Paek et al., 2014; Phua et al., 2018). According to the LC4MP, watching pleasant and favorable content (e.g., a sexy celebrity) in cigarette advertising may activate the appetitive system and, thus, facilitate smokers' eager of vaping (Clayton et al., 2017; Sanders-Jackson et al., 2019). Petty et al. (1983) found that participants had better memory of celebrity endorsed ads compared to average-person endorsed ones, suggesting that viewers may allocate more cognitive resources to encode information presented by celebrities. Furthermore, celebrity endorsed commercials are more likely to intensify motivational activation (i.e., bodily arousal) because celebrity endorsement is considered to be effective in drumming up consumers' enthusiasm and excitement (Phua et al., 2018). Therefore, we propose the following hypothesis:

Hypothesis 2 (H2): Compared with average-citizen endorsed e-cigarette commercials, celebrity-endorsed commercials will elicit **a)** more attention (indicated by heart rate deceleration) and **b)** greater arousal (indicated by decreased skin conductance level).

Vaping urge and ad liking

A large body of research on e-cigarette advertising has focused on message effects on the attitudes and behavioral intentions of smokers. For example, exposure to smoking or vaping scenes (vs. no vaping visuals) significantly increased smokers' vaping urge and desire (Kang et al., 2009; Kim et al., 2015; King et al., 2018). Petty and Cacioppo (1984) found that for people who perceive the product as irrelevant or unimportant (i.e., low involvement), increasing the number of arguments yielded more favorable attitudes toward the ad and greater purchase intention. Alternatively, Lang et al. (2015) argued that symbolic messages (e.g., verbal arguments) impede biological imperative responses and enable cognitive thinking. Adding more arguments may not only elicit weaker biological responses such as vaping urge, but also facilitate more rational thinking about the promoted product, especially among those with little smoking experience. This suggests less favorable attitude toward the ad and lower vaping intention. In spite of little research investigating argument quantity and celebrity endorsement simultaneously, there is some evidence suggesting the potential interaction effect between the two factors on audiences in the context of advertising. For instance, Lee and Park (2014) operationalized endorsement strength as the number of endorsement arguments, and they uncovered a significant interaction effect between endorsement strength and celebrity-product match on viewers' ad liking and intention of purchasing the advertised sports drink. Put differently, the impact of argument quantity on viewers' attitudes was more salient when the match between the endorser and the product was high. Inspired by this finding, we reckon that

argument quantity and endorsement type may interact with one another to affect audiences in the context of e-cigarette commercial viewing. Thus, the following research questions is proposed:

Research Question 1 (RQ1): How will argument quantity and endorsement type in e-cigarette commercials affect non-smokers' ad liking and vaping urge?

Methods

Design and stimuli

The experiment used a 2 (endorsement type: celebrity and average citizen) \times 2 (argument quantity: low and high) \times 2 (message repetition) within-subjects design. Eight e-cigarette commercials were selected from YouTube.com, with four being endorsed by celebrities and the other four being endorsed by average citizens. Endorsed celebrities were recognized by the authors and most of the participants, and present in the commercials from the beginning to the end. Average citizens were actors/actresses and/or people present in the commercials who were not recognized by the authors and participants. The endorsement type variable was successfully manipulated by asking participants the question of "Can you recognize the actor/actress in the video?" after each video. The recognition rate for celebrities ranged from 75% to 88.9%, and 2.8% to 8.3% for average-citizen videos. Persuasive arguments were coded based on the coding scheme developed by Paek et al. (2014). Paek et al. (2014) created a classification of message characteristics by analyzing about 400 e-cigarette videos on YouTube. In light of that classification, we coded each single piece of information embedded in the stimuli as a persuasive argument if it fits any of the following categories: economic benefit, social benefit, psychological benefit, threat/fear benefit, and health claims (see detailed definitions in Paek et al., 2014). High argument-quantity commercials contain on average four or five different types of arguments, with 164.75 words per minute (e.g., the Blu e-cigarette commercials endorsed by Jenny McCarthy). Low argument-quantity commercials had on average zero or one type of argument, with 22.65 words per minute on average (e.g., the Blu e-cigarette commercials endorsed by Stephen Dorff). Each commercial is one-minute long.

Participants and procedure

Forty-one undergraduates (aged 18–23, $M = 20.34$, $SD = 1.14$; 37 female) from a state university participated in this study, with 23 reporting that they never smoked a cigarette or e-cigarette and 18 reporting that they only tried one or two cigarettes before. In accordance with prior research on smoking experience, the present study classified the participants as nonsmokers (Husten, 2009). Most participants reported as White ($n = 35$), followed by Asians ($n = 7$), American Indian or Alaska Native ($n = 4$), and Black or African Americans ($n = 1$). One participant identified being more than one race, and another one preferred not to answer.

After participants read and signed an informed consent form, they were asked to seat individually in front of a large television screen. Experimenters began with the cleaning procedure following Potter and Bolls' (2012) guidelines for physiological data collection. Electrodermal activity (EDA) data were collected using two pre-gelled salt-free disposable electrodes and measured from participants' non-dominant hand. Electrocardiography (ECG) data were collected using pre-gelled isotonic disposable electrodes placed on participants' right and left forearms with one for each side. A third-ground electrode was placed on the wrist of a participant's non-dominant arm. The two physiological measures were time-locked to message presentation and collected with a sampling rate of 2000 Hz using the BIOPAC MP150 system. Once the quality of physiological data was ensured, participants were asked to wear a headphone and watch the eight e-cigarette commercials. The stimuli and follow-up self-report questions were all presented in a random order.

Dependent variables

Heart rate change

Heart rate change from baseline was used to denote the amount of attention participants paid to each stimulus. The deceleration of heart rate over time signifies increased attention allocated to commercials (Potter & Bolls, 2012).

Bodily arousal level

Bodily arousal level was assessed by skin conductance level measured through EDA from the eccrine sweat glands. High skin conductance level over time means high bodily and emotional arousal (Potter & Bolls, 2012).

Ad liking

Two 7-point semantic differential items, anchored by dislike/like and unfavorable/favorable respectively, were used to assess participants' liking of e-cigarette commercials (Collins et al., 2019). Each participant's scores on the two items were averaged to create an index of ad liking for each commercial. Correlation of the two items was .91.

Vaping urge

Vaping urge was measured by three questions with options ranging from 1 (*strongly disagree*) to 7 (*strongly agree*) on a 7-point Likert scale (Collins et al., 2019). The three questions included "I have a desire for an e-cigarette right now," "If it were possible, I probably would smoke an e-cigarette now," and "I have an urge for an e-cigarette." Scores on the three questions were averaged to create an index of one's vaping urge for each commercial. Cronbach's alpha of the three items was .94.

Covariate variable

Structural and content features in commercials could co-vary, along with other focal variables, to influence viewers'

information processing. Research has shown that information introduced per camera change (i.e., *ii/cc*) determines the amount of cognitive resources demanded by the message. Higher rate of *ii/cc* leads to more attention allocated by viewers (Park & Bailey, 2018). The video coding scheme (see Lang et al., 2007) evaluates the overall emotional level including message valence and arousal, calculates the total number of camera change, and identifies seven types of changes at each camera change (changes between the scene before and after the camera change), summed as *ii*. The seven types include changes in emotion, form, perspective, object, relatedness, distance from the central object, and new content. The total number of camera changes across the entire message is calculated as *cc*. Then, the ratio of *ii* over *cc* is quantified as the information introduced per camera change for that specific message. Two coders evaluated *ii* and *cc* for each of the eight stimuli with an inter-coder reliability of .96.

Physiology data preprocessing

We used AcqKnowledge 5.0 to preprocess and extracted all the physiological data. For the ECG signal, the QRS complex segments were automatically identified and converted to heart rate via the AcqKnowledge software. The R peaks that were incorrectly identified by the software were manually adjusted, and heart rate was re-calculated. EDA data were averaged to 1 Hz due to its slow response (Dawson et al., 2007).

Data of the five seconds before the onset of each stimulus were averaged as the baseline data for each stimulus. The change scores from the baseline (each data point during message exposure minus the baseline score) were used for data analysis.

Because the presentation computer failed to send digital markers to the BIOPAC machine, physiological data from the first 16 participants were not synced with stimuli, making the data useless. For the rest 25 participants, heart rate data from one participant were deleted due to too much body movement. The final sample size was 24 for heart rate data and 25 for skin conductance. Post hoc

power analysis using G*Power revealed a power of .96 for repeated measures ANOVA, with a minimum effect size ($\eta^2_p = .13$), sample size ($n = 24$), and measurement points of 60 (one data point for each second for a 60-second stimulus).

Analytical procedure

For physiological data

We implemented a cross-classified multilevel model, with random intercepts for each participant and each stimulus. The full model also included the following fixed-effect terms: time, endorsement type, argument quantity, interaction effects thereof, and the control variable (information introduced per camera change).

For self-report data

The model for self-report data comprised the same random-effect terms as above, two fixed-effect terms (endorsement type and argument quantity), and the control variable.

Results

Argument quantity, attention, and arousal

H1a predicted that participants would pay more attention to e-cigarette commercials with more arguments. The results showed no main effect of argument quantity ($p = .19$) but a significant interaction effect of argument quantity \times time ($b = .03$, $p = .000$, see Table 1 for statistical summaries). Participants exhibited a linearly decreasing heart rate for viewing the low argument-quantity commercials but not for high argument-quantity commercials. Figure 1 shows that the high argument-quantity commercials elicited more attention (lower heart rate change score) at the beginning but over time more attention was paid to the low argument-quantity commercials. H1a was partially supported.

Table 1. Statistics summaries of multilevel models for dependent variables.

Predictors	Vaping urge			Ads liking			Heart rate			Skin conductance		
	Est	CI	p	Est	CI	p	Est	CI	p	Est	CI	p
(Intercept)	1.38	0.87–1.89	<.001	3.64	2.20–5.08	<.001	2.75	–1.50–7.00	.205	0.49	0.23–0.76	<.001
Endorsement type	0.18	–0.03–0.39	.098	–0.81	–1.45––0.18	.012	–0.29	–1.67–1.09	.679	–0.14	–0.25––0.04	.006
Argument quantity	–0.26	–0.48––0.05	.015	–1.43	–2.06––0.80	<.001	–0.94	–2.34–0.46	.187	–0.22	–0.33––0.12	<.001
<i>ii/cc</i>	0.16	–0.27–0.58	.474	0.01	–1.26–1.27	.994	–1.22	–4.87–2.44	.515	–0.20	–0.42–0.02	.078
Endorsement type * Argument quantity	0.25	–0.05–0.55	.108	1.57	0.67–2.46	.001	–	–	–	–	–	–
Time	–	–	–	–	–	–	–0.05	–0.06––0.03	<.001	–0.01	–0.01––0.01	<.001
Time * Endorsement type	–	–	–	–	–	–	–0.04	–0.06––0.03	<.001	–0.00	–0.01–0.00	.400
Time * Argument quantity	–	–	–	–	–	–	0.03	0.02–0.05	<.001	0.00	–0.00–0.01	.364
σ^2		0.48			1.75			54.75			0.87	
τ_{00}		0.31 _{ID}			0.88 _{ID}			6.82 _{ID}			0.03 _{ID}	
ICC		0.00 _{stimuli}			0.06 _{stimuli}			0.83 _{stimuli}			0.00 _{stimuli}	
N		41 _{ID}			41 _{ID}			24 _{ID}			26 _{ID}	
Observations		8 _{stimuli}			8 _{stimuli}			8 _{stimuli}			8 _{stimuli}	
Marg R ² /Cond R ²		0.066/NA			0.088/0.406			0.021/0.141			0.029/0.065	

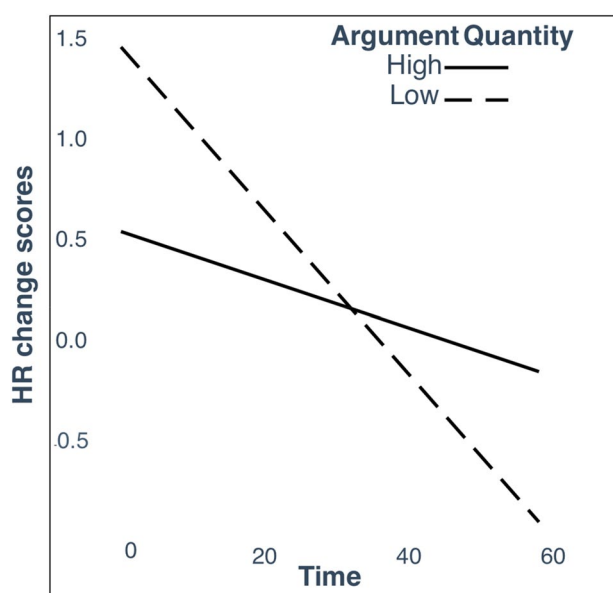


Figure 1. Heart rate change from baseline during E-cigarette commercial viewing as a function of argument quantity.

H1b predicted lower arousal for viewing high versus low argument-quantity commercials. Consistent with our hypothesis, high argument-quantity commercials elicited lower levels of arousal in viewers ($b = -.22$, $p < .001$). Results showed no significant interactions.

Endorsement, attention, and arousal

H2 predicted that participants would be more attentive to (H2a) and more aroused by (H2b) celebrity-endorsed commercials as compared to average-citizen endorsed ones. Although there was no significant main effect of endorsement type on heart rate ($p = .68$), results showed a significant endorsement type and time interaction ($b = -.04$, $p < .001$). As shown in Figure 2, messages with celebrity

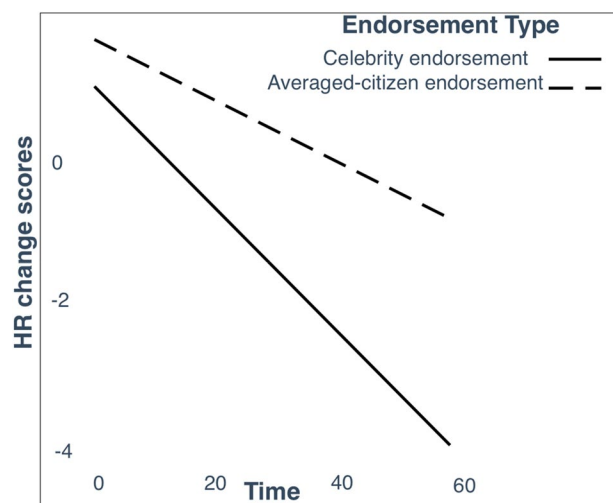


Figure 2. Heart rate change scores during e-cigarette commercial viewing as a function of endorsement type.

endorsement elicited more attention in viewers than non-celebrity endorsement. H2a was supported.

For H2b, results showed a significant main effect for endorsement type on skin conductance ($b = -.14$, $p = .01 < .05$). Contrary to our prediction, celebrity-endorsed commercials elicited lower arousal than average-citizen endorsed commercials. Thus, H2b were not supported.

Argument quantity, endorsement type, ad liking, and vaping urge

RQ1 asked about the effect of argument quantity and celebrity endorsement on ad liking and vaping urge. Results revealed a significant main effect of argument quantity on ad liking ($b = -1.4$, $p < .001$) and vaping urge ($b = -.26$, $p = .015 < .05$). Compared to high argument-quantity, low argument-quantity generated higher ad liking and vaping urge (for ad liking: $M_{\text{low argument-quantity}} = 3.36$, $SE_{\text{low argument-quantity}} = .13$; $M_{\text{high argument-quantity}} = 2.7$, $SE_{\text{low argument-quantity}} = .11$; for vaping urge: $M_{\text{low argument-quantity}} = 1.77$, $SE_{\text{low argument-quantity}} = .08$; $M_{\text{high argument-quantity}} = 1.62$, $SE_{\text{low argument-quantity}} = .07$).

Results showed a significant main effect of endorsement ($b = -.81$, $p = .012 < .05$) and a significant interaction effect of argument quantity and endorsement on ad liking ($b = 1.57$, $p = .001 < .05$). Figure 3 indicates that increasing the number of arguments significantly decreased ad liking for average-citizen endorsed advertisements but not for celebrity-endorsed ones. There was no significant endorsement effect on vaping urge.

Discussion

The goal of this study was to understand nonsmoking young adults' responses to e-cigarette commercials as a function of argument quantity and celebrity endorsement. Our study revealed that commercials with fewer arguments elicited more attention, higher emotional arousal, more ad liking

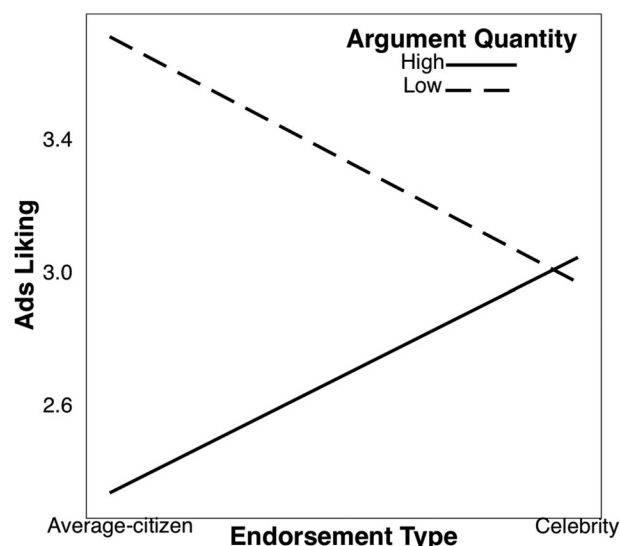


Figure 3. Interaction effect of endorsement type and argument quantity on e-cigarette ad liking.

and vaping urge in participants. Celebrity-endorsed commercials elicited more attention but lower emotional arousal than average-citizen endorsed ones. Interestingly, increasing argument-quantity did not affect ad liking for celebrity endorsed commercials, but decreased ad liking for average-citizen endorsed ones.

In line with the LC4MP, more arguments elicited higher attention at the beginning. However, compared to high argument-quantity, low argument-quantity elicited a steeper increase of attention over time. One plausible explanation is that arguments about multiple risks of smoking conventional cigarettes, as presented to serve as a comparison to e-cigarette products, may trigger nonsmokers' defensive message processing. Defensive message processing happens when viewers' aversive system activates and is characterized with increases in heart rate, arousal, and unpleasantness (Clayton et al., 2019, 2020). Because nonsmokers tend to have a stable anti-smoking state, mentioning the negative effects of smoking conventional cigarettes through words such as "offensive odor," "stains and holes in clothes," and "lung cancer" may activate nonsmokers' aversive system and lead to defensive message processing. When one's aversive system is activated, the person is likely to devote more attention to identify potential threats in those commercials. Because high argument-quantity commercials have more negative words (even though they were used to describe the advantages of e-cigarettes), the overemphasis of unfavorable health outcomes may steer nonsmokers toward a more defensive state, resulting in less information intake and less ad liking. Future research should test how nonsmokers respond to arguments that present negative effects of smoking conventional cigarettes in the context of e-cigarette promotion.

Not surprisingly, celebrity-endorsed commercials elicited greater attention than average-citizen endorsed ones. Consistent with the LC4MP standpoint, celebrity endorsement generated higher appetitive system activation than average-citizen endorsement. Furthermore, increasing the number of arguments in celebrity-endorsed commercials did not reduce participants' ad liking, suggesting that celebrities were able to increase the appetitive system activation to a level that overrode the aversive system activation caused by viewing high argument-quantity commercials. By contrast, when commercials were endorsed by average citizens, the appetitive system may not be activated to the tipping point to override the increased activation of the aversive system due to high argument-quantity viewing. This may explain why increasing the number of arguments lowered participants' ad liking for average-citizen endorsed commercials, but not for celebrity endorsed ones.

Unexpectedly, in the present study, participants' emotional arousal levels (skin conductance activity) were not significantly affected by endorsement type. One possible explanation is that participants as nonsmokers had little interest in e-cigarettes and thus were not emotionally involved with the ad content, even for commercials endorsed by celebrities. This was reflected in their low vaping urge ($mean = 1.69$ on a 7-point Likert scale) and decreasing emotional arousal during ad viewing, which was even lower than their baseline, suggesting a much bored state during ad viewing.

The ELM framework provides additional theoretical framework for explaining the interaction effect of argument quantity and celebrity endorsement on ad liking. Because nonsmokers have few experiences with smoking or vaping, they are less likely to be involved with e-cigarette topics. As such, celebrity-related information is likely to serve as heuristic cues for nonsmokers when it comes to ad evaluation. Celebrity endorsement glamorizes the commercials and e-cigarette products by transferring consumers' positive perceptions of the celebrity to the endorsed ads and products (Phua et al., 2018). As Chang (2007) noted, information in ads that consumers use to evaluate products (called *diagnostic product information*) has significant effects on consumers' ads evaluation and intention of consumption. When different diagnostic information, such as endorsement and arguments, is combined together in an ad, the way the information jointly affects audiences could be complex and dynamic. The effect of argument quantity on ad liking tends to plateau when the ad features celebrity endorsement, whereas the effect tends to diminish when the ad features average-citizen endorsement. It is possible that when endorsers are celebrities who have high fame and trust among viewers, effects due to the changes of argument quantity may be suppressed. In contrast, when endorsers are unknown average-citizens, effects of increased argument quantity may come to the fore.

Lastly, only argument quantity was found to influence on vaping urge. This shows the strong stability of nonsmokers' anti-smoking behavior. Nonetheless, it should be noted that participants' exposure to e-cigarette commercials was quite short in the experiment (only one minute for each stimulus). The fact that they paid increased attention to those commercials calls for future research on the effect of repeated exposure to such e-cigarette commercials and on whether more exposure to e-cigarette commercials would lead to stronger vaping urge and purchase intention.

Several weaknesses of this study should be noted. Because the sample in our experiment was mainly comprised of White Caucasian and female students, future studies can extend this line of research to young adults with more variant background and identities, such as different regions, institutions, cultures, and social circumstances. The stimuli in our experiment featured only a limited number of argument types with most of them being about health benefits. E-cigarette commercials with youth-oriented themes—such as magic, humor, fantasy, and romance (Padon et al., 2017)—without mentioning the disadvantages of tobacco smoking may increase nonsmokers' smoking or vaping urge. Future research should examine how such arguments affect viewers. It would also be promising to compare the potential effects of these arguments on current, ex-, and nonsmokers.

Taken together, our study highlights that persuasive appeals do not work linearly; two pieces of diagnostic persuasive information do not necessarily work better than one piece of information in leading to ads effectiveness. The finding calls further attention to the effect of the dynamic and complex use of persuasive information in advertising (Chang, 2007; Han & Lang, 2020). From a practical

perspective, this study highlights the possibility that social media e-cigarette posts by average Internet users without many benefit claims can serve to arouse and spur otherwise less interested young adults. The findings have implications for public health policy makers regarding e-cigarette marketing regulation. Young adults are more likely to encounter e-cigarette-related information on social media, suggesting that certain type of commercials, such as YouTube ads with low argument quantity by average users, may ultimately elicit vaping behavior among young adults. Our research supports policymakers' plans to put more restrictions on e-cigarette advertising and warrants more studies in this area.

Declaration of interest

We have no conflicts of interests to disclose.

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