

How do Online Comments Affect Perceived Descriptive Norms of E-Cigarette Use? The Role of Quasi-Statistical Sense, Valence Perceptions, and Exposure Dosage

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By facilitating user participatory features such as online comments, digital media expand the means through which individuals can get access to others' behavior choices. This opens new research avenues in the pursuit of understanding how social influence operates in the virtual space. The current study examined whether anonymous others' behavior choices within the online comment board may affect viewers' descriptive norm perceptions in the real world. Results show that, given sufficient total exposure, viewers' "quasi-statistical sense" allowed them to correctly identify the numerical majority through subtle individual behavior cues embedded in the online comments, which effectively influenced their estimation of the actual e-cigarette use prevalence among the U.S. population. Perceived behavior choice dominance and valence stance dominance toward e-cigarette use on the online comment board were found to mediate the relationship. Implications for the underlying mechanism of descriptive norm perception formation and future directions are discussed.

Keywords: Online Comments, Social Influence, Descriptive Social Norms, Quasi-Statistical Sense, Exposure Dosage, E-Cigarette Use.

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Introduction

While different subfields of social sciences take their own departure from the theoretically rich construct "social norms," it is in general understood as shared customary rules or conventions, including values, standards, expectations, and traditions that function as a "social proof" heuristic and govern group behaviors as well as social order (Bicchieri, 2005; Fung & Scheufele, 2014; Lapinski & Rimal,

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2005; Sherif, 1936). Cialdini, Reno, and Kallgren (1990) proffered two types of norms, *injunctive* and *descriptive norms*, that guide behavior decisions, with the former providing information about what *ought or is expected to be done*, and the latter describing what is *actually and commonly done* by social others. In other words, injunctive norms promote behavior compliance through expected social rewards or sanctions, whereas descriptive norms motivate actions through behavior prevalence information. Both norms are considered potent tools for influencing cognition and behavior changes (Fishbein & Ajzen, 2010). As social norms are unwritten rules in a society, and that individuals often have limited access and attention to a full picture of what others think and do, they tend to form subjective perceptions of social norms (i.e., perceived norms) based on their own observations. Such normative perceptions, accurate or not, matter much more than the actual norms in guiding decision-making (Lapinski & Rimal, 2005; Rimal & Real, 2003; Tankard & Paluck, 2016).

Interestingly, while individuals can often interpret social approval or disapproval information correctly, their subjective perceptions of descriptive norms may not always match the actual behavior prevalence in the environment (Borsari & Carey, 2003; Cruz, Henningsen, & Williams, 2000; Neighbors, Dillard, Lewis, Bergstrom, & Neil, 2006; Prentice & Miller, 1993). However, it remains unclear how individuals construct their perceived behavior prevalence in their day-to-day life in the first place. Theories that explain the public opinion formation process, such as the Spiral of Silence Theory (Noelle-Neumann, 1974), may shed light on the underlying mechanism. One crucial premise of the theory stipulates that, people have a *quasi-statistical sense* that allows them to gauge the prevailing opinion climate through scrutinizing their social environment. In other words, people can instinctively collect opinion or behavior information through local observation and unique experiences, sense the dominance distribution, and act accordingly. The findings from the classic Asch experiments also corroborated this idea, by providing empirical evidence to suggest that individuals were able to correctly sense the majority answer in the group, and that such observations were quite precise as there was an increase in conformity with more confederates (Asch, 1955, 1956).

As our media landscape continues to evolve, individuals have turned increasingly to social media and other online platforms which provide access to others' opinions and behavior choices through user-generated content, such as online comments (Lee & Tandoc, 2017). This provides us unprecedented opportunities to examine the underlying process of descriptive norm perception formation with the new media platform where mediated and interpersonal processes intersect, extending the Asch paradigm from an off-line group setting to an online comment board setting. Therefore, in the current investigation, we aim to understand how exposure to online comments that contain anonymous others' behavior choices may shape one's descriptive norm perceptions, namely perceived prevalence of the target behavior in the real world, through their quasi-statistical sense. In the next sections that follow, we elaborate on important considerations and factors that may contribute to the formation process.

Individual behavior cues as normative information

People frequently use two sources of information to understand descriptive social norms—systematic summary information, and scattered individual behavior cues (Tankard & Paluck, 2016). Summary information refers to prevalence statistics usually provided by census, survey results, newspaper reports, or educational campaigns, and is considered the most straightforward way to deliver descriptive norm information. In fact, most previous studies in the realm of social norms manipulate descriptive norm perceptions by directly providing summary information in the messages, such as “almost 75% of guests who are asked to participate in our new resource savings program do help by using their towels more than once” (Goldstein, Cialdini, & Griskevicius, 2008). While such descriptive norm information often reflects the actual behavior prevalence in the environment, it does not resemble the

typical way in which individuals form their own perceptions based on their subjective experiences; however, such subjectively formed perceptions through accumulative exposure to individual behavior cues in everyday life are likely to be more influential in behavioral decisions and are thus the focus of the current study.

Individual behavior cues, which refer to behaviors (or lack thereof) either performed by surrounding reference groups or portrayed in media content, convey the descriptive norm information in a relatively implicit way, but may be the most typical source that allow individuals to perceive and gauge behavior prevalence based on what they have observed and inferred by themselves (Lapinski & Rimal, 2005; Tankard & Paluck, 2016). The subjective perceptions of behavior distribution formed in this way might be quite powerful in affecting people's cognitions and behaviors. This proposition echoed Opp (1982)'s Theory of Evolutionary Norm Formation (TENF), which aimed to explain the emergence and formation process of norms spontaneously developed in everyday life (termed "evolutionary norms," which are different from institutionally prescribed norms, i.e., "institutional norms," or norms as the end-product of bargaining, i.e., "voluntary norms"). According to TENF, observations of recurrent behaviors (i.e., repeatedly seeing a particular behavior being performed by others in a certain situation) are essential for norm emergence and formation. Considering that fueled by fear of isolation, human beings' instinctual *quasi-statistical sense* may help automatically collect and infer distribution information about opinions and behaviors in their social surroundings (Deutsch & Gerard, 1955; Noelle-Neumann, 1993; Scheufele & Moy, 2000), behaviors recurrently practiced by others may be correctly identified and serve as cues to instigate the descriptive norm perception formation process (Opp, 1982).

Social influence embedded in online comments

These days, the ever-evolving web technologies expand the means individuals employ to obtain behavioral information by facilitating user participatory features such as online user-generated comments (Walther & Jang, 2012). This also opens new research avenues in the pursuit of understanding how social influence is exercised in the virtual space. Accumulating evidence has suggested the powerful impacts of online comments in guiding how individuals process and evaluate mass media content (Lee & Tandoc, 2017; Neubaum & Krämer, 2017), and affecting their interpretations and perceptions such that people's attitudinal judgments tend to follow the direction where they believe the dominant opinion wind blows, despite the fact that people who leave online comments are oftentimes anonymous strangers, and only consist of a small and non-representative sample of opinions (Salganik, Dodds, & Watts, 2006; Shi, Messaris, & Cappella, 2014; Walther, DeAndrea, Kim, & Anthony, 2010). For example, Walther et al. (2010) found that if people perceived that the opinion climate on the comment board was positive towards an anti-marijuana ad, they tended to give a higher evaluation on the ad. According to the authors, physical isolation and visual anonymity in computer-mediated communication lead individuals to identify with the depersonalized commenters and consider them as peers based on assumed similarity (Reicher, Spears, & Postmes, 1995). While most of the existing literature focused on how online comments affect individuals' attitudinal judgements, to the best of our knowledge, no study has examined their effects on shaping people's normative perceptions. More importantly, the normative and valence information contained in online comments almost always intertwines to influence perceptions, thus the unique contribution of the former has not been parsed out from general valence effect in the past literature.

In view of this, the current study experimentally manipulates the distribution of individual behavior cues in the online comment board while maintaining a balanced valence tone across comment topics and examines whether such manipulation would affect people's descriptive norm perceptions toward the behavior in the real world.

Scientific uncertainty surrounding e-cigarette use

We investigated the question in the context of electronic cigarette (also called e-cigarettes) use or vaping behavior. E-cigarettes are designed with battery-operated heating elements to transform a nicotine solution and other chemicals into aerosol without the combustion of tobacco (Emery, Vera, Huang, & Szczytko, 2014; Riker, Lee, Darville, & Hahn, 2012). Some studies suggested that e-cigarettes may hold promise as a great smoking-cessation tool, while others argued that vaping may cause nicotine addiction or act as a gateway to tobacco or even drug use (Riker et al., 2012; Siegel, Tanwar, & Wood, 2011). As the scientific evidence is far from certain, consensus about the benefits and risks associated with e-cigarette use has not been achieved yet. Despite the contentious debate, e-cigarettes remain popular in the United States (Hitchman, McNeill, & Brose, 2014). Considering the uncertainty surrounding vaping and that individuals' likelihood of following what most others do is usually heightened under conditions of ambiguity (Kim, Kim, & Niederdeppe, 2015; Rimal, Lapinski, Cook, & Real, 2005), individuals' prevalence estimation may be particularly susceptible to normative information surrounding them within this behavior context.

Specifically, we refer to explicit indications in the comments that an individual or a group of individuals (either the commenters themselves or people they know) are using or have used e-cigarettes as e-cigarette user descriptive norms ("user-norm"). Comments may also contain clear indications that an individual or a group of individuals (either the commenters themselves or people they know) are *not* using or have *not* used e-cigarettes, and these normative cues are non-e-cigarette-user norms ("non-user-norm"). Absence of e-cigarette use descriptive norms ("no-norm") refers to no mentions about e-cigarette use behavior in the comments. In the current study, we vary the number of comments that contain user-norms and non-user-norms to create two normative directions such that some participants read predominantly more comments that contain user-norms (i.e., High-prevalence direction), while others read predominantly more non-user-norms comments (i.e., Low-prevalence direction). To ensure a clean manipulation of normative directions, commenters' valence stance towards e-cigarette use expressed on the comment board is maintained as balanced across all conditions. On this basis, we suggest the following hypothesis:

H1: Participants in the High-prevalence conditions on average have significantly higher descriptive norm perceptions about e-cigarette use in the real world, compared to those in the Low-prevalence conditions.

Social proximity of reference groups

In addition, as previous research has indicated (e.g., Campo et al., 2003; Spartz, Su, Griffin, Brossard, & Dunwoody, 2017), central to individuals' prevalence estimation was the social proximity of the reference groups in relation to themselves, such that descriptive norm perceptions of more distal groups (e.g., the average person in the United States) were more susceptible to influence and distortion whereas estimates for proximal reference groups (e.g., close friends, family members, and neighbors) may be more factually based as their behaviors are more likely to be observed and verified (Borsari & Carey, 2003). In fact, observing publicly visible behaviors of close others from immediate social environment more frequently serves as a parallel information source that contributes to normative perception formation rather than an outcome of media influence (Mead, Rimal, Ferrence, & Cohen, 2014). Moreover, public user postings reacting to online news are often deemed as reflections of the opinion climate of an abstract heterogeneous mass audience (Lee & Jang, 2010), thus it is more likely that the normative direction manipulation through online comments would provide cues more relevant to distal groups' prevalence estimation. However, previous research has also indicated that, depending on

the visibility and the nature of behaviors, sometimes individuals can be agnostic about the actual norms of proximal others—pervasive misperceptions of risk behavior prevalence were observed even when close peers were examined as the target reference group (Perkins, 2014). Therefore, it is worth exploring H1 with descriptive norm perceptions of reference groups with varied social proximity. Specifically, we gauge descriptive norm perceptions with a set of items that refer to different social reference groups, with some being more distal and some more proximal. Exploratory factor analysis will be conducted to reveal the underlying factor structure. If more than one factor emerges which suggest clear distinction of the descriptive norm perception constructs based on reference group proximity, we will examine H1 with each factor as an outcome variable. We thus ask:

RQ1: Will the effect of normative direction manipulation, as specified in H1, differ based on the social proximity of reference groups when gauging descriptive norm perceptions about e-cigarette use in the real world?

The mediational pathways: perceived behavior choice dominance and valence stance

According to TENS, observations of recurrent behaviors may set in motion perceptions of *behavior regularity* and *behavior preference*, which ultimately lead to norm formation. To put it more concretely, if one observes that a behavior is repeatedly performed in a certain situation, more frequently than the lack of the behavior or other behavior alternatives, the impression develops that performing the behavior should be a regularity under similar scenarios; the recurrent behavior pattern may also hint that the net utility or intrinsic values of the behavior must be deemed high, and the endorsement or preference to this behavior must be strong (Opp, 1982). We thus propose two mediational pathways to further understand the underlying mechanism between our normative direction manipulation and descriptive norm perception outcomes, if one or more direct effects are observed based on the results of H1 and R1.

First, considering that individuals may employ their quasi-statistical sense to gauge opinion climate or behavior distribution on the online comment boards, the resulting perceived behavior regularity (or operationally, perceived behavior choice dominance, i.e., whether predominantly more commenters choose to use or not use e-cigarettes) may act as a mediator between normative direction manipulation and descriptive norm perceptions.

H2a: Perceived behavior choice dominance within the online comment board mediates the relationship between normative direction manipulation and descriptive norm perceptions about e-cigarette use in the real world.

Second, consistent with the perceived behavior preference argument proposed in TENS, previous studies observed normative and attitudinal structure crossover linkages such that intended norm manipulation was found to affect both normative and attitudinal components (Miniard & Cohen, 1979; Oliver & Bearden, 1985; Ryan, 1982; Smetana & Adler, 1980). That is to say, one choosing to perform a behavior as stated in a comment may be interpreted by the readers as the commenter attitudinally endorsing the behavior as well (i.e., “s/he must think conducting this behavior is good”). If this is the case, although commenters’ valence stance toward e-cigarettes on the comment board is designed to stay balanced in all conditions, norm manipulation may still affect readers’ overall impressions of valence stance dominance on the comment board, such that those in the High-prevalence conditions tend to perceive the commenters to be more positive and vice versa. We thus hypothesize:

H2b: Perceived valence stance dominance within the online comment board mediates the relationship between normative direction manipulation and descriptive norm perceptions about e-cigarette use in the real world.

The two mediational pathways will be examined simultaneously. In particular, the two proposed mediators are allowed to correlate considering their potential mutual influence.¹

Exposure dosage and visual avatar as enhanced normative cues

Considering that the descriptive norm information as implicated in the distribution of the behavioral cues might be too implicit for people to infer, the current study also explored two variations in experimental manipulation that may potentially make the normative cues more salient and enhance perception formation. The first factor we considered was the dose of exposure, as sufficient exposure to messages usually needs to be guaranteed before expecting any cognition or behavior changes (Gerbner, 1998; Hornik, 2002). Multiple exposure to consistent messages is effective in enhancing people's likelihood of accepting beliefs, values, and norms by providing opportunities for learning and memorizing, as well as the likelihood of availability to the information at the time of judgment (Bargh, Chen, & Burrows, 1996; Higgins, 1996; Potter, 1993; Tversky & Kahneman, 1982).

The second variation to the manipulation we considered was to add visual behavioral cues to increase the visual prominence of the stimulus. According to the Focus Theory of Normative Conduct (Cialdini et al., 1990), people learn norms from salient behaviors and actions that stand out and easily catch their attention. People's perceptions and decisions are more likely to be swayed with the presence of visual behavior in their close environment (Cialdini, 2003; Mcshane, Bradlow, & Berger, 2012). In the computer-mediated environment, one way to increase the salience of the behavior stimulus would be to demonstrate the behavior using avatars, the digital representations of people, including but not limited to graphical icons (cartoon humans, nonhumans), profile pictures (real human photos), interactive bots, etc.; in fact, most online networking websites provide cue-rich platforms for users to communicate in an environment that is mixed with both textual and visual cues, and find that such features effectively facilitate online social interaction (Boyd & Ellison, 2007; Nowak & Rauh, 2005; Westerman, Tamborini, & Bowman, 2015). Therefore, in the current study, we add an anonymous cartoon vaper profile icon adjacent to each user-norm comment. For non-user-norm and no-norm comments, no vaping behavior is added to the profile icon. We thus hypothesize:

H3: Compared to single-dose textual comments (a) doubling the exposure dosage of the textual comments, or (b) adding visual behavioral cues to the single-dose textual comments, would produce greater changes in descriptive norm perceptions about e-cigarette use in the real world.

Consistent with the earlier hypotheses, if more than one descriptive norm perception factors emerge, we will examine H3 with each factor as an outcome variable.

Method

Participants

A total of 702 U.S. adults were recruited through Amazon Mechanical Turk (MTurk). Eligibility and screening procedures were implemented to ensure the credibility and reliability of responses (final $N = 691$; see Online Supplementary Materials Appendix A for details). Fifty-nine percent of the participants were female, and the sample included 79.3% White, 6.7% African American, 5.9% Hispanic/Latino, and 5.3% Others. The mean age was 38.06 ($SD = 12.23$), ranging from 18 to 75.

Most of them had finished high school (97.8%) and 62.81% had finished college. Slightly more than half of the participants (56.2%) have smoked 100 cigarettes or more in their lifetime, and 44.6% have ever used an e-cigarette, even one or two puffs. Most of the participants in the final sample had heard of vaping or using e-cigarettes before the study date (95.4%).

Study design and procedures

This study adopted a 2 normative directions (High-prevalence vs. Low-prevalence) \times 3 normative cues (10 comments vs. 20 comments vs. 10 comments plus visual cues) + 1 (no-comment control) between-subject design. To examine the net effect of normative influence, comment valence was held balanced (i.e., equal amount of positive and negative topics) across all treatment conditions. The experiment used an online Qualtrics-based survey, distributed through MTurk. Participants were told the purpose of the study was to ask their opinions about some online materials related to health issues. Eligible participants were randomly assigned to one of the seven conditions. They all first read the same news article about e-cigarettes. The treatment groups then read a total of 10 or 20 comments (single versus double total exposure) accompanying the article, before moving to the outcome assessment pages where dependent variables and demographics were measured, while the control group was directly brought to these pages. All participants were debriefed at the end of the study.

Stimulus materials

News article

The news article was created by modifying real news articles collected from the online websites of top news outlets including *New York Times*, *Wall Street Journal*, and *Huffington Post*. Considering that the news article serves as a cover story for the experimental manipulation and was viewed by all subjects across conditions, the article was modified in a way such that no normative information was mentioned at all, and the valence or tone towards e-cigarette use was held balanced (i.e., no dominant favorable or unfavorable overall viewpoint towards e-cigarettes use). The participants were told that the news article about e-cigarettes was selected from one of the top news outlets to increase the credibility of the material.

Comments

Online user-generated comments responding to e-cigarette related news articles were also collected from the above online news outlets. Twenty-two comments, each reflecting a unique topic or theme about e-cigarettes, were selected and further modified to be used as stimuli in the study. Among these comments, four contained topics of neutral valence, and for the rest, half contained negative valence ($n = 9$) and the other half were positive about e-cigarette use ($n = 9$). These comments were pre-tested with an independent sample ($N = 298$) to confirm that the valence of each comment was perceived and interpreted as we intended. We then modified each of these comments into three versions that contained either user-norm, non-user-norm or no-norm information, while keeping the remaining content in the comments exactly the same. For example, for the comment that talks about the safety issue regarding the chemicals added to e-cigarette flavors, the original no-norm comment was “*I’ve read that the chemicals used to flavor e-cigarettes are the same stuff often added to foods, so they should be safe, right??*,” user-norm comment added a behavior indication following the no-norm comment “*I tried several flavors,*” and non-user-norm comment added “*I don’t vape.*” To increase the ecological validity of the study and address the potential case-category confound issue (Jackson, 1992; Shi et al., 2014), we developed a comment allocation algorithm that ensured the comments each participant saw were randomly drawn from the comments pool, randomly ordered, and balanced in valence. The descriptive norm information expressed in the comments were mixed at a 7:2:1 ratio based on the

conditions they were assigned, i.e., High-prevalence conditions had 70% user-norm, 20% non-user-norm, and 10% no-norm comments, and vice versa for the Low-prevalence conditions. In this way, each participant saw a unique set of comments, but within each treatment condition, the comments would maintain balanced valence tones and the same configurations for normative information distribution (see Online Supplementary Materials Appendix B for details of the comments pre-test, example comments stimuli, and the comment allocation algorithm).

To examine the potential influence of exposure dosage, we also included the double exposure conditions, where participants read 20 comments with the same configuration as those in the 10 comments conditions (i.e., randomly drawn from the pool, randomly ordered, balanced in valence, had a norm information ratio of 7:2:1). In addition, to see whether visual cues would enhance the descriptive norm manipulation, we also had the visual cues conditions, where participants read 10 comments with the same structure as those in the 10 comments only conditions, with a vaper avatar image appending to each of the user-norm comments to increase the salience of vaping behavior indication (see Figure S1 in Online Supplementary Materials). Non-user-norm and no-norm comments had usual anonymous avatar images attached to the comments as in the other conditions. Figure 1 visually demonstrates all experimental conditions.

Measures

Descriptive norm perceptions

The focal dependent variable, descriptive norm perceptions about e-cigarette use in the real world, was assessed with two sets of questions. As discussed earlier, considering that distal and proximal descriptive norm perceptions may have different levels of susceptibility to influence, descriptive norm perceptions were asked in a way with varied social proximity of the reference groups, to facilitate examination of the underlying factor structure of the construct (see Online Supplementary Materials Appendix C for item details). The first set of questions consisted of seven items that asked the participants to gauge the prevalence of e-cigarette use behavior among different reference groups. The descriptive norm perceptions were also measured with a scale that asked the participants to indicate how much they agree or disagree with six statements about the popularity of e-cigarette use (e.g., “In the U.S., many people vape or use e-cigarettes”). Exploratory factor analysis was then conducted on all the standardized items (due to differences in ranges of response options across items) to uncover the underlying factor structure of the descriptive norm perceptions construct.

Perceived dominant behavior choice on the comment board

To understand how participants in the treatment groups perceive the dominant behavior choice among commenters, we asked them to rate the following statements about the comments on a 5-point scale, ranging from “strongly disagree” to “strongly agree”: (a) They were posted mostly by vapers or commenters who know others who vape, or (b) They were posted mostly by non-vapers or commenters who don’t know others who vape ($r = .75, p < .001$, after reverse coding the second item). The average score of the two items was used to gauge the participants’ perceived behavior prevalence within the constructed online comment boards.²

Perceived valence stance on the comment board

While the valence of the comments was intentionally constructed to be balanced, it is still possible that the norm manipulation may affect the valence perceptions. We thus also measured valence perceptions by asking the participants (treatment groups only) to indicate whether the comments they read were (a) in favor, or (b) against e-cigarette use on a 5-point scale ranging from “strongly disagree” to “strongly agree” ($r = .62, p < .001$, after reverse coding the second item). The average score of the

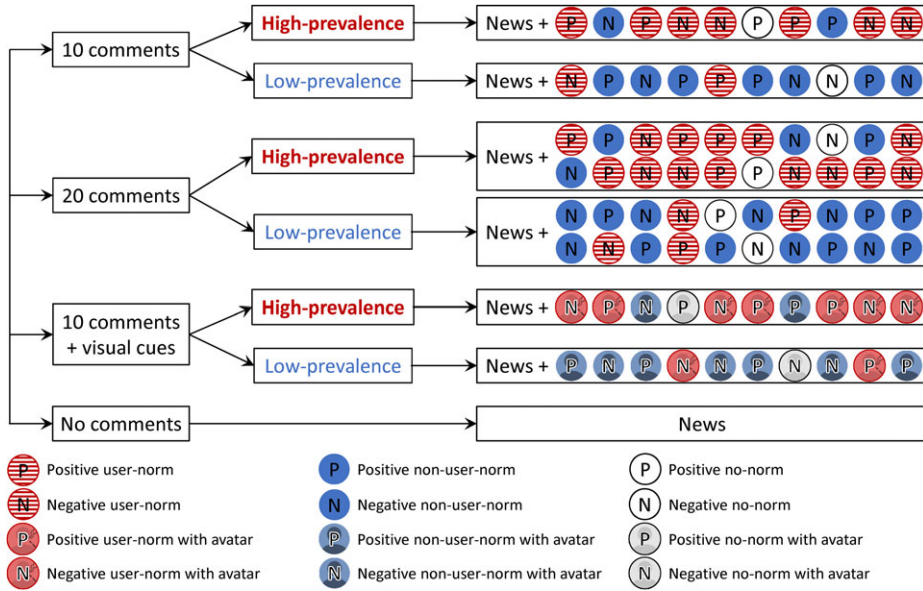


Figure 1 Experimental conditions and an example of composition for each condition.

two items was used to gauge the participants’ perceptions of the commenters’ valence stance dominance within the online comment boards. All analyses were conducted using Stata 14.0.

Results

Factor analysis

Exploratory factor analysis extracted two factors with the eigenvalue $\lambda \geq 1$, which we termed *proximal descriptive norm perceptions* (all factor loadings $> .58$), and *distal descriptive norm perceptions* (all factor loadings $> .61$). Proximal ($\alpha = .89$) and distal descriptive norm perceptions ($\alpha = .86$) were then examined in the subsequent analyses separately as two focal outcome variables. See Table 1 for mean proximal and distal descriptive norm perceptions in each condition and Appendix C, Table S1 in Online Supplementary Materials for factor analysis details.

Hypothesis testing

To test our hypotheses, we first conducted a two-way full-factorial MANOVA within the treatment conditions, with normative cues and normative directions as fixed factors, and perceived dominant behavior choice on the comment board, valence perceptions, and descriptive norm perceptions (both proximal and distal) as dependent variables.³ The overall model was significant, Wilks’ $\lambda = .53$, $F(20, 1841.70) = 19.73$, $p < .001$. Results for each of the two factors revealed a significant multivariate effect for normative directions, Wilks’ $\lambda = .54$, $F(4, 555.00) = 116.85$, $p < .001$ (H1). The main effect of normative cues and the interaction effect of the two factors were not observed in the omnibus test. Given the significance of the overall test, the univariate main effects were examined with a series of two-way ANOVAs. As summarized in Table 2, normative directions had a significant positive main effect on behavior dominance and valence perceptions such that being exposed to predominantly more user-norm comments led people to believe that (a) the comments were posted mostly by vapers or

Table 1 Mean Dominance Perceptions, Valence Perceptions, Proximal Descriptive Norm Perceptions and Distal Descriptive Norm Perceptions across Conditions

Individual Conditions	Sample Size <i>n</i>	Dominance Perceptions <i>M (SE)</i>	Valence Perceptions <i>M (SE)</i>	Proximal Norms <i>M (SE)</i>	Distal Norms <i>M (SE)</i>
1. High-prevalence 10 comments	97	3.77 (.08)	3.43 (.08)	-.01 (.07)	-.00 (.09)
2. High-prevalence 20 comments	92	3.86 (.07)	3.38 (.07)	.08 (.08)	.17 (.08)
3. High-prevalence 10 comments + visual	93	3.69 (.07)	3.49 (.07)	-.02 (.07)	.00 (.08)
4. Low-prevalence 10 comments	97	2.49 (.09)	2.51 (.08)	-.01 (.09)	.02 (.09)
5. Low-prevalence 20 comments	98	2.47 (.09)	2.45 (.08)	-.21 (.07)	-.31 (.09)
6. Low-prevalence 10 comments + visual	87	2.25 (.09)	2.41 (.08)	-.02 (.07)	-.04 (.09)
7. No-comment news-only control	127	-	-	.15 (.07)	.13 (.07)

Note: The mean scores and standard errors of the variables are presented. Behavior dominance perceptions and valence perceptions were measured on 5-point scales ranging from “strongly disagree” to “strongly agree.” Considering that the items used for measuring the descriptive norm perceptions had inconsistent response ranges, the common metric of standardized z-scores were used for these items to facilitate analyses.

Table 2 Two-way ANOVAs of Perceived Dominant Behavior Choice on The Comment Board, Valence Perceptions, Proximal and Distal Descriptive Norm Perceptions by Normative Cues and Normative Directions

	<i>df</i>	Dominance Perceptions		Valence Perceptions		Proximal Norms		Distal Norms	
		<i>F</i>	ω^2	<i>F</i>	ω^2	<i>F</i>	ω^2	<i>F</i>	ω^2
Cues (C)	2	3.12*	.01	.26	.00	.30	.00	.47	.00
Directions (D)	1	412.35***	.42	220.23***	.28	2.29	.00	5.58*	.01
C × D	2	.48	.00	.60	.00	2.26	.00	5.12**	.01
R ²		.43		.28		.01		.03	

Note: *N* = 564, **p* < .05, ***p* < .01, ****p* < .001.

commenters who knew vapers, or (b) the comments were in favor of e-cigarette use. Normative cues only affected perceived dominant behavior choice on the comment board. A significant interaction effect was observed between normative directions and cues in predicting distal descriptive norm perceptions. Simple main effects analysis indicated that the high-prevalence conditions produced significantly higher distal descriptive norm perceptions than the low-prevalence conditions when the

participants were exposed to a total of 20 comments ($p < .001$; H3a), but such effect was not observed when the total exposure was 10 comments ($p = .83$) or 10 comments plus visual cues ($p = .70$; H3b).

Our second set of hypotheses proposed mediational pathways between experimental manipulation and descriptive norm perceptions through changes in behavior dominance perceptions and valence dominance perceptions. Taking into consideration the significant moderation effect of normative cues, we conducted a multi-group moderated mediation analysis, comparing the indirect effects between normative directions and descriptive norm perceptions, among the normative cues categories (Hayes, 2017). Considering that the proximal descriptive norm perceptions were not affected by our experimental manipulation (Table 2), we focused on the distal descriptive norm perceptions variable as the dependent variable in the analysis. Figure 2 illustrated the path analysis model, which was examined simultaneously across the three groups of the normative cues variable. The goodness-of-fit indices suggested that the model was a good fit to the data, $\chi^2(18) = 24.41$, $p = .14$, TLI = .99, CFI = .98, RMSEA = .04. The indirect and total effects were estimated with the Sobel's approach, and the bootstrapping procedures (with 500 replications) were implemented to construct bias-corrected confidence intervals surrounding them. The results, as summarized in Table 3, converged to reveal a positive conditional indirect effect, such that participants who were in the high-prevalence conditions (as opposed to those in the low-prevalence conditions) perceived higher user-norm dominance and more favorable valence towards e-cigarettes on the online comments board, which in turn led to higher descriptive norm perceptions of e-cigarette use among distal others; and such mediational pathways were observed only where the participants were exposed to a double dosage of messages (i.e., 20 comments conditions). According to Table 3, in the 20-comments conditions, both behavior dominance perceptions and valence perceptions served as significant mediators, with the former contributing to 78.07% of the joint indirect effects. H2 was partially supported.

Additional analyses

Finally, to understand absolute changes from the baseline that may be produced by the normative direction manipulation, we conducted additional analyses to compare between the treatment conditions and the control condition where no normative information was presented. Two one-way ANOVAs were conducted with a three-category experimental condition variable (i.e., High-prevalence combined, Low-prevalence combined, and news-only control) as the independent variable and the two types of descriptive norm perceptions as the dependent variables. Significant overall effects were observed for both dependent variables (distal: $F(2, 688) = 4.82$, $p < .01$, $\omega^2 = .01$; proximal: $F(2, 688) = 4.42$, $p < .05$, $\omega^2 = .01$). Planned contrasts indicated significant differences in both descriptive norm perceptions between the Low-prevalence and the control conditions (distal: $F(1, 688) = 7.61$, $p < .01$, $r = -.13$; proximal: $F(1, 688) = 8.67$, $p < .01$, $r = -.14$), while no significant difference was observed between the High-prevalence and the control conditions (distal: $F(1, 688) = .76$, $p = .39$; proximal: $F(1, 688) = 3.01$, $p = .08$). This set of analyses indicated that, being exposed to predominantly non-user-norm comments can significantly lower individuals' distal and proximal descriptive norm perceptions from the baseline anchored by the news article.

Discussion

Human beings are equipped with antennae that quiver to every subtle change in their social environment; they sense what is typical and desirable in their surroundings, which can profoundly shape their perceptions about social reality and guide behavior decisions (Noelle-Neumann, 1974, 1993).

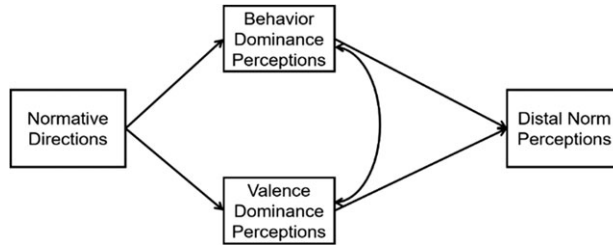


Figure 2 Multi-group moderated mediation path analysis model.

Note: In the multi-group moderated mediation analyses, no explicit interactions were depicted in the model, as they were implicit in the multiple group analysis itself. The exogenous variable normative directions in the model is a dummy variable with the low-prevalence conditions as the base category.

Table 3 Indirect and Total Effects for Mediation Analyses

Normative Cues Categories	Indirect Effects			Total Effects		
	Dominance Perceptions	Valence Perceptions	Joint ES	BC CIs	Total ES	BC CIs
10 comments	-.027	.045	.018	[-.188-.207]	.084	[-.126-.288]
20 comments	.219*	.015*	.235*	[.049-.437]	.301**	[.112-.490]
10 comments + visual	.023	.025	.048	[-.152-.253]	.114	[-.055-.282]

Note: ES = effect size. $N = 564$. Indirect and total effect sizes are standardized. BC CIs stand for bias-corrected confidence intervals constructed with the bootstrapping procedures (500 replications). The effects are considered significant if the CIs do not include zero. Since the independent variable is a dichotomous variable (with the low-prevalence conditions serving as the reference category), the signs (i.e., positive vs. negative) of the ESs reflect the comparisons between high- and low-prevalence conditions on the values of the mediator and dependent variables.

* $p < .05$, ** $p < .01$.

Descriptive social norms have long been utilized to promote positive behavior changes, and the very first step would be to find ways that can effectively affect people’s subjective perceptions of norms. Therefore, a better understanding of how individuals infer and form such perceptions is crucial. Despite the substantial body of literature and theories exploring the impact of social norms on cognitions and behaviors, the investigation and theorization on the sources and formation processes of normative perceptions have been pursued in a surprisingly small number of studies (Friedkin, 2001; Mead et al., 2014). The current study is among the first efforts that has demonstrated the formation process of descriptive norm perceptions through less explicit manipulation with constructed distributions of individual behavior cues using online comments.

We observed that, given sufficient total exposure (i.e., being exposed to 20 comments in this study), the normative direction manipulation, (i.e., the constructed behavior choice distribution among a group of small and non-representative online commenters), was able to affect people’s distal descriptive norm perceptions, such that compared to those in the Low-prevalence conditions, participants in the High-prevalence conditions had a significantly higher estimation of the actual e-cigarette

use prevalence among the U.S. population. This finding is particularly intriguing because such change is likely to be a result of private acceptance of the descriptive norms, as opposed to public compliance observed in many face-to-face lab settings, considering the characteristic of anonymity of the online environment. The finding also highlighted the importance of sufficient total exposure in bringing normative information to focus (Cialdini et al., 1990). Considering that compared to summary statistics, normative information delivered in the form of scattered individual behavior cues is much subtler to detect, this finding speaks to the importance of ensuring sufficient exposure to normative cues before expecting individuals' "quasi-statistical sense" to accurately picture the behavior distribution. A larger pool of evidence may also lend stronger credibility to the majority side, such that they are more likely to be deemed as being truly representative of the collective truth. Moreover, our finding also corroborated the idea that norms do not exist independently of the social proximity of reference groups. We provided experimental evidence that descriptive norm perceptions of more socially distal groups are more malleable and thus more susceptible to distortions. Previous theorization (e.g., Theory of Normative Social Behavior; Rimal & Real, 2005) and empirical evidence put great emphasis on proximal over distal descriptive norm perceptions, as perceived norms emanating from one's close social referents are often found to be more predictive of personal behavior choices than those from a more diffused or abstract social group (Rimal, 2008). However, considering that close others' behavior choices are relatively easy to be observed and verified, such impression based on local experience is less likely to be influenced unless the actual behavior rates change noticeably in their surrounding environment (Tankard & Paluck, 2016). Our findings echoed previous research that people's normative perceptions are more likely to be affected for distal groups that they know less well (Borsari & Carey, 2003; Prentice, 1990). When it comes to decision-making beyond individuals' own risk behavior choices, for example, public policy support or opposition that may potentially affect a much wider population, distal descriptive norm perceptions may be more salient and influential as it serves as a reference (regardless of its accuracy) to the population-level behavioral prevalence estimation one normally does not have access to. The malleability of distal descriptive norm perceptions observed in the current study provides important regulatory implications toward online commentary considering the potential of perceived distal norms in facilitating or inhibiting norm-motivated collective decisions and societal changes, and speaks to the necessity of development in social norms theories to explicate how proximal and distal descriptive norm perceptions may weigh differently under decision-making scenarios of different nature and scope.

To further explicate the underlying mechanisms of distal descriptive norm perception formation, we examined two mediational pathways, informed by TENF's theorization of the day-to-day life norm formation process (Opp, 1982). The results confirmed that the perceived behavior choice dominance and valence stance dominance toward e-cigarette use on the online comment board mediated the above relationship. We observed that people in the High-prevalence conditions recalled that more vapers (or people who know vapers) than non-vapers left comments on the comment board, while those in the Low-prevalence conditions recalled that more non-vapers (or people who know non-vapers) left the comments. The behavior choice statements in the comments also affected their valence perceptions: compared to those in the Low-prevalence conditions, participants in the High-prevalence conditions were more likely to believe that as a whole the comments expressed a predominantly favorable valence stance towards e-cigarette use, although overall valence was by design held balanced in all conditions. This finding confirmed our hypothesis that behavior choices may have implicitly conveyed the commenters' attitudinal preferences too. An additional assessment of the viewers' attitude towards the target behavior in future studies may help better establish the norm-attitude interdependence structures. Through the parallel examination of the two mediational pathways, we were able to confirm that changes in *local* (i.e., within the comment board) normative and valence perceptions both

play an important role in the formation of distal descriptive norm perceptions, with the former contributing to 78.07% of the joint indirect effects. Finally, the significant indirect effects observed in the 20-comments conditions suggested that, given sufficient total exposure, the normative direction manipulation can effectively affect both behavior dominance and valence dominance perceptions within the online comment board, which in turn lead to corresponding changes in participants' estimation of anonymous others' behavior prevalence in the real world. This set of findings illustrated how local numerical majority in behavior choices and valence stances inferred from online anonymous user-generated comments may shape people's cognitions not only within the online comment board, but also extend its impact broadly and powerfully to the real world. These mediational pathways illuminated future directions and avenues for social change in the online environment.

We also conducted additional exploratory analyses to understand the absolute changes our experimental manipulation produced in comparison with the baseline descriptive norm perceptions obtained from the control condition. Our results indicated that Low-prevalence conditions significantly lowered people's descriptive norm perceptions from the baseline, whereas High-prevalence conditions did not produce any significant shifts. We speculate that two potential mechanisms may account for this finding. First, "non-user-norm" comments contain active negation of a behavior, which may stand out as more salient to the viewers (Beukeboom, Finkenauer, & Wigboldus, 2010); second, previous research found that when the position expressed in the user-generated comments was opposite to that advocated in a news article, viewers were more likely to infer public sentiments based on the comments, and perceived the actual public sentiment being more discrepant from the news' position than did those who read only the news (Lee & Jang, 2010). In our study, as a type of "institutional signal" (discussed below), the news article set a relatively high anchor for descriptive norm perceptions (news-only control condition, Table 1). If viewers trust the comments-induced normative perceptions more, those in the Low-prevalence conditions (i.e., the opposite normative direction) may have produced even more discrepant normative perceptions against the anchor set by the news article. However, this remains a speculation unless we can systematically vary the normative directions of news and comments and examine their interaction effects. Further investigation is warranted to interrogate deeper into this interesting pattern.

Finally, we would like to acknowledge some limitations of the current study and provide suggestions for future directions. First of all, we found that the news-only control condition yielded the highest descriptive norm estimation. Close scrutiny of our instructions prior to the news page, we found that for the purpose of a reasonable cover story, we described the news article as "a short news article about e-cigarettes selected from one of the top news outlets," and we suspect that the information about "top news outlet" might have given participants an institutional signal, which seems to suggest that the popularity or prominence of this topic has already reached the level where mainstream top news outlets would like to report on it (Silverblatt, 2004; Tankard & Paluck, 2016). Therefore, the language of "top news outlet" may have inflated the level of descriptive norm estimation in the control condition and should be removed in future studies. Another issue worth noticing with our research design is that the ratio of the normative direction dominance was set to be 7 (dominant norm): 2 (the opposite norm): 1 (no-norm), however, whether this ratio would affect normative perceptions differently compared to other ratios (say 6:3:1) was not apparent to us. In addition, classic conformity studies informed us that, conditions with unanimous opinions (i.e., 10:0:0) versus those with dominant opinions (e.g., 9:1:0 or 8:2:0) may have very different impacts on descriptive norm perceptions such that as long as the opinions in the group are not unanimous, the normative pressures created by the majorities are substantially reduced (Asch, 1955; Tanford & Penrod, 1984). Therefore, testing across a range of potential ratios in combination with varied total exposure may be a fruitful next step that can further our understanding towards how the "quasi-statistical organ" works, and identify optimal

conditions for normative perception formation. Moreover, when operationalizing visual avatars, the same avatar was used for both non-user-norm and no-norm comments. This was because it was difficult to visually demonstrate the “absence of behavior” without bringing in other potentially contaminating factors (e.g., placing a cross symbol “X” on the avatar to indicate non-vaper may unwittingly bring in injunctive norm information that contains approval/disapproval message). Future studies are encouraged to design visual avatars that could effectively distinguish non-user-norm and no-norm comments and to situate the experimental manipulation in a setting where associating profile images with users’ behavior status appears more ecologically valid, for example, online forums dedicated for smokers and vapers (e.g., smoking cessation chatroom). It is also important to pre-test the visual avatars to ensure they are sufficiently salient to attract viewers’ attention. Finally, we would like to make a few notes regarding the generalizability of the study findings. Since the comments were obtained from online news websites and contained concrete discussion topics related to e-cigarette use, on average they tended to be more civilized, purposeful and eloquent compared to those found on other online platforms, and thus may not represent user-generated comments of different quality. In addition, considering that we only examined a single behavior within an MTurk sample, the scope to which our study findings can be generalized is limited. In order to establish the robustness of the current findings, future studies are encouraged to examine across a diverse range of behaviors that are potentially of different nature compared to vaping, situate in different online media platforms, and with more representative samples or targeted subpopulations to understand whether results would prevail in different settings within the United States, as well as in different cultures.

Conclusion

The present study experimentally manipulated the distribution of individual behavior cues about e-cigarette use embedded in online comments, with an aim to understand how group pressure is manifested and exercised in the virtual space. It provides novel evidence of individuals’ quasi-statistical sense that accurately gauges behavior distribution in immediate environments, and identifies crucial factors that trigger and facilitate the formation of descriptive norm perceptions. The study findings also provide practical implications for professionals and practitioners on how to better harness the power of social influence in the digital platforms. Commenters are never a representative sample of the public, however we found that their disproportionate representation of voices and behavior choices on the online comment board could distort viewers’ perceived behavior prevalence in real life and potentially influence their behavioral intention. Previously, when disseminating campaign messages online, the common practice was to heavily focus on the control over comment valence. In view of our study findings, we encourage professionals to also take into consideration self-identification of risky behavior choice information disclosed by the commenters. Another potential application of this finding is to design online health interventions by constructing online social support groups with carefully planned behavior choice distribution (i.e., the risky behavior choice being the minority). In this way, the majority healthy behavior choice may be gradually internalized as a norm within the minority individuals through the powerful mechanism of social influence.

Supplementary material

Supplementary material are available at *Journal of Computer-Mediated Communication* online.

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Notes

- 1 The examination of behavior choice and valence stance dominance perceptions as mediators is also consistent with the conceptual model advocated by O'Keefe (2003) and Tao and Bucy (2007) that intrinsic message properties (e.g., manipulation of normative directions in our case) and message-evoked cognitive responses (taking the form of perceptions, emotions, and evaluations, etc.) should be conceptually separated, and examined simultaneously in a mediation model to provide a more complete picture for media effects investigation. This recommendation has been adopted in many previous studies (e.g., Feng & Burlison, 2008; Kim, Bigman, Leader, Lerman, & Cappella, 2012; Tal-Or, Cohen, Tsfati, & Gunther, 2010; Tong, Van Der Heide, Langwell, & Walther, 2008).
- 2 In accordance with O'Keefe (2003), this study did not treat measures of perceived dominant behavior choice and valence perceptions on the comment board as manipulation checks, since they are intrinsic message features that are independent of participants' perceptions. In other words, no matter how many user-norm comments the participants thought they were exposed to, the user-norm comments did differ in dosage; no matter whether the participants thought overall the commenters held more or less favorable valence stance towards e-cigarettes, the comments were indeed constructed with an equal number of pre-tested positive and negative topics. These measures were instead, more usefully explored as potential mediators between the manipulation and the dependent variables (see O'Keefe, 2003; Tao & Bucy, 2007 for a more extensive discussion).
- 3 Normality checks and Levene's test for homogeneity of variance were carried out with the dependent variables and the assumptions were met.

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