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Interacting with Social Media Ads: Effects of Carousel Advertising and Message Type on Health Outcomes

Lewen Wei[a], Guolan Yang[b], Heather Shoenberger[c], and Fuyuan Shen[c]

[a]Gamification Group, Faculty of Information Technology and Communication Sciences, Tampere University, Tampere, Finland; [b]Department of Communication, Journalism, and Public Relations, Oakland University, Rochester, Michigan, USA; [c]Bellisario College of Communications, Pennsylvania State University, University Park, Pennsylvania, USA

ABSTRACT

Carousel advertisements (ads) on social media provide consumers with the opportunity to scroll left and right when reading an ad's content. Such an interactive advertising format has great potential to elevate consumers' interactive and engagement experience with ads, which might be further linked with increased advertising effectiveness. The present study sets out to explore the efficacy of carousel advertising for communicating public health issues by considering both media-specific (i.e., noncarousel versus carousel) and message-specific (i.e., statistics versus narrative) characteristics. Through two experiments, we found reading carousel ads increased participants' control perception, which was positively associated with their message engagement and then favorable ad-related outcomes. Yet, contrary to predictions, the narrative-based carousel ad was found to be no more interactive or engaging than the statistics-based one in affecting perceptual and attitudinal outcomes. We discuss the theoretical and practical implications of these findings for interactive advertising research.

People are exposed to countless commercials every day—from obvious sources (e.g., on network TV) to more subtle channels of advertising that they may only be peripherally aware of via websites and social media. Out of various types of modern advertising, carousel advertising, as a new advertisement format, has been growing in popularity on social media platforms, such as Instagram, Facebook, and Twitter (Cavill 2020). With carousel ads, advertisers can display multiple images or videos in one single ad, and users are able to see all the ad content by swiping left and right on their social media feeds (Ballard 2015).

Thus far, carousel ads are considered effective for growing business. According to Sloane (2015), carousel ads earn a greater number of click-through traffic than regular sponsored posts on Facebook. One explanation is that carousel ads are more efficient than regular ads in driving user engagement because advertisers can tell interesting stories by putting multiple images or videos into the proper sequence (see example in Peterson 2015). Yet, in addition to product/service promotion, advertising also involves advocating for health issues. In recent years, an increasing number of health ads have been appearing on social media, created by organizations, government agencies, and individuals, that leverage the interactive media environment (Park, Rodgers, and Stemmle 2011). Different from product placement that aims to increase brand-related attitude and intentions (Liu, Chou, and Liao 2015), the goal of health advertising is usually to increase the awareness of health risks or encourage the adoption of healthy lifestyles (Kees

CONTACT Lewen Wei ✉ lewen.wei@tuni.fi 🖂 Gamification Group, Faculty of Information Technology and Communication Sciences, Tampere University, Kanslerinrinne 1, 33100 Tampere, Finland.

Lewen Wei (PhD, Pennsylvania State University) is a Postdoctoral Research Fellow in the Gamification Group, Faculty of Information Technology and Communication Sciences, Tampere University.

Guolan Yang (PhD, Pennsylvania State University) is an Assistant Professor in the Department of Communication, Journalism, and Public Relations, Oakland University.

Heather Shoenberger (PhD, University of Missouri; JD, University of Missouri) is an Assistant Professor in the Department of Advertising and Public Relations, Donald P. Bellisario College of Communications, Pennsylvania State University.

Fuyuan Shen (PhD, University of North Carolina) is a Professor and Head of the Department of Advertising and Public Relations, Donald P. Bellisario College of Communications, Pennsylvania State University.

2010; Morton, Williams, and Morris 2020). In light of such different goals, a question is raised: Would carousel advertising be still effective in communicating public health issues on social media?

In addition to the effect of ad format, persuasion literature also suggests the important role of message content features. Of particular relevance to carousel advertising is the difference between narrative and nonnarrative ads. Broadly referring to embedding a story line in an ad, narrative ads can increase one's engagement with the ad (Lien and Chen 2013). A meta-analysis further revealed a small but statistically significant impact of using narrative-based health messages (versus nonnarratives) on influencing attitudes, beliefs, and behaviors (Shen, Sheer, and Li 2015). Extending such positive narrative effects, a recent stream of research has explored the use of interactive narratives that purportedly drive people's engagement enough to produce favorable outcomes (Carpentier, Rogers, and Barnard 2015; Green and Jenkins 2014). Against this backdrop, combining the carousel format with narrative content has great potential to collectively amplify people's interactive experience with health ads and thereby increase health message effectiveness.

Taken together, in the current study, we set out to investigate the impact of carousel health advertising by incorporating media-specific and message-specific characteristics, seeking to provide theoretical and practical implications for advertising research in optimizing the future use of carousel ads.

Literature Review

Interactivity in Carousel Advertising

According to Cho and Leckenby (1997), interactivity can be categorized in terms of the nature of communication targets. Three types of interactivity then emerged: (1) user–machine interactivity, which emphasizes technological devices' responsiveness; (2) user–user interactivity, which looks into interpersonal interactions; and (3) user–message interactivity, which underscores the extent to which users can interact with a message's format and content (Liu and Shrum 2002). Advertising research thus far has often focused on examining the effects of user–machine interactivity in increasing advertising effectiveness by granting consumers opportunities to alter the hosting environment of ads such as websites (e.g., McMahan, Hovland, and McMillan 2009; Voorveld, van Noort, and Duijn 2013). Yet making changes to user–machine interactivity usually requires efforts from entities other

than advertisers. Therefore, attending to the user–message interactivity that advertisers can manage also plays an essential part in the advertising processes, which is what we focus on in the present study.

Liu and Shrum (2002) identified three dimensions of interactivity: active control, two-way communication, and synchronicity. Pertaining to using carousel ads for communicating health-related purposes, the active control dimension, broadly referring to voluntary actions in message processing out of one's own will (Carpentier, Rogers, and Barnard 2015; Liu and Shrum 2002), is an important factor in enriching mediated experience with the ad message. Past advertising research has operationalized active control in many fashions, be it people choosing not to click on pop-up banner ads (Liu and Shrum 2002), selecting a car of a preferred brand over others when encountering advertising in a racing video game (Siemens, Smith, and Fisher 2015), or being able to skip preroll ads in streaming video services (Belanche, Flavián, and Pérez-Rueda 2017). Despite those nuances, essential to the active control dimension is the opportunity for people to decide how they want to interact with advertising.

With that in mind, we consider the carousel format as being more interactive than regular format (i.e., basic social media post) by enhancing user control over the message. Although individuals can also execute control with regular format, for example, by not extensively processing the ad content or ignoring the ad, we argue that the carousel format adds distinct layers of control to the experience. First, compared to a regular post that presents all information at once, a carousel ad enables consumers to see one small part of the ad first and then decide whether they want to proceed with the rest of the ad, and they must actively scroll forward to do so. This is also conducive to creating suspense, which helps retain curiosity about content—in a similar vein to entertainment media sometimes capitalizing on the mystery appeal to increase audience enjoyment (Knobloch-Westerwick and Keplinger 2006). Second, the carousel format allows consumers to choose what parts of an ad to read, which could augment the perception that people can choose the pace and sequence of reading. That is, they do not necessarily have to read the ad in a linear manner from the beginning to the end; they are able to scroll back and forth if they are interested in one particular piece of information.

Taken together, the carousel format can potentially provide actual interactivity by enhancing people's control over the ad message. That said, it is important to

unpack the underlying mechanisms to accurately map out such interactivity effects on advertising outcomes. Perceived interactivity is, foremost, the immediate perceptual outcome of actual interactivity to shape attitudinal responses (Wu 2005). As such, a plethora of advertising research has provided pertinent empirical support to establish the "actual interactivity—perceived interactivity—outcome" sequence (e.g., Gao, Rau, and Salvendy 2009; Hu and Wise 2021; Wei, Sun, and Liu 2020). Against this backdrop, we expect that reading a carousel ad would amplify people's perceptions of being in control of their reading experience to a greater extent than reading a regular sponsored post on social media. Therefore, we offer our first hypothesis:

> **H1:** The carousel ad will increase people's control perception to a greater extent than the regular ad does.

Message Engagement and Persuasion Outcomes

The enhanced control perception resulting from user–message interactivity is conducive to amplifying engagement with the given ad message. Although research thus far has conceptualized engagement in slightly different ways in light of contextual variances (see Mollen and Wilson 2010), in the present study we adopt the "overall sensation of being engrossed in a story" definition by Busselle and Bilandzic (2009, p. 325), because it generally describes the extent to which a person is cognitively and affectively involved with message processing.

Empirical research supports the positive association between user–message interactivity and message engagement. For instance, Oh and Sundar (2015) found that when a website included anti-smoking embedded hyperlinks (i.e., operationalizing interaction with messages) to prompt users to look for more information when reading persuasive messages, they cognitively engaged with the presented information more than browsing a website without such hyperlinks. In another study, researchers found that allowing readers to change the progression of stories during reading (i.e., user interactivity) enhanced interaction and increased readers' engagement with the story (Carpentier, Rogers, and Barnard 2015). Hence, the actual user–message interactivity has the potential to alter the level of message engagement, and in light of the aforementioned "actual interactivity—perceived interactivity—outcome" sequence, the relationship between actual interactivity and message engagement is likely to be mediated by perceived interactivity.

Accordingly, when applied to the carousel advertising context, we expect a similar positive relationship between the control perception elevated by carousel ads and people's engagement with the ad content. But why is engagement so important in carousel advertising? Because it relates to consumers' experience with advertising (Calder, Malthouse, and Schaedel 2009) and helps shape their responses to ad-related persuasive communication (Wang 2006; Voorveld et al. 2018). One key pathway to successful health campaigns is the attenuation of counterarguing that manifests cognitive resistance to persuasion (Moyer-Gusé 2008), a higher level of which might preclude people from taking recommended actions in the message. Prior persuasion literature has found that highly engaged people tend to allocate most of their cognitions and emotions to the message (Slater and Rouner 2002). In other words, they focus on the content per se and tend to forget about time and their surroundings (Green and Brock 2000). As a result, increased engagement makes people less aware of the persuasive intent of the media content (Moyer-Gusé 2008) and reduces counterarguing against persuasion (Dal Cin, Zanna, and Fong 2004; Slater and Rouner 2002). In line with this reasoning, we expect that the interactive carousel format can potentially lead to less intense message counterarguing. Our next hypothesis follows:

> **H2(a):** The effect of carousel ads on counterarguing is sequentially mediated by control perception and message engagement such that a carousel ad will be more likely than a regular ad to enhance people's control perception, which is associated with more message engagement and, subsequently, less counterarguing.

Going beyond how people process the ad message, it is of equal importance to examine perceptual and attitudinal outcomes. Thus far, researchers have consistently anchored perceived message effectiveness, message attitude, and issue attitude as critical dimensions of persuasion effectiveness (e.g., Cho, Shen, and Wilson 2014) in that they directly reflect the extent to which people find the persuasive message convincing. Furthermore, empirical evidence supports the positive relationship between engagement and perceived message effectiveness (Kim, Shi, and Cappella 2016), message attitude (Wang 2006), and issue attitude (Ren and Shen 2020). Therefore, in our study context, we accordingly predict more favorable health advertising outcomes brought about by the carousel format via heightened control perception and message engagement. This forms the basis of our next hypothesis:

> **H2:** The effect of carousel ads on **(b)** perceived message effectiveness, **(c)** message attitude, and **(d)**

issue attitude is sequentially mediated by control perception and message engagement such that the carousel ad will be more likely than the regular ad to enhance people's control perception, which is associated with more message engagement and then a higher level of perceived message effectiveness and more favorable message attitude and issue attitude.

Interactive Narratives

Engagement and resulting ad-related outcomes hinge upon not only ad format but also ad content (Bruce, Murthi, and Rao 2017). When evaluating the utility of carousel ads, it is also important to take into consideration *what* is being communicated in those ads. In light of recent scholarly interests in interactive storytelling that also leverage the benefits of interactivity (Carpentier, Rogers, and Barnard 2015; Green and Jenkins 2014; Oh, Lim, and Hwang 2020), we argue for the combinatory influence imposed by the carousel format and narrative evidence in inducing favorable ad-related outcomes.

In contrast to argument-based persuasion (e.g., the use of statistical evidence) that presents robust logical reasonings to convince the target audience (Kreuter et al. 2007), narrative persuasion highlights the process of telling stories that contain one or more characters who experience a series of events (Bilandzic and Busselle 2013), the plot of which usually describes their motivations and behaviors with vivid details. In processing narrative messages, engagement stands out as one of the key underlying mechanisms. For example, Green and Brock (2000) developed the transportation-imagery model, theorizing that people who are highly absorbed into the story are very likely to agree with the opinions advocated in the story and generate a positive attitude toward the story character. This is because while reading a narrative-based message "[o]ur thoughts are centered on the story, we respond emotionally to the characters and events, and we picture the events as they unfold" (Dal Cin, Zanna, and Fong 2004, p. 181). Slater and Rouner (2002) later proposed the extended elaboration likelihood model, which explicitly identified the associations between heightened message engagement with narratives and persuasion outcomes such as reduced counterarguing. That is, those who are engaged with the story tend to allocate most of their cognitions and emotions to the story and thereby are less likely to critically process the embedded persuasive information.

Advertisers routinely tell exciting and engaging stories to achieve their commercial goals. Compared to nonnarrative ads, narrative ones are more likely to emotionally engage consumers and be perceived as more credible (Kim, Ratneshwar, and Thorson 2017). In addition, the persuasive intent of narrative messages is also considered less noticeable (Moyer-Gusé and Nabi 2010), which could potentially foster desirable consumer responses to narrative advertising. For health communication specifically, the popular entertainment-education contents are usually presented in the narrative format. They are story based but mixed with health information, which could effectively enhance audiences' knowledge of the corresponding health issue and shift their beliefs (Morgan, Movius, and Cody 2009).

Taken further, in recent years researchers have started to explore the effects of a more advanced form of storytelling: interactive narratives. The idea of incorporating interactivity into narrative persuasion is deeply rooted in the phenomenological understanding of human–environment relationships. As such, in addition to conceiving narrative as a structured story with a coherent theme, if we consider reading a narrative as going through the journey started and carried on by protagonists, the experientiality of narratives makes it stand out from other argument-based persuasive messages (Bilandzic and Busselle 2013). Yet conventional narratives normally do not involve readers in deciding how the story should proceed (Green and Jenkins 2014), which greatly limits their ability to connect with readers and enhance their reading experience. To remedy such discrepancy, television professionals have made great efforts to develop interactive TV narratives (Ursu et al. 2008) and interactive documentaries (Nogueira 2020) as they consider interactive storytelling effective in enhancing the sense of control for the audience to decide which parts of the narrative they would like to view and in what order (Ursu et al. 2008).

Against this backdrop, the carousel format provides a great opportunity to naturally boost narrative persuasion effectiveness as it is formatted in a way that invites people to "participate" in narrative reading. Although people might not be able to change the message content in the exact same manner as observed in many interactive storytelling practices (e.g., see Green and Jenkins 2014), the combination of carousel and narrative should produce a more interactive experience with ad messages than narrative regular ads, nonnarrative carousel ads, and nonnarrative regular ads. As a result, the heightened control perception could further engage consumers in processing the information. For example, in studying mental health
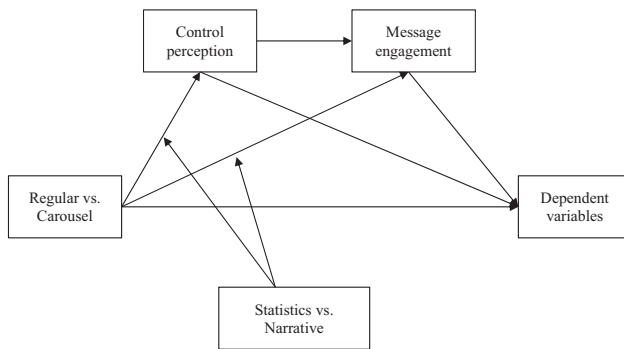
Figure 1. Conceptual model for moderated mediation in both Study 1 and Study 2.

stigma, Kim and Stout (2010) found that when participants could control message sequence in reading a narrative, they were able to comprehend the story better, which is a proxy of more narrative engagement (see Busselle and Bilandzic 2009). Likewise, in Oh, Lim, and Hwang (2020), when communicating about the obesity epidemic, interactive storytelling was found to enhance perceived interactivity that drove up participants' narrative transportation by the story compared to not having such interactivity. Hence, following the reasoning provided by Green and Jenkins (2014), we argue that compared to statistical evidence, the narrative content in a carousel ad will amplify message engagement via control perception to a greater extent than a regular ad. We therefore hypothesize:

> **H3:** The carousel ad will be more likely than the regular ad to enhance people's control perception, which is associated with more message engagement and, subsequently, **(a)** less counterarguing, **(b)** greater perceived message effectiveness, **(c)** more favorable message attitude, and **(d)** improved issue attitude. The mediation effect will be stronger when the ad is featured with a narrative than with statistical evidence.

Figure 1 provides our conceptual model for the relationships between the key variables in our studies.

Study Overview

We conducted two experiments to investigate the effectiveness of carousel health advertising and its underlying mechanisms, both of which took the form of a 2 (message format: regular versus carousel ad) × 2 (message type: statistical evidence versus narrative) online between-subjects design. In both studies, we chose to sample from college students and/or young adults for two reasons. First, carousel ads are commonly used on social media such as Facebook and Instagram (Influencer Marketing Hub n.d.) where

adults in the age group of 18 to 29 continue to be the most active users (Tankovska 2021). Second, compared to adolescents and older adults, young adults (approximately 18 to 26 years old), while at this critical development phase of life, today face enormous challenges to their health and well-being (Institute of Medicine and National Research Council 2015). Therefore, if proper social media messages can be designed and delivered to this particular segment of audience, it might help bring in positive influences at both the individual and society level.

Both Study 1 and Study 2 followed the same study procedure approved by the institutional review board. After consenting to participate in the study, all participants were first randomly assigned to read a health message varying in format and content. We designed all stimuli ads to simulate a real Facebook page. Notably, Facebook was chosen over other visual-oriented social media such as Instagram because we wanted to focus on basic text-based messages in carousel advertising before exploring varied pictorial/video-based ones that might introduce additional imagery experience (Lutz and Lutz 1977) to consumers. The Facebook message was then designed to be sent by a fictitious user named Eden Linden. Because carousel ads on Facebook are always sponsored, all stimuli were adjusted accordingly to denote sponsorship. After finishing viewing the Facebook page, participants were then directed to complete a questionnaire asking about their perceptions and attitudes toward the message and the advocated issue, followed by measurements of individual background information.

Study 1

Method

Sample[1]

We recruited 188 participants from a large public university in the United States, all of whom were enrolled in undergraduate communication classes; they agreed to participate in exchange for extra class credit. After removing duplicate and incomplete responses, the final data set consists of 171 participants. There were 139 females, 30 males, one participant indicating "other," and one who preferred not to disclose gender. Their ages ranged from 18 to 23 years ($M = 20.57$, $SD = 1.19$). In this sample, 128 participants identified themselves as Caucasian, 23 as Asian/Pacific Islander, nine as Latino/Hispanic, four as African American, five as multiracial, and two as other.

Stimuli

In Study 1, we chose opioid addiction as the study context because overdosing on opioids is a prevalent public health issue seriously affecting the U.S. population (National Institute on Drug Abuse 2020). Especially in light of increasing concerns of opioid addiction among student populations (Field 2018), it is critical to raise their awareness of its danger.

The regular ad message resembled a typical Facebook post with text and four generic pictures related to opioid addiction, which were carefully selected to avoid including any specific human figure to bias participants' perceptions. In the carousel ad conditions, all message contents remained the same, yet they were divided into four consecutive posts in a sequence that allowed participants to scroll among them.[2]

The statistics-based ad message was featured with numerical descriptions of opioid addiction, such as "On average, 130 Americans die every day from an opioid overdose" and "In fact, as many as 1 in 4 patients receiving long-term opioid therapy in a primary care setting struggles with opioid addiction." The narrative ad message, instead, was featured with a coherent story describing how an 18-year-old college student had been struggling with opioid overdose. All contents were adapted from reliable sources such as the Centers for Disease Control and Prevention (CDC) website.

Measurement

Unless indicated, all items were measured using a 7-point Likert scale, with $1 = $ *Strongly disagree* and $7 = $ *Strongly agree*.

Covariate

Informed by research on narrative persuasion (e.g., Green and Jenkins 2020; Slater and Rouner 2002), we statistically controlled transportability, issue familiarity, and issue involvement in this study.

Transportability was measured using the scale developed by Dal Cin, Zanna, and Fong (2004) with 17 items, such as "In general, when reading a story, I find I can easily lose myself in the story," Cronbach's $\alpha = .92$, $M = 4.35$, $SD = 1.11$. Issue familiarity was measured using a single item: "To what extent are you familiar with the issue of opioid addiction in general?" ($1 = $ *Not at all*, $7 = $ *Very much*). Issue involvement was measured by asking participants to indicate their perceived relevance of opioid addiction. Adopted from Zaichkowsky (1994), the four bipolar adjective scale items on a 7-point rating scale included: *Unimportant/Important*, *Irrelevant/Relevant*, *Means nothing/Means a lot to me*, and *Uninvolving/Involving*, Cronbach's $\alpha = .89$, $M = 4.68$, $SD = 1.56$.

Mediator

Control perception was measured with six items adapted from Y. Liu (2003), Song and Zinkhan (2008), and Wu (2005). Sample items contained "I was in control of my navigation through reading the message" and "While reading the message, I had absolutely no control over what I could do to the message" (reverse coded), Cronbach's $\alpha = .75$, $M = 3.24$, $SD = 1.31$.

Message engagement was measured by asking participants to indicate the extent to which they felt absorbed into the message. The seven items were adopted from Appel et al. (2015), Taeyong and Biocca (1997), and Oh, Bellur, and Sundar (2018) and included "When reading the message, I could picture in the scene of the events described in the message" and "When I finished reading the message, I felt like I came back to the 'real world' after a journey," Cronbach's $\alpha = .83$, $M = 3.77$, $SD = 1.16$.

Dependent Variable

We measured four ad-related outcomes.

To measure counterarguing, two items were adopted from Nabi, Moyer-Gusé, and Byrne (2007). Participants were asked to indicate the extent to which they agree or disagree with statements, such as "When reading the message, I found myself actively agreeing with points made in the message," Cronbach's $\alpha = .79$, $M = 3.24$, $SD = 1.31$.

Message effectiveness was measured with five bipolar adjective items: *Unbelievable/Believable*, *Not persuasive/Persuasive*, *Not effective/Effective*, *Uninformative/Informative*, and *Not credible/Credible* (Cronbach's $\alpha = .79$, $M = 5.26$, $SD = .93$).

Both attitude toward the message and attitude toward the issue were measured using the same four bipolar adjective items: *Bad/Good*, *Negative/Positive*, *Unfavorable/Favorable*, and *Undesirable/Desirable* (message: Cronbach's $\alpha = .83$, $M = 3.92$, $SD = 1.20$; issue: Cronbach's $\alpha = .97$, $M = 2.05$, $SD = 1.43$) (Osgood, Suci, and Tannenbaum 1957).

Table 1 presents bivariate correlations among measured variables.

Results

Hypothesis 1 proposed that the carousel ad would increase participants' control perception of their reading experience. To test this, we specified a univariate

analysis of covariance (ANCOVA) with message format listed as the independent variable and control perception as the dependent variable while controlling for measured covariates and message type. The main effect was significant such that reading the carousel message ($M = 4.94$, SE $= .11$) induced a higher level of control perception than reading the regular one ($M = 4.13$, SE $= .11$), F (1, 165) $= 29.20$, $p < .001$, partial $\eta^2 = .15$. Therefore, hypothesis 1 was supported.

Hypotheses 2(a) through 2(d) predicted a serial mediation via control perception and message engagement to explore mechanisms underlying carousel effects. To test this, we employed Model 6 in PROCESS macro (Hayes 2018) with message format as the independent variable and control perception and message engagement as two serial mediators while controlling for measured covariates and message type. As shown in Table 2, there was one significant indirect effect via both mediators on counterarguing such that compared to the regular post, the carousel one led to a higher level of control perception, which was further associated with participants' message engagement, thereby reducing their counterarguments against information presented in the message.

Therefore, hypothesis 2(a) was supported, while hypotheses 2(b), 2(c), and 2(d) were rejected.

Hypotheses 3(a) through 3(d) predicted the moderation by the message type (statistical evidence versus narrative) on the carousel effect. We then employed Model 84 in PROCESS macro (Hayes 2018) with message type as the moderator while other setups remained the same. No statistically significant moderated mediation was found on any dependent variable, thus rejecting hypothesis 3.

Study 2

Study 1 provided preliminary evidence of carousel ads increasing control perceptions that enhanced reading experience to elicit some favorable ad-related outcomes. However, the observed effect occurred only on counterarguing but not attitudinal judgments. We speculate that it might be due to social desirability biases commonly observed when reporting health-related attitudes (Schmidt et al. 2010) such that participants were constrained by normative social expectations from disclosing their true attitudes toward opioid overdose. In addition, further evidence is needed to explore the (in)effectiveness of narrative ads on altering carousel advertising outcomes. Against this backdrop, we conducted Study 2 with a different health topic (i.e., vaping) seeking to extend findings in Study 1.

In Study 2, in addition to counterarguing and perceived message effectiveness, we propose two community-level outcome variables to replace individual attitudes examined in Study 1—respectively, risk perception and policy support seeking—to attenuate social desirability biases. Both variables are of critical interest to policymakers (Niederdeppe et al. 2014; Sjöberg 2001). Therefore, if the proper ad format can be implemented to communicate proper contents, health advertising can contribute to effective

Table 1. Bivariate correlations among measured variables in Study 1.

	1	2	3	4	5	6	7	8	9
1									
2	.28***								
3	−.11	−.27***							
4	.12	.20**	−.46***						
5	.06	.12	−.30***	.29***					
6	.05	.04	.09	−.12	.21**				
7	.14	.25***	−.27***	.40***	.25**	.06			
8	.24**	−.02	−.21**	.32***	.13	−.02	.41***		
9	.24**	.24**	−.18*	.16*	.04	−.05	.18*	−.004	

Note. 1 = control perception; 2 = message engagement; 3 = counterarguing; 4 = message effectiveness; 5 = message attitude; 6 = issue attitude; 7 = issue involvement; 8 = issue familiarity; 9 = transportability.
*$p < .05$; **$p < .01$; ***$p < .001$.

Table 2. Mediation results in Study 1.

DV	Direct Effect	Indirect Effect			Total Effect
		IV-M1-DV	IV-M2-DV	IV-M1-M2-DV	
Counterarguing	$B = -.10$, SE $= .19$, $p = .61$	$B = -.02$, BootSE $= .08$, 95%CI [−.18, .13]	$B = .07$, BootSE $= .05$, 95%CI [−.02, .19]	$B = -.07$, BootSE $= .03$, 95%CI [−.14, −.02]	$B = -.11$, SE $= .18$, $p = .53$
Message effectiveness	$B = -.14$, SE $= .14$, $p = .32$	$B = .03$, BootSE $= .06$, 95%CI [−.09, .16]	$B = -.03$, BootSE $= .03$, 95%CI [−.09, .01]	$B = .03$, BootSE $= .02$, 95%CI [−.004, .07]	$B = -.11$, SE $= .13$, $p = .38$
Message attitude	$B = .06$, SE $= .20$, $p = .77$	$B = -.001$, BootSE $= .06$, 95%CI [−.12, .11]	$B = -.02$, BootSE $= .03$, 95%CI [−.09, .03]	$B = .02$, BootSE $= .02$, 95%CI [−.03, .07]	$B = .05$, SE $= .18$, $p = .76$
Issue attitude	$B = -.08$, SE $= .24$, $p = .73$	$B = .09$, BootSE $= .10$, 95%CI [−.09, .31]	$B = -.004$, BootSE $= .04$, 95%CI [−.09, .06]	$B = .004$, BootSE $= .03$, 95%CI [−.05, .07]	$B = .003$, SE $= .22$, $p = .99$

Note. IV = message format (0 = regular, 1 = carousel); M1 = control perception; M2 = message engagement; DV = dependent variable.

policymaking. As such, previous research provided some evidence linking message engagement with risk perception (Dillard, Ferrer, and Welch 2018) and policy support (Rickard et al. 2021). We thereby analogously predict that the carousel (narrative) ad will be more effective in increasing risk perception and policy support via control perception and message engagement as follows:

H2: The effect of a carousel ad on **(e)** risk perception and **(f)** policy support is sequentially mediated by control perception and message engagement such that the carousel ad will be more likely than the regular ad to enhance people's control perception, which is associated with more message engagement and, subsequently, a higher level of risk perception and policy support.

H3: The carousel ad will be more likely than the regular ad to enhance people's control perception, which is associated with more message engagement and, subsequently, a higher level of **(e)** risk perception and **(f)** policy support. The mediation effect will be stronger when the ad is featured with a narrative than with statistical evidence.

Method

Sample

Study 2 also focused on the young adult population. We recruited 213 Amazon Mechanical Turk (MTurk) workers situated in the United States via the CloudResearch platform, requesting them to be either current college students or in the age range between 18 and 35 years. After removing those who failed the manipulation check, the final data set consisted of 170 valid responses. Upon successful completion, participants were compensated with $1.00 for this 10-minute study.

There were 92 males, 76 females, one indicating "other," and one preferring not to disclose gender. Their age ranged from 18 to 53 ($M = 27.19$, $SD = 6.41$). In this sample, 92 participants identified themselves as Caucasian, 24 as Asian/Pacific Islander, 22 as African American, 18 as multiracial, 10 as Latino/Hispanic, and four as Native American. In addition, 51.76% participants had active college enrollment, and 45.88% had prior experience with tobacco products.[3]

Stimuli

In Study 2 we chose vaping as the study context due to its substantial threat to individual and public health (CDC 2020). In addition, its alarming prevalence among young adults also invites more research to implicate pertinent policymaking (Al-Hamdani, Hopkins, and Park 2020).

The manipulation of ad format was similar to that in Study 1. To enhance the realism of the carousel format, we made further improvements by cropping a preview of the next post to the current one when reading the first three posts to mimic the current carousel practices on Facebook.

Consistent with Study 1, the statistics-based ad message included numerical descriptions such as "Young adult use of e-cigarettes increased from 2.4% in 2012 and 2013 to 5.2% in 2017, and increased again to 7.6% in 2018 based on a recent analysis." For the narrative ad message, we prepared two versions to increase its external validity. After going through news coverage about vaping among young adults, we identified two major motivations behind vaping, respectively: (1) current smokers turning to e-cigarettes for convenience and (2) nonsmokers relenting to peer pressure. Then, we created two narratives based on news articles from sources such as CNN. In the experiment, participants were randomly assigned to read one of the three messages.[4]

Measurement

In Study 2, some focal variables were measured with the same scale and response categories used in Study 1, including control perception (Cronbach's $\alpha = .81$, $M = 5.07$, $SD = 1.21$), message engagement (Cronbach's $\alpha = .83$, $M = 4.36$, $SD = 1.29$), counterarguing (Cronbach's $\alpha = .82$, $M = 2.96$, $SD = 1.67$), message effectiveness (Cronbach's $\alpha = .92$, $M = 5.46$, $SD = 1.27$), transportability (Cronbach's $\alpha = .89$, $M = 4.69$, $SD = .96$), issue familiarity ($M = 4.98$, $SD = 1.52$), and issue involvement (Cronbach's $\alpha = .95$, $M = 3.38$, $SD = 1.78$).

For newly proposed hypotheses, we included measurements of risk perception and policy support. We also added a manipulation-check item to validate our manipulation of the carousel format. One question was prepared to check our manipulation for the message format: "When reading the message, did you click buttons to scroll left/right on the website?" We removed participants who failed this manipulation check ($n = 43$)—that is, those who had been assigned to read the carousel message but chose "No" and those who had been assigned to read the regular message but chose "Yes."

Risk perception was measured with seven items adapted from Jungmi, Wen, and Wu (2020). Sample items include "E-cigarette use harms brain" and "E-

cigarettes are safe" (reverse-coded), Cronbach's $\alpha =$ .77, $M = 5.38$, $SD = 1.08$.

Policy support of vape-free campus was measured with seven items adapted from Jungmi, Wen, and Wu (2020). Sample items include "University campuses should be 100% vape-free" and "Violators of the vape-free policy should be fined," Cronbach's $\alpha = .92$, $M = 5.01$, $SD = 1.48$.

Table 3 presents bivariate correlations among measured variables.

Results

To test the effect of carousel format on control perception (hypothesis 1), we specified the same ANCOVA as in Study 1. Supporting hypothesis 1, reading the carousel post ($M = 5.40$, $SE = .12$) led to more prominent control perception than reading the regular post ($M = 4.75$, $SE = .12$), $F (1, 164) = 13.72$, $p < .001$, partial $\eta^2 = .08$.

To test the serial mediation underlying the carousel effect (hypothesis 2), we employed Model 6 in PROCESS macro (Hayes 2018) with the same setup as in Study 1. As shown in Table 4, we found significant indirect effects on message effectiveness and policy

support via the control perception–message engagement sequence. Consistent with Study 1, reading the carousel post increased participants' control perception, which was further associated with their engagement with the message, thereby leading them to consider the message as persuasive and show support for relevant policies of vape-free campus. Hence, hypotheses 2(b) and 2(f) were supported, while hypotheses 2(a) and 2(e) were rejected.

To test whether message type (statistical evidence versus narrative) could moderate the aforementioned relationship (hypothesis 3), we employed Model 84 in PROCESS macro (Hayes 2018) with the same setup as in Study 1. Again, we did not find statistically significant moderated mediation by message type, thereby rejecting hypothesis 3.

Discussion

Through two experiments, we examined the effectiveness of carousel advertising in communicating public health issues on social media. Both studies corroborated a higher level of control perception resulting from the carousel format. Such heightened perception was further associated with people's message engagement, which led to more favorable ad-related outcomes (albeit inconsistently between two studies). Yet, inconsistent with prior research (Carpentier, Rogers, and Barnard 2015; Kim and Stout 2010), the narrative carousel ad was found as no more interactive or engaging than the statistics-based ad to affect ad-related outcomes.

There are several possible explanations. First, the interactivity afforded by the carousel format might be sufficiently powerful to amplify people's perception of interaction with the ad, thereby creating a ceiling effect with which reading a narrative or statistics-based ad did not make a consequential difference on their interactive experience. Alternatively,

Table 3. Bivariate correlations among measured variables in Study 2.

	1	2	3	4	5	6	7	8	9
1	—								
2	.41***	—							
3	.05	.11	—						
4	.26***	.37***	−.35***	—					
5	.14	.08	−.31***	.47***	—				
6	.05	.19*	−.24**	.46***	.40***	—			
7	.25**	.46***	.04	.26***	.07	.10	—		
8	−.05	.04	.05	.04	.03	−.07	.22**	—	
9	.07	.25***	.17*	−.01	−.17*	−.09	.05	.20*	—

Note. 1 = control perception; 2 = message engagement; 3 = counterarguing; 4 = message effectiveness; 5 = risk perception; 6 = policy support; 7 = transportability; 8 = issue familiarity; 9 = issue involvement.
*$p < .05$; **$p < .01$; ***$p < .001$.

Table 4. Mediation results in Study 2.

DV	Direct Effect	Indirect Effect			Total Effect
		IV-M1-DV	IV-M2-DV	IV-M1-M2-DV	
Counterarguing	$B = −.06$, SE $= .27$, $p = .84$	$B = .02$, BootSE $= .08$, 95%CI [−.15, .19]	$B = −.02$, BootSE $= .03$, 95%CI [−.10, .04]	$B = .02$, BootSE $= .03$, 95%CI [−.03, .08]	$B = −.04$, SE $= .26$, $p = .88$
Message effectiveness	$B = .06$, SE $= .19$, $p = .75$	$B = .10$, BootSE $= .06$, 95%CI [−.02, .23]	$B = −.06$, BootSE $= .06$, 95%CI [−.18, .03]	$B = .06$, BootSE $= .03$, 95%CI [.01, .13]	$B = .04$, SE $= .19$, $p = .83$
Risk perception	$B = .25$, SE $= .17$, $p = .14$	$B = .05$, BootSE $= .06$, 95%CI [−.06, .17]	$B = −.02$, BootSE $= .02$, 95%CI [−.07, .02]	$B = .02$, BootSE $= .02$, 95%CI [−.01, .06]	$B = .31$, SE $= .16$, $p = .07$
Policy support	$B = −.16$, SE $= .24$, $p = .51$	$B = −.03$, BootSE $= .07$, 95%CI [−.19, .11]	$B = −.05$, BootSE $= .05$, 95%CI [−.16, .03]	$B = .05$, BootSE $= .03$, 95%CI [.01, .12]	$B = −.19$, SE $= .23$, $p = .42$

Note. IV = message format (0 = regular, 1 = carousel); M1 = control perception; M2 = message engagement; DV = dependent variable.

implementing an interactive narrative might need to go beyond simply letting people take charge of the progression while reading. As such, Green and Jenkins (2014) conceptualized interactive narratives as "stories that allow readers to determine the direction of the plot, often at key decision points" (p. 479). Yet, for carousel advertising, letting consumers make actual changes to ad contents might create barriers to effective content creation for advertisers, which makes narrative carousel ads rather unrealistic on social media. Furthermore, it could also be due to the influence imposed by participants' coping with persuasion. According to the persuasion knowledge model (Friestad and Wright 1994), if people are aware of the commercial nature of advertising practices, they might develop certain mechanisms to cope with persuasion attempts. In our study context, then, despite narratives being conceived as less apparent in persuasive intent in general (Moyer-Gusé and Nabi 2010), embedding them into sponsored social media ads to advocate for public health might be considered too obvious in trying to change people's attitudes and beliefs. As a result, our participants might consciously detach themselves from engaging with the storytelling, which further rendered our persuasive message ineffective when combined with the carousel format.

Another noteworthy finding is that the effect of carousel ads was not always significant on all persuasion outcomes. In Study 1, the significant effect was observed on counterarguing, which was not replicated in Study 2, where we found significant effects on message effectiveness and policy support. Such incoherence might result from topical differences between opioid addiction and vaping, which has occurred in prior research when various health topics were involved (e.g., Nan, Verrill, and Kim 2017). Thus, more research in carousel health advertising is needed to validate its effectiveness on social influence.

Theoretical Implications

The results of our two studies provide important theoretical implications to current literature on interactive advertising. For decades, perceived interactivity has been an important mechanism to explain how consumers might process interactive advertising (e.g., Lee and Cho 2019; Voorveld, Neijens, and Smit 2011; Wei, Sun, and Liu 2020; Wu 2005). In the present study, we explored how advertisers might be able to leverage both ad format (i.e., carousel) and ad content (i.e., narrative) to influence the consumer perception of interactivity when communicating health messages.

Corroborating the prominent role of perceived interactivity, we found the carousel ad's superiority in engaging consumers compared to a regular social media post by granting more control over their reading experience. This echoes the importance of augmenting consumers' interactions with commercial messages in contemporary interactive advertising (Voorveld et al. 2018). It also indicates a need for scholars to further explore other types of persuasive interactivity features to increase advertising effectiveness.

Second, the null findings with regard to the effect of narrative in carousel advertising merit more in-depth investigations. In fact, the narrative persuasion literature suggests that a variety of factors can influence narrative effects, including message features such as framing (Kim and Nan 2019) and individual differences such as dichotomous thinking (Lu and Sinha 2019). In addition, the underlying mechanisms to account for narrative persuasion include not only holistic experience with message reading (i.e., control perception and message engagement in the present study) but also specific responses to the plot (e.g., counterfactual thinking in Tal-Or et al. 2004) and the character(s) (e.g., identification in De Graaf et al. 2012). Therefore, examining the effect of storytelling in interactive advertising can benefit from dissecting the narrative at more granular levels.

Third, the inconsistency emerging from carousel effects on persuasion outcomes may be due to the different health issues used in the experiments. Prior research on health advertising effects has focused on a diverse selection of health issues, such as healthy food options (Kees 2010), disease awareness (Hall, Jones, and Iverson 2011), and safe-sex behaviors (Morton, Williams, and Morris 2020). Our study adds to existing literature with insights about how to use interactive ad formats to communicate issues of opioid addiction and vaping, with findings implicating unique characteristics associated with each health context.

Practical Implications

Our findings provide critical practical implications for advertising and marketing practices. Incorporating interactivity features into digital advertising was shown to be advantageous via amplified perceived interactivity and engagement with the ad message for more advertising effectiveness. Therefore, practitioners could continue developing interactive ad delivery based on the carousel format and find more

innovative ways that further enable consumers to be part of the advertising process without compromising advertising outcomes.

Moreover, our study indicates the feasibility of leveraging carousel advertising for public health issues in addition to product placement. Hence, advertisers and social media managers are encouraged to work together in developing health campaigns using interactive ads such as the carousel format to engage social media users and foster desirable healthy behavioral changes.

Limitations and Future Research

There are several limitations in this study. First, we focused on comparing narrative and statistics-based information in carousel ads. Yet narrative effects can be a result of many message-level characteristics. For example, our narrative stimuli featured the first-person perspective, whereas some prior research suggests the superiority of third-person storytelling (Christy 2018). Therefore, future research could test varied message features of the same narrative to see if a particular type of interactive storytelling for public health would be most effective in inducing favorable persuasion outcomes.

Second, the primary goal of the present study is to explore how carousel advertising could be leveraged for health communication. As such, we limited the source of stimuli ads to an unfamiliar individual to reduce the effect of confounding variables such as known media organizations, brands, celebrities, or influencers, as existing advertising research has illuminated the great potential of increased involvement with familiar entities in shaping ad-related outcomes (e.g., Edwards, Lee, and Ferle 2009; Siemens, Smith, and Fisher 2015). In future research, scholars are encouraged to continue this line of inquiry by examining the extent to which the ad effectiveness would vary as a function of other types of message sources.

Third, our manipulation for the regular ad was relatively text-heavy, which to some degree is unfavorable to ad processing as consumers in the real world may have less patience to read a long sponsored post. Although the text-image ratio between the regular and carousel ad in our study is an integral part of our deliberate message design, researchers could experiment with different types of ad presentation to reduce the length of texts in future studies.

Despite these limitations, carousel advertising can be a theoretically and empirically important complement to existing interactive advertising research.

Future research can continue this line of inquiry by exploring how carousel advertising is received when message contents, sources, and/or delivery formats vary with a more representative sample to inform pertinent practices in a more comprehensive manner.

Notes

1. We ran additional analyses to check whether the distribution of demographic variables (i.e., gender, age, and race) across different experimental conditions was statistically equivalent. For gender and race, we ran chi-square analyses. For age, we ran a univariate analysis of variance. In Study 1, we found nonsignificant difference in gender (χ^2 ($df = 3$) = 3.21, p = .36), age (F (1, 167) = 3.53, p = .06, partial η^2 = .02), and race (χ^2 ($df = 5$) = 7.10, p = .21). In Study 2, we also found nonsignificant difference in gender (χ^2 ($df = 3$) = 4.40, p = .22), age (F (1, 166) = .22, p = .64, partial η^2 = .001), and race (χ^2 ($df = 5$) = 8.91, p = .11). Therefore, participants across different conditions were not significantly different from one another in terms of their demographics.

2. All stimuli materials were not included in this article to protect copyrights. However, they can be requested from the corresponding author upon reasonable request.

3. In Study 2, participants' student status and vaping status varied. We specified a ANCOVA by treating these two binary variables as fixed factors along with our focal independent variables. We found neither significant main effects of student status (student status, F (1, 149) = .53, p = .59, partial η^2 = .01; vaping status, F (1, 149) = 3.76, p = .054, partial η^2 = .03) nor significant interaction effects with the two independent variables. Therefore, we did not statistically control for their effects.

4. In Study 2, we created two versions of narratives for stimulus sampling. To ensure their equivalence, we ran all the analyses in the main body of the article with the message type independent variable modified to have three levels: statistical evidence, vaping-for-convenience narrative, and vaping-for-peer-pressure narrative. We did not find any significance between the two narrative conditions on outcome variables. Therefore, we did not differentiate these two narratives when interpreting results.

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No financial interest or benefit has arisen from the direct applications of this research.

ORCID

Lewen Wei 🆔 http://orcid.org/0000-0002-4387-2779

Guolan Yang 🆔 http://orcid.org/0000-0002-8123-1841
Heather Shoenberger 🆔 http://orcid.org/0000-0001-6211-1361

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