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Don't Like Them but Take What They Said: The Effectiveness of Virtual Influencers in Public Service Announcements

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Abstract: Despite the growing use of virtual influencers in communicating public service announcements (PSAs), their PSA communication effectiveness remains underexplored. Virtual influencers are digital entities who generate content on social media to establish a digital identity and personal brand. This research examines the effectiveness of virtual (vs. human) influencers in conveying PSAs, focusing on consumers' attitudes toward the influencers and their acceptance of PSA messages. Three experimental studies (N = 1429) spanning different cultural contexts reveal that consumers hold a less favorable attitude toward virtual (vs. human) influencers who post PSAs. Nevertheless, virtual influencers are equally effective as human influencers in influencing consumers' acceptance of PSA messages. Dual-mediation processes involving mind perception and novelty perception are identified. Furthermore, we find that incorporating emotional appeal can enhance the effectiveness of virtual (vs. human) influencers' PSA communications. These findings contribute to the literature on virtual influencer marketing and PSA marketing, offering practical insights for leveraging virtual influencers in PSA campaigns.

Keywords: virtual influencers; public service announcement (PSA); advertisement appeal; message acceptance

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1. Introduction

Public service announcements (PSAs) are advertisements designed to communicate vital social issues to the public, aiming to shape people's attitudes and behaviors on matters such as health, safety, and the environment. By communicating these issues, PSAs play an important role in fostering individual well-being and promoting societal sustainability. With the development of digital technologies, including artificial intelligence and computer graphics, virtual influencers have emerged on social media as a novel medium for PSA communication. For example, the World Health Organization recruited virtual influencer Knox Frost, who has over a million followers on Instagram, to disseminate health-related messages, including the importance of maintaining good hygiene and focusing on mental well-being during the COVID-19 pandemic [1]. Additionally, female virtual influencers such as Noonoouri and Zoe Dvir have been actively advocating for sustainability and green consumption in fashion [2].

Despite the growing prevalence of virtual influencers in public communications, there is limited understanding of consumers' attitudes and responses toward such practices. Consumer attitudes are relevant to various actors in this phenomenon. For PSA marketers, the use of virtual influencers is often considered due to their high malleability, controllability, low risk of transgressions, and popularity among younger generations [3]. However, the ultimate objective is to influence consumers' attitudes and behaviors concerning the advocated issues, making consumers' attitudes toward the PSA message a key concern. For social media influencers, communicating PSAs can help build their identity and self-image by demonstrating their concerns for important social issues. This is particularly important

for virtual influencers because their identities are entirely "constructed". Thus, understanding consumers' attitudes toward influencers who communicate PSAs is important for these influencers.

Previous research on virtual influencer marketing has predominantly focused on brand marketing [4–7], with little exploration of the role of virtual influencers in public communication. Given the widespread use of virtual influencers, it is both theoretically and practically important to understand their effectiveness and the strategies for incorporating them into public communication. In this research, we investigate the following questions: how, when, and why does the type of influencer (virtual vs. human) affect the effectiveness of PSA communications? Specifically, we examine two aspects of PSA effectiveness: (1) consumers' attitudes toward the influencer and (2) PSA message acceptance.

We argue that virtual (vs. human) influencers can impact PSA effectiveness through dual pathways. On the one hand, virtual influencers are perceived as lacking mind compared to human influencers. Mind perception is the recognition of mental capacities in other entities [8], and it has been shown to positively influence consumer engagement in brand marketing campaigns [9]. We suggest that this lack of mind in virtual influencers could negatively affect their PSA communication effectiveness. On the other hand, virtual influencers communicating social issues like PSAs may be perceived as unexpected, unusual, striking, and impressive. This novelty might attract more attention and result in better memory retention relating to the PSA information [10,11], potentially offsetting the negative pathway of mind perception. Therefore, the overall impact of influencer type on PSA communication effectiveness could be mixed. Moreover, in line with the mind perception pathway, we propose a boundary condition for the effect of influencer type on PSA effectiveness—emotional appeal. Specifically, incorporating emotional (vs. non-emotional) appeal in a PSA can enhance the relative effectiveness of PSAs posted by virtual (vs. human) influencers.

To examine these propositions, we conducted three experimental studies spanning different cultural contexts, various PSA topics, and diverse influencer characteristics. Study 1 examines the main effect of influencer type on PSA effectiveness in the context of environmental concerns in consumption. Study 2 tests the effect in a health consumption context and examines the dual-mediation model through measurements of mind perception and novelty. Study 3 extends the investigation by testing the moderating role of PSA appeal type (emotional vs. non-emotional). Our findings reveal that while consumers generally hold a less favorable attitude toward virtual (vs. human) influencers who post PSAs, virtual influencers can be as effective as human influencers in influencing consumers' PSA message acceptance. The proposed dual-mediation processes and the moderating role of emotional appeal are supported.

Building on communication theory [12,13], which identifies three basic aspects shaping effective communication—the message sender, the message itself, and the message receiver—this research seeks to fill gaps in several research domains: First, from the perspective of the message sender, prior research on how a PSA communicator or spokesperson influences PSA effectiveness has primarily focused on comparing different types of human communicators such as celebrities, peers, and victims [14–16]. However, little has been known about the role that virtual entities can play in PSA communication. This research induces and examines virtual influencers as a novel type of PSA communicator, investigating how, why, and when this new type of message senders can impact the effectiveness of PSA communications. Second, from the perspective of the message itself, this research extends the literature on virtual influencer marketing beyond its traditional focus on brand and product promotion, exploring its application in the context of PSAs. Given the distinct objectives and nature of business versus public communications, the effects and underlying mechanisms in these contexts may differ. While previous studies on virtual influencers have largely centered on brand marketing [4–7], this research fills the gap by exploring their effectiveness and the strategies that optimize their impact in PSA campaigns. Third, this research extends communication theory by reconsidering the traditional focus on message

acceptance (or receivers' attention to and memory of the message) as the primary measure of communication effectiveness, where consumer attitudes toward the message sender are typically viewed as an antecedent to message acceptance [17–19]. We propose a new perspective by examining how PSA communication can, in turn, shape receivers' attitude toward the message sender (influencer), revealing a discrepancy between consumer attitudes toward the influencer and message acceptance. Additionally, the findings offer practical and actionable insights for leveraging virtual influencers in PSA campaigns.

In the following sections, we first review the relevant literature and theoretical foundations, which inform the development of our theoretical framework and hypotheses. Next, we present three studies designed to systematically test these hypotheses. Finally, we conclude with a discussion of the findings, highlighting the theoretical contributions, practical implications, and limitations of the research.

2. Theoretical Background and Hypothesis Development

2.1. Virtual Influencer Marketing

Virtual influencers are digital entities with an anthropomorphic appearance and generate content on social media to attract and influence followers [20,21]. Compared with human influencers, virtual influencers offer higher controllability and malleability, with a lower risk of transgressions [20,22]. However, do these advantages translate to better marketing performance? So far, the research comparing the effectiveness of virtual versus human influencer marketing has yielded mixed results.

Some studies have found that consumer responses to virtual influencers more negatively compared to human influencers, with virtual influencers being less effective in promoting brand attitude and purchase intention [23–25]. Conversely, other studies have found no significant differences between the two in several marketing aspects, such as consumer engagement and brand perception [26], parasocial interaction [27], perceived level of personalization, and consumers' willingness to follow [28]. Additionally, in negative contexts such as misconduct, virtual and human influencers can have equally detrimental effects on brands. Switching to another virtual influencer does not effectively mitigate the negative impact of an influencer's mistake, as consumers are more likely to perceive virtual influencers as an indistinguishable whole rather than unique individuals [26]. Moreover, previous research has also identified the superiority of virtual (compared to human) influencers in reducing consumers' appearance anxiety [29].

These mixed findings suggest that the discrepancies in brand marketing performance between virtual and human influencers are not unidirectional, and that the underlying mechanisms are multifaceted. On the one hand, due to their synthetic nature, virtual influencers are generally believed to lack sensory capabilities, particularly for proximal senses (i.e., haptic, olfactory, and gustatory) [23,30]. They are also perceived as being lower in trustworthiness, authenticity, social presence, emotional engagement, and humanness, and higher in social psychological distance compared to human influencers [3,24,25,27,28,31,32]. According to communication theory [12,13], source credibility and audience trust in the message sender largely influence the effectiveness of communications [33]. Therefore, the above drawbacks of virtual influencers could undermine their marketing effectiveness. On the other hand, virtual influencers are usually rated higher in attractiveness and novelty, which can enhance consumers' willingness to share word-of-mouth [20,28]. These positive aspects may counterbalance the negative effects caused by their drawbacks mentioned above.

The mixed findings on the main effect of virtual (vs. human) influencers on marketing effectiveness also suggest the presence of moderators. That is, each type of influencer may be more suitable for specific contexts. These moderators generally include characteristics of products, messages, consumers, and contexts. For example, regarding product categories, virtual (vs. human) influencers are found to be more effective in endorsing technology products (vs. beauty products) [20] and are more likely to provide comparable endorsements to human influencers for functional (rather than experiential or symbolic) products [24].

Regarding consumer characteristics, virtual influencer marketing is more effective for consumers with a higher need for uniqueness [28] and for those with elevated levels of empathy [34]. Regarding message characteristics, previous research shows that using video (vs. image) content in endorsement posts can enhance consumers' emotional engagement and parasocial relationships with the virtual influencer, increasing their purchase intention to similar level as human influencers [25]. Regarding contexts or environments, virtual influencers are found to be more trustworthy in a virtual (vs. real) environment and when companioned by a virtual (vs. human) companion [32]. They are also more likely to convince young consumers in a low (vs. high) product involvement context [3].

While most of the existing research on virtual influencer marketing has focused on brand marketing [4–7], there is limited research on the effectiveness of virtual influencers in public service announcements (PSAs). Jiang et al. [35] found that in the context of green product promotion, the anthropomorphism of virtual influencers is positively related to consumers' purchase intentions and brand attitudes, as highly anthropomorphic virtual influencers are perceived to be more credible. Similarly, studies on the effectiveness of virtual influencers in promoting corporate social responsibility (CSR) suggest that human influencers are more effective than human-like and anime-like virtual influencers in inducing consumer engagement with CSR activities. This is also due to a higher source credibility associated with human influencers [14,36].

In the current research, we aim to explore the effectiveness of virtual influencers in PSA campaigns. This investigation extends the existing literature on virtual influencer marketing and PSA marketing. Furthermore, it holds practical implications for the strategic use of virtual influencers in public service advertising. We examine the differential impacts of virtual and human influencers in PSA communication, covering various social issues, consumer cultural backgrounds, and influencer characteristics. Additionally, we investigate two aspects of PSA effectiveness: consumers' attitudes toward the influencer, and their PSA message acceptance, shedding light on different stakeholders in this phenomenon.

2.2. PSA Effectiveness

Public service announcements (PSAs) are messages designed to communicate important social issues, such as environmental protection and health behaviors [26]. Prior research has explored various factors that influence PSA effectiveness. Drawing on the communication model [13], these factors can be categorized into the characteristics of the sender (communicator), the message itself (PSA content), and the receiver (consumer). First, the characteristics of the sender include the role of the spokesperson (e.g., national celebrities, local celebrities, or victims) [15], the similarity between the communicator and the consumers (peer or expert) [16], and the congruence between the communicator and the PSA [36]. For example, prior research shows that for PSAs advocating healthy lifestyles, such as healthy diets and exercise, featuring a patient with health problems as a spokesperson could elicit greater consumer message adoption intentions compared to featuring an actor as the spokesperson [37]. Second, the characteristics of the message include the framing of the PSA (positive vs. negative framing; [38]), appeal type (e.g., emotional appeal) [39], novelty of the PSA, and the generation source of the image in the PSA (e.g., generated by human vs. AI) [40]. For instance, PSAs on skin cancer that use a mix of emotional appeals, including humor and sadness, can evoke feelings of compassion in consumers, thereby motivating intended behaviors [39]. Green advertisements with novel content can increase attention and enhance the likelihood of recall [41]. However, charity advertisements featuring AI-generated images of the communicator may harm consumers' donation intentions [40]. Third, characteristics of the receiver include factors such as the mood of the PSA viewer [42] and the target group of the PSA (e.g., whether the viewers engage in the misbehavior identified in the PSA or not) [43]. For example, consumers who engage in the misbehavior mentioned in the PSA (e.g., smokers) are more likely to show reactance or defensive responses to the anti-smoking PSAs compared to non-smokers, especially to those with negative or threatening information [43].

In this research, we extend the understanding of how sender characteristics influence PSA effectiveness by examining the impact of virtual (vs. human) influencers in PSA communications. Beyond the traditional focus on message acceptance, we also explore how different types of PSA communicators—virtual vs. human influencers—affect consumers' attitudes toward the influencers from a personal branding perspective [44]. Personal branding is "a strategic process of creating, positioning, and maintaining a positive impression of oneself based in a unique combination of individual characteristics, which signal a certain promise to the target audience through a differentiated narrative and imagery" [44] (p. 6). Prior research suggests that personal brand development typically involves competence (e.g., expertise in a field), morality (adherence to ethical standards), humanity, and fostering audience involvement [45,46]. In this research, we assume that PSA communications may signal morality and thus facilitate personal brand building, as reflected in consumer attitudes toward influencers. However, the extent of this effect may vary between human and virtual influencers.

We propose dual pathways through which virtual (vs. human) influencers impact PSA effectiveness. On the one hand, we propose that virtual influencers are perceived as lower in mind than human influencers, which could undermine their effectiveness in PSA communications. Mind perception refers to the recognition of mental capacities in other entities, which encompasses two dimensions: agency (the capacity to plan, exert self-control, etc.) and experience (the capacity to feel and sense) [8,47]. Past research suggests that virtual influencers are perceived as lacking sensory capabilities [7,47], which are essential for the "experience" dimension of mind perception. This aligns with prior research showing that consumers attribute less responsibility to virtual (vs. human) influencers for both successful and unsuccessful endorsement outcomes due to a lower mind perception of virtual influencers [48]. Additionally, the perception of human mind is positively associated with consumers' authenticity perception in the virtual influencers [27]. Since the authenticity of sender is also crucial for PSA message communication [49], we argue that there is likely a negative effect of virtual (vs. human) influencers on PSA effectiveness through lower mind perception.

On the other hand, we propose that the higher novelty of virtual (vs. human) influencers can enhance the persuasiveness of their PSA communication. Novelty is the degree of perceived newness [50]. We argue that virtual influencers engaging in ethical behavior and revealing personal opinions regarding social issues (e.g., advocating for animal rights) will positively violate consumers' expectations about them, creating a sense of novelty. This novelty can increase consumer attention, curiosity, engagement, and likelihood of recall, all of which can be beneficial for the persuasiveness of PSAs [51–53]. This argument aligns with past research showing that virtual influencers are generally perceived as novel [27,54], and that novelty can drive consumer involvement, further enhancing the persuasiveness of a message [51,55]. Therefore, we argue that there is likely a positive effect of virtual (vs. human) influencers on PSA effectiveness through higher novelty.

In sum, we propose dual mechanisms, working in different directions, underlying the effect of influencer type on PSA effectiveness. Based on these dual mediating pathways, we speculate that the main effect could be mixed theoretically, leading to two competing hypotheses regarding main effects:

Hypothesis 1a. *Virtual influencers are less effective than human influencers in PSA communications.*

Hypothesis 1b. *Virtual influencers are more effective than human influencers in PSA communications.*

Hypothesis 2a. *(Negative mediation through mind perception.) Virtual (vs. human) influencers are perceived as lacking mind, which, in turn, can undermine the effectiveness of their PSA communications.*

Hypothesis 2b. *(Positive mediation through novelty.) Virtual (vs. human) influencers are perceived as higher in novelty, which, in turn, can increase the effectiveness of their PSA communications.*

2.3. The Moderating Role of PSA Appeal Type

If virtual influencers' PSA communications are less effective than those of human influencers due to the former's lower mind perception, then strategies that enhance this perception should improve the effectiveness of virtual influencers' PSA communications. Previous studies suggest that virtual influencers can narrow the gap between themselves and humans by mimicking human behaviors, such as displaying sensory cues in advertisements [30]. We propose that adopting emotional appeals in PSAs can also enhance the mind perception of virtual influencers, thereby enhancing the effectiveness of their PSA communications.

Emotional appeal involves persuasive communication that emotionally engages viewers with the message [56]. In contrast, non-emotional or rational appeal usually focuses on presentation of factual information, characterized by objectivity [57]. Virtual influencers, like their human counterpart, can share feelings and emotions in PSAs. Since the capacity to feel and sense is an important dimension of mind perception, we argue that expressing emotions in PSAs can enhance consumers' perception of mind in virtual influencers. In contrast, since the mind perception of human influencers is already high relative to virtual influencers, the positive effect of incorporating emotional appeals in PSAs may be less pronounced for them compared to virtual influencers. Therefore, we propose that incorporating an emotional (vs. non-emotional) appeal in PSAs is likely to enhance the effectiveness of virtual (vs. human) influencers' PSA communications through an enhanced mind perception of virtual (vs. human) influencers. This proposition aligns with past research on virtual influencer brand marketing, showing that virtual influencers who display emotions in product endorsing posts can increase consumer engagement and attitudes [58–60]. Thus, we hypothesize the following (see Figure 1 for the full theoretical framework):

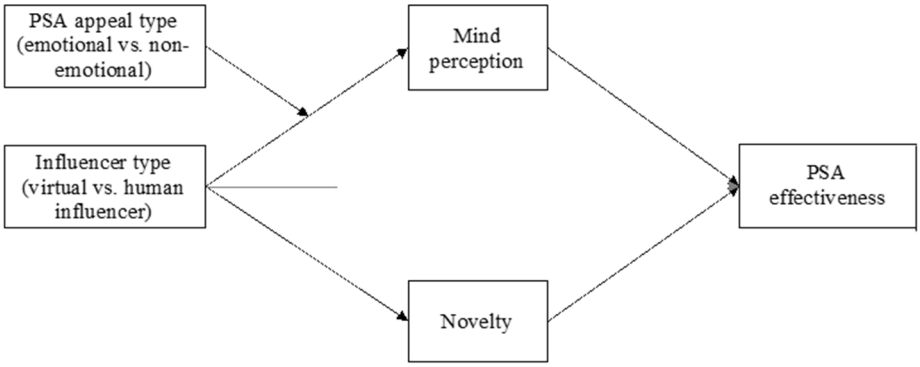

Figure 1. Theoretical framework.

Hypothesis 3. *The effect of influencer type (virtual vs. human) on PSA effectiveness (H1) is moderated by PSA appeal type (emotional vs. non-emotional). Specifically, emotional (vs. non-emotional) appeal can increase the effectiveness of virtual (vs. human) influencers' PSA communication.*

3. Methods

3.1. Study 1

The purpose of Study 1 was to explore the impact of influencer type (virtual vs. human) on PSA effectiveness (H1) by manipulating influencer type. In this study, we adopted a PSA topic advocating green consumption and environmental protection, specifically opposing the use of disposable plastic.

3.1.1. Participants and Design

We recruited 241 US participants through CloudResearch. Two participants did not pass the attention check question and were excluded, leaving 239 valid participants (51.05% female, M_{age} = 38.44, SD = 11.43) for analysis. This study employed a two-cell (influencer-type: virtual vs. human) between-subject design.

First, participants were randomly assigned to one of the two influencer-type conditions. They viewed a PSA post on Instagram opposing the use of disposable plastics, which was posted by either a virtual influencer or a human influencer. The posts in both influencer type conditions were identical except for the profile photos of the influencer (see Appendix A for the stimuli). To control for the attractiveness and other potential confounds associated with different profile photos, we used the same human image for both conditions. The image for the virtual influencer's profile photo was created by applying image processing filters to make it appear more "virtual".

After viewing the PSA post, participants were asked to answer questions regarding PSA effectiveness, including attitudes toward the influencer and PSA message acceptance. For attitudes toward the influencer, participants rated how much they liked the influencer (1 = not at all, 7 = very much). For PSA message acceptance, participants rated how much they agreed with the following statements: (1) It is irresponsible to use disposable plastic products; (2) I should not use disposable plastic products; (3) I will use disposable plastic products in the future (1 = strongly disagree, 7 = strongly agree; the last item was reverse-coded). The three items were averaged into a single PSA message acceptance measure for analysis (Cronbach's $\alpha = 0.74$). Last, we collected control variables, such as participants' mood, frequency of using plastic, and demographic information (gender, age, and education level).

3.1.2. Results and Discussion

- PSA effectiveness

To examine the effect of influencer type on attitudes toward the influencer, we conducted a one-way ANOVA with influencer type as an independent variable and attitude toward the influencer as a dependent variable. As predicted, the main effect of influencer type on attitude toward the influencer was significant ($F(1, 237) = 10.18$, $p = 0.002$, $\eta_p^2 = 0.04$). Specifically, participants had a less favorable attitude toward a virtual influencer who posts PSAs than a human influencer ($M_{virtual} = 3.63$, SD = 1.88 vs. $M_{human} = 4.35$, SD = 1.63; see Figure 2). The effect remained significant after controlling for participants' mood, frequency of using plastic, and demographic variables ($F(1, 232) = 9.43$, $p = 0.002$, $\eta_p^2 = 0.04$).

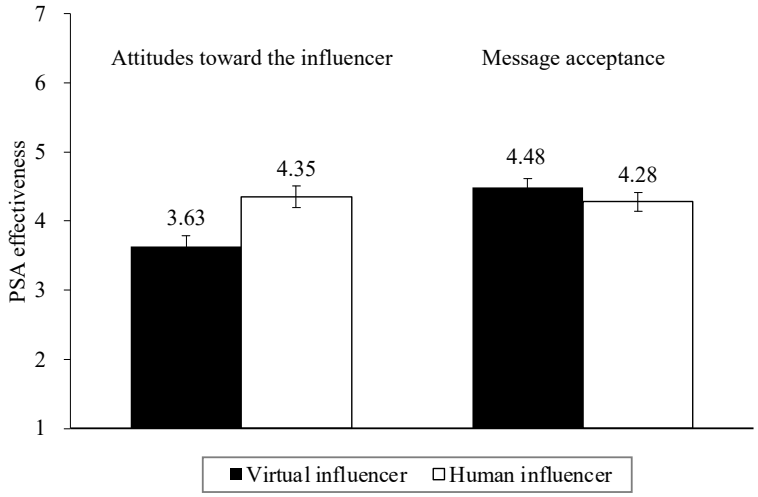

Figure 2. The effect of influencer type on PSA effectiveness (Study 1).

To examine the effect of influencer type on PSA message acceptance, we conducted a one-way ANOVA with influencer type as an independent variable and PSA message acceptance as a dependent variable. The results suggested that the main effect of influencer type on PSA message acceptance was not significant ($M_{virtual} = 4.48$, SD = 1.45 vs. $M_{human} = 4.48$, SD = 1.47; $F(1, 237) = 1.07$, $p = 0.30$, $\eta_p^2 = 0.004$; see Figure 2). This effect

remained insignificant after controlling for participants' mood, frequency of using plastic, and demographic variables (F(1, 232) = 1.11, p = 0.29, η_p^2 = 0.01).

- Discussion

Study 1 shows that consumers demonstrate a less favorable attitude toward virtual (vs. human) influencers who post PSAs. Nevertheless, there is no significant difference between the two types of influencers in terms of impacting consumer message acceptance. These results partly support H1a, suggesting that the main effects of influencer type on PSA effectiveness may vary depending on the aspect of PSA effectiveness being focused on. In Study 2, we examined the effects within a different PSA context and tested the underlying mechanisms for the main effects of influencer type on PSA effectiveness.

3.2. Study 2

Study 2 had two goals. First, to ensure the robustness and generalizability of the effect observed in Study 1 (the impact of influencer type on PSA effectiveness), we extended the study context to a different PSA topic (i.e., health behaviors). Second, we sought to examine the dual-mediation paths through mind perception and novelty. We predicted that on the one hand, a lower perception of mind in virtual (vs. human) influencers may undermine the effectiveness of virtual influencers' PSA communication (H2a). On the other hand, a higher perception of novelty in virtual (vs. human) influencers may enhance the effectiveness of virtual influencers' PSA communication (H2b).

3.2.1. Participants and Design

We recruited 404 US participants (49.50% females; M_{age} = 38.80, SD = 12.06) through CloudResearch. After excluding 2 participants who failed the attention check procedure, 402 participants (49.75% female; M_{age} = 38.80, SD = 12.09) remained for analysis. This study employed a two-cell (influencer-type: virtual vs. human) between-subjects design.

First, participants were randomly assigned to one of the two influencer-type conditions. They viewed a PSA post advocating for a low-carb diet on Twitter, posted by either a virtual influencer or a human influencer. As in Study 1, the posts in both conditions were identical except for the profile image of the influencer (see Appendix B for the stimuli).

After presenting the PSA post, we measured two mediators through two established scales: mind perception and novelty. For mind perception, participants were asked to rate the extent to which they think the influencer possesses capacities such as (1) feeling fear; (2) exercising self-control; (3) feeling pleasure; (4) remembering; (5) feeling hunger; and (6) acting morally (1 = not at all, 7 = very much; Cronbach's α = 0.96) [47]. For novelty, participants rated how much they thought the influencer was (1) unusual, (2) novel, (3) unique, (4) striking, and (5) noticeable (1 = not at all, 7 = very much; Cronbach's α = 0.85) [61].

Then, we assessed PSA effectiveness: attitude toward the influencer and PSA message acceptance. Attitude toward the influencer was measured using the same measurement as in Study 1. For PSA message acceptance, participants rated how much they agreed with the following statement on a 7-point scale: (1) "Low-carb diet is beneficial for my health" (1 = strongly disagree, 7 = strongly agree); (2) "I should keep a low-carb diet" (1 = strongly disagree, 7 = strongly agree); (3) "How likely are you to try a low-carb diet in a year?" (1 = very unlikely, 7 = very likely). The three items were averaged into a single PSA message acceptance measure for analysis (Cronbach's α = 0.90). Lastly, we measured control variables, which included participants' diet habits (whether or not they followed a low-carb diet before taking the survey: 1 = yes, 2 = no) and perceived body size (1 = skinny, 7 = obese). Demographic information including age, gender, and education level were also collected.

3.2.2. Results and Discussion

- PSA effectiveness

To examine the effect of influencer type on attitude toward the influencer, we conducted a one-way ANOVA with influencer type as an independent variable and attitude toward the influencer as a dependent variable. Consistently with Study 1 and Hypothesis 1a, the results showed that the main effect of the influencer type on attitude toward the influencer was significant ($F(1, 400) = 33.10$, $p < 0.01$, $\eta_p^2 = 0.08$). Specifically, participants reported a less favorable attitude toward the virtual influencer ($M = 2.96$, $SD = 1.76$) than a human influencer ($M = 3.92$, $SD = 1.58$) who posted a low-carb diet PSA. The effect remained significant after controlling for participants' perceived body size, diet habits, and demographic variables ($F(1, 395) = 31.83$, $p < 0.001$, $\eta_p^2 = 0.08$).

To examine the effect of influencer type on PSA message acceptance, we conducted a one-way ANOVA with influencer type as an independent variable and PSA message acceptance as a dependent variable. Consistently with Study 1, the main effect of the influencer type on PSA message acceptance was not significant ($F(1, 400) = 0.07$, $p = 0.79$, $\eta_p^2 < 0.001$). The effect remained insignificant after controlling for participants' perceived body size, diet habits, and demographic variables ($F(1, 395) = 0.46$, $p = 0.50$, $\eta_p^2 = 0.001$).

- Mind perception

To explore the effect of influencer type on mind perception, a one-way ANOVA was conducted with influencer type as an independent variable and mind perception as the dependent variable. The results showed that participants had a significantly lower mind perception of the virtual influencer ($M = 2.33$, $SD = 1.42$) than of the human influencer ($M = 5.36$, $SD = 1.24$) who posted a low-carb diet PSA ($F(1, 400) = 519.51$, $p < 0.001$, $\eta_p^2 = 0.57$). The effect remained significant after controlling for participants' perceived body size, diet habits, and demographic variables ($F(1, 395) = 520.44$, $p < 0.001$, $\eta_p^2 = 0.57$).

- Novelty

To explore the effect of influencer type on novelty, a one-way ANOVA was conducted with influencer type as an independent variable and novelty as the dependent variable. The results showed that participants perceived a significantly higher level of novelty when seeing the virtual influencer ($M = 3.45$, $SD = 1.37$) than when seeing the human influencer ($M = 2.53$, $SD = 1.41$) posting a low-carb PSA ($F(1, 400) = 43.63$, $p < 0.001$, $\eta_p^2 = 0.10$). The effect remained significant after controlling for participants' perceived body size, diet habits, and demographic variables ($F(1, 395) = 41.64$, $p < 0.001$, $\eta_p^2 = 0.10$).

- Mediation analysis

Next, we tested the proposed mediation models. We first examined the mediation effect with attitude toward the influencer as the dependent variable, influencer type (0 = human influencer, 1 = virtual influencer) as the independent variable, and mind perception and novelty as two mediators (PROCESS Model 6; 5000 bootstrap resamples). The results showed that compared with the human influencer, participants perceived a significantly lower mind ($\beta = -3.03$, $SE = 0.13$, $t = -22.79$, $p < 0.001$) and higher novelty ($\beta = 0.92$, $SE = 0.14$, $t = 6.61$, $p < 0.001$) in the virtual influencer posting a low-carb PSA. Further, both mind perception ($\beta = 0.56$, $SE = 0.05$, $t = 10.74$, $p < 0.001$) and novelty ($\beta = 0.40$, $SE = 0.05$, $t = 8.01$, $p < 0.001$) had positive effects on attitude toward the influencer. More importantly, consistently with our hypotheses, the indirect effect of influencer type on attitude toward the influencer through mind perception was negative and significant ($\beta = -1.69$; $SE = 0.16$), with a 95% confidence interval excluding zero [−2.0126, −1.3895]. In contrast, the indirect effect of influencer type on attitude toward the influencer through novelty was positive and significant ($\beta = 0.36$; $SE = 0.07$), with a 95% confidence interval excluding zero [0.2368, 0.5082]. Additionally, results suggested that the direct effect of influencer type on attitude toward the influencer was not significant ($\beta = 0.36$; $SE = 0.22$; $p = 0.09$, 95% CI = [−0.0622, 0.7855]; see Figure 3).

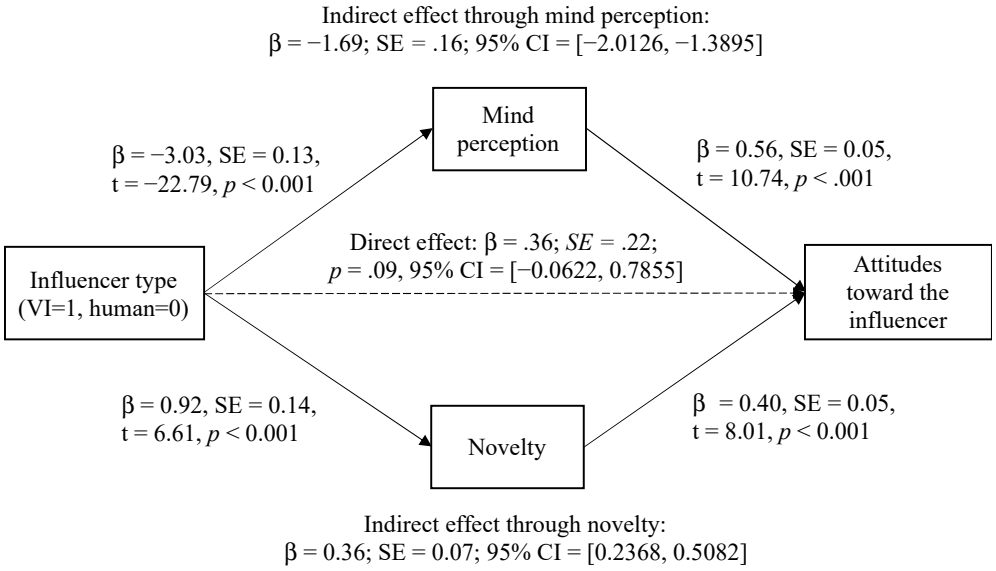

Figure 3. Mediation analysis on attitudes toward the influencer (Study 2).

Similarly, we examined the mediation effect on PSA message acceptance. We conducted a mediation analysis with influencer type (0 = human influencer, 1 = virtual influencer) as an independent variable, mind perception and novelty as two mediators, and PSA message acceptance as the dependent variable (PROCESS Model 6; 5000 bootstrap resamples). Similarly to the results above, participants perceived a significantly lower mind (β = −3.03, SE = 0.13, t = −22.79, $p < 0.001$) and higher novelty (β = 0.92, SE = 0.14, t = 6.61, $p < 0.001$) in the virtual influencer compared to the human influencer posting a low-carb PSA. Further, both mind perception (β = 0.16, SE = 0.06, t = 2.76, $p = 0.01$) and novelty (β = 0.17, SE = 0.06, t = 2.98, $p = 0.003$) had positive effects on PSA message acceptance. More importantly, consistently with our hypotheses, the indirect effect of influencer type on PSA message acceptance through mind perception was negative and significant (β = −0.49; SE = 0.17), with a 95% confidence interval excluding zero [−0.8287, −0.1662]. In contrast, the indirect effect of influencer type on PSA message acceptance through novelty was positive and significant (β = 0.15; SE = 0.06), with a 95% confidence interval excluding zero [0.0461, 0.2732]. Additionally, the direct effect of influencer type on PSA message acceptance was not significant (β = 0.04; SE = 0.16; $p = 0.79$, 95% CI = [−0.2719, 0.3572]; see Figure 4).

- Discussion

Building on Study 1, Study 2 examines the proposed effects in a different PSA domain and provides consistent results for the main effect of influencer type on PSA effectiveness. Specifically, the results show that participants hold a less favorable attitude toward the virtual (vs. human) influencer posting a low-carb diet PSA, but accept the PSA message equally to those viewing the PSA posted by a human influencer. These findings were consistent with Study 1, and further provide partial support for H1a.

More importantly, this study provides evidence for the proposed dual-mediation model (H2): a lower perception of mind in virtual (vs. human) influencers undermines the effectiveness of virtual influencers' PSA communication. Conversely, a higher perception of novelty in virtual (vs. human) influencers enhances the effectiveness of their PSA communication.

Moreover, the results suggest that the positive effect of mind perception on attitude toward the influencer is stronger than its effect on PSA message acceptance, as evidenced by the larger coefficient. This may help explain the differential main effects of influencer type on the two dependent variables. In other words, while mind perception plays an important role in influencing consumer attitude toward influencers, it has a less pronounced impact on consumers' PSA message acceptance or behavioral intention. Therefore, the

major drawback of virtual influencers (i.e., lower mind perception) is less detrimental in influencing public attitudes and behaviors regarding the social issues communicated in PSAs.

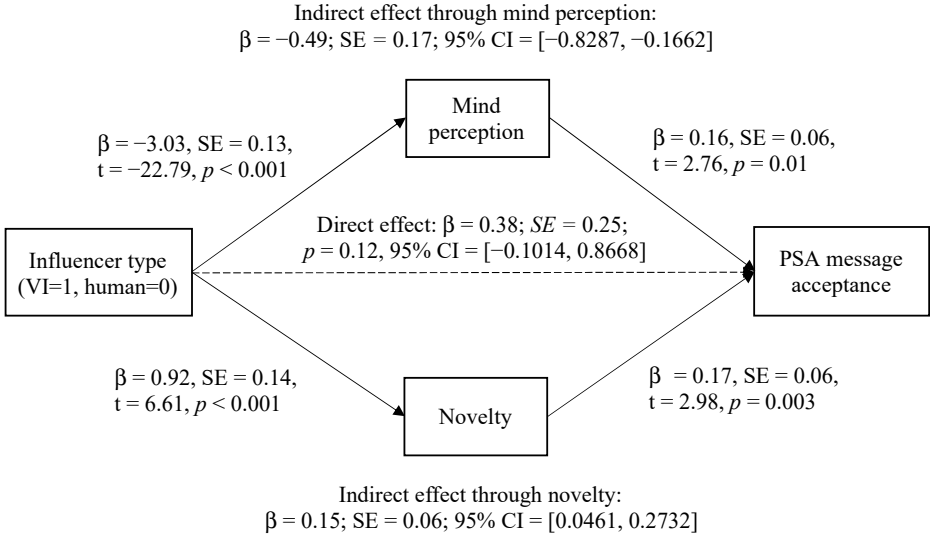

Figure 4. Mediation analysis on PSA message acceptance (Study 2).

3.3. Study 3

Study 3 had two primary objectives. The first was to test the moderating role of PSA appeal type (emotional vs. non-emotional) in the effect of influencer type on PSA effectiveness. We predicted that incorporating an emotional (vs. non-emotional) appeal in PSAs could enhance the effectiveness of virtual (vs. human) influencers' PSA communication (H3). The second objective was to further increase the generalizability of the findings. To achieve this, we adopted a different influencer, designed a different PSA post, and tested the effects in a sample pool with a different cultural background.

3.3.1. Participants and Design

We recruited 1077 participants through InsightWorks, a large consumer panel with a representative sample in China. After excluding participants who failed the attention check, we had 788 valid participants for analysis (28.68% female; M_{age} = 44.63, SD = 16.86). This study employed a 2 (influencer type: virtual vs. human) × 2 (PSA appeal type: emotional vs. non-emotional) between-subjects design.

Participants were randomly assigned to either the virtual or human influencer condition. They viewed a PSA on Instagram opposing the use of plastics, posted by either a virtual influencer or a human influencer. In the emotional appeal condition, participants were presented with messages expressing emotions and feelings, such as empathy, pain, and self-blame for the Earth's suffering from disposable plastic pollution. In contrast, in the non-emotional condition, participants were presented with objective and informational messages with data demonstrating the burden that the Earth bears due to disposable plastic pollution (see Appendix C for the stimuli).

As in previous studies, we measured PSA effectiveness in two aspects: attitude toward the influencer and PSA message acceptance. Attitude toward the influencer was measured using the same items as in Studies 1 and 2. For PSA message acceptance, participants rated their agreement with the following statements on a 7-point scale: (1) "The use of disposable plastic products can cause harm to the environment"; (2) "I should not use disposable plastic products"; (3) "I will not use disposable plastic products in the future" (1 = strongly disagree, 7 = strongly agree). These three items were averaged into a single measure for PSA message acceptance for analysis (Cronbach's α = 0.71).

To check the effectiveness of PSA appeal type manipulation, we measured participants' agreement with the following statements: (1) "The post provided emotional content";

(2) "The post was emotional" (1 = strongly disagree, 7 = strongly agree). We averaged the two items into a single emotional appeal perception index (r = 0.10, p = 0.004). Then, participants' mood and frequency of using disposable plastic products were measured as control variables. Finally, demographic information (age, gender, and education level) was collected.

3.3.2. Results and Discussion

- Manipulation check

To verify the effectiveness of the PSA appeal type manipulation, we conducted an independent t-test with participants' emotional appeal perception index as the dependent variable and PSA appeal type condition as the independent variable. The results showed that the PSA post in the emotional condition was perceived as significantly more emotional than the PSA post in the non-emotional condition ($M_{emotional}$ = 5.24, SD = 1.05 vs. $M_{non\text{-}emotional}$ = 4.90, SD = 1.12; t (786) = 4.38, $p < 0.001$, d = 0.31). This result suggests that the appeal type manipulation was successful.

- PSA effectiveness

To test Hypothesis 3, a two-way ANOVA was conducted with influencer type as the independent variable, appeal type as the moderator, and attitude toward the influencer as the dependent variable. The results showed that the main effects of influencer type (F(1, 784) = 1.82, p = 0.18, η_p^2 = 0.002) and appeal type (F(1, 784) =2.03, p = −0.15, η_p^2 = 0.003) on attitude toward the influencer were not significant. Importantly, there was a significant two-way interaction between the influencer type and appeal type on the attitude toward the influencer (F(1, 784) = 4.27, p = 0.04, η_p^2 = 0.005). Further contrast analysis suggested that in the non-emotional PSA appeal condition, participants had a more favorable attitude toward the human influencer (M = 5.83, SD = 1.00) than the virtual influencer (M = 5.55, SD = 1.24; F(1, 784) = 5.83, p = 0.02). In the emotional appeal condition, there was no significant difference between the virtual and human influencer conditions on the attitude toward the human influencer (M = 5.60, SD = 1.17 vs. M = 5.54, SD = 1.18; F(1, 784) = 0.26, p = 0.61; see Figure 5). After controlling for participants' mood, frequency of using plastic, and demographic information, the above interaction effect on the attitude toward the influencer remained significant (F(1, 778) = 3.80, p = 0.05, η_p^2 = 0.01).

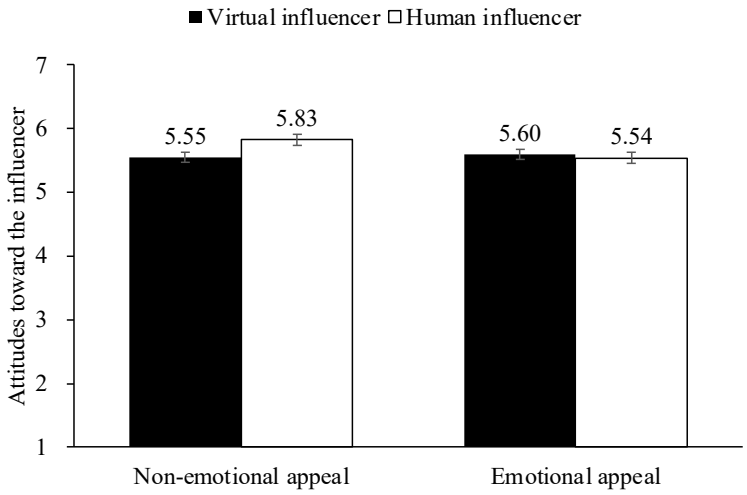

Figure 5. Interaction effect of influencer type and emotional appeal on consumer attitudes toward the influencer (Study 3).

For PSA message acceptance, a two-way ANOVA was conducted with the influencer type as the independent variable, appeal type as the moderator, and PSA message acceptance as the dependent variable. The results showed that the main effects of influencer

type (F(1, 784) = 0.09, p = 0.76, η_p^2 < 0.001) and appeal type (F(1, 784) = 0.74, p = 0.39, η_p^2 = 0.001) on PSA message acceptance were not significant. Importantly, there was a significant interaction between influencer type and appeal type on PSA message acceptance (F(1, 784) = 4.42, p = 0.04, η_p^2 = 0.01). A further contrast analysis suggested that in the non-emotional PSA appeal condition, there was no significant difference between the virtual and human influencer conditions on PSA message acceptance (M = 5.46, SD = 1.11 vs. M = 5.60, SD = 1.02; F(1, 784) = 1.61, p = 0.20). In the emotional appeal condition, participants in the virtual influencer condition (M = 5.56, SD = 1.17) had a higher PSA message acceptance than those in the human influencer condition (M = 5.37, SD = 1.17; F(1, 784) = 5.83, p = 0.02; see Figure 6). After controlling for participants' mood, frequency of using plastic, and demographic information, the above interaction effect on the attitude toward the influencer remained significant (F(1, 778) = 3.96, p = 0.05, η_p^2 = 0.01).

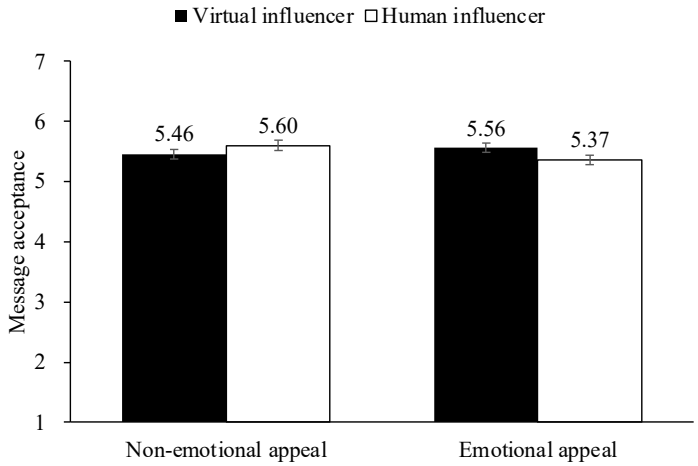

Figure 6. Interaction effect of influencer type and emotional appeal on PSA message acceptance (Study 3).

- Discussion

Study 3 tests the moderating role of PSA appeal type using a different sample pool, with different influencers, and a new PSA design compared to previous studies. The findings show that in the non-emotional appeal condition, the effect of influencer type on PSA effectiveness replicates the results of previous studies. However, incorporating an emotional appeal in the PSA enhances the effectiveness of virtual (vs. human) influencers' PSA communications. This moderating effect is observed in both aspects of PSA effectiveness: consumer attitude toward the influencer and PSA message acceptance. These findings provide support for our H3.

4. General Discussion

Public service announcements (PSAs) communicated by virtual influencers are gaining prevalence on social media platforms. However, the current understanding of consumers' responses to these practices is still limited. This research helps address this gap by examining the effectiveness of virtual influencers compared to human influencers in conveying PSAs, focusing on consumers' attitudes toward the influencers and their acceptance of PSA messages. Through three studies, we found that consumers hold less favorable attitudes toward virtual influencers who post PSAs compared to human influencers. Nonetheless, this attitude discrepancy does not extend to the acceptance of the PSA content itself (Studies 1 and 2). Study 2 further revealed dual mediating processes underlying the above effects: the perceived lower levels of mind in virtual influencers compared to human influencers undermine their PSA communication effectiveness, while a higher perception of novelty in virtual (vs. human) influencers enhances their effectiveness of PSA communications. Additionally, Study 3 demonstrated that the use of emotional appeals in PSAs can enhance

the virtual (vs. human) influencers' PSA communication effectiveness, including both consumer attitudes toward the virtual influencer and message acceptance. These results were consistent across different PSA topics, experimental settings, and samples from different cultural contexts, supporting the robustness and generalizability of our findings.

Overall, the empirical findings from this research highlight the potential for virtual influencers to effectively communicate PSAs. Despite the generally less favorable consumer attitudes toward virtual influencers, they can be as effective as human influencers in impacting PSA message acceptance. The primary drawback of virtual influencers—lower mind perception—is less detrimental when balanced by their novelty appeal, and especially when leveraged by strategies that boost their perceived mind.

4.1. Theoretical Contribution

This research contributes to the existing literature in several ways. First, it contributes to the literature on virtual influencer marketing. Previous research on virtual influencer marketing has primarily focused on brand marketing, investigating the effectiveness of virtual influencers in product or service endorsements [4–7]. There is little research on the role of virtual influencers in public service announcement (PSA) communications. Given the prevalence and the important social consequences of these practices, it is critical to advance the understanding and theoretical insights of this phenomenon. The current research contributes to this line of research by exploring how virtual (vs. human) influencers impact the effectiveness of PSA communications. Moreover, we investigate two key consequences resulting from such communications: consumers' attitudes toward the influencer and their PSA message acceptance. Prior research comparing the effectiveness of virtual influencers and human influencers has yielded mixed results, with some suggesting that virtual influencers are as effective as human influencers in brand marketing [26–28], while others report a more negative consumer response [23–25]. Our findings shed light on these mixed findings by suggesting that the observed impact of influencer type (virtual vs. human) on communication effectiveness can vary depending on the specific dimension of effectiveness considered. Specifically, we found that in the context of PSA communication, although virtual influencers tend to generate less favorable consumer attitudes when posting PSAs compared to human influencers, they can still achieve comparable levels of PSA message acceptance. Additionally, we suggested that the mixed findings observed in prior research may also arise from the complex mechanisms behind the effects. Our research uncovered two underlying mechanisms that went in opposite directions: the lower perceived levels of mind in virtual (vs. human) influencers undermine their PSA communication effectiveness, while the higher perception of novelty associated with virtual (vs. human) influencers enhances their PSA communication effectiveness. Prior research has shown that a lower mind perception of virtual influencers could negatively influence consumer engagement in brand marketing campaigns [9]. However, our findings extend this understanding by indicating that while mind perception plays an important role in influencing consumer attitudes toward influencers, it has a less pronounced impact on PSA message acceptance. Therefore, the primary limitation of virtual influencers (i.e., lower mind perception) is less detrimental when it comes to influencing public attitudes and behaviors regarding the social issues communicated in PSAs. These findings underscore the complex dynamics between mind perception, novelty, and PSA effectiveness, and highlight the potential for virtual influencers to effectively communicate PSA messages, particularly when leveraging their novelty appeal.

Second, this research advances the literature on PSA communication by introducing the type of social media influencer as a factor influencing PSA effectiveness. Prior studies examining the characteristics of PSA communicators have primarily focused on human spokespersons, such as celebrities, peers, and victims [15,16,37]. For instance, there is research showing that victims or patients, compared to celebrities, often elicit greater consumer message acceptance because they are perceived as more authentic [37]. Our study extends this line of research by comparing virtual and human influencers as different types

of message senders. We show that the novelty associated with virtual influencers can counterbalance their lower perceived mind perception, thereby maintaining the effectiveness of their communication in PSAs. This finding highlights the importance of novelty in social issue communications.

Moreover, past research on PSA effectiveness has mainly focused on the consumers' message acceptance [38–41]. Our research broadens this perspective by considering the bi-directional influence of PSA communications on influencers' personal brands. Not only do influencers bring their brand assets to the PSA, but engaging in PSAs also shapes consumers' attitudes toward the influencers themselves, impacting their personal branding. This has implications for the personal branding literature, as our findings indicate that PSAs might be less effective for virtual (vs. human) influencers in building their personal brand, likely due to their lower perceived mind, which is essential for moral judgment [8] and for a personal brand.

Third, this research also extends communication theory by revealing a discrepancy between consumer attitudes toward the influencer and their message acceptance. Traditionally, communication effectiveness has been studied and measured as message acceptance (or receivers' attention to and memory of the message), and consumers' attitude toward the message sender is often viewed as an antecedent of message acceptance [17–19]. However, we provide a new perspective by examining how the PSA communication can influence receivers' attitudes toward the message sender (i.e., influencers). Our findings indicate a complex relationship where consumers might hold less favorable attitudes toward virtual influencers due to perceived inauthenticity and a lack of mind, yet still accept the messages conveyed in PSAs. This discrepancy might indicate dual processing paths in consumer reception of influencer communications—affective attitudes toward the influencer and cognitive processing of the message content. By examining these dual paths, our study adds depth to the understanding of how consumers process influencer-based communications, suggesting that message acceptance might not always be a result of attitudes toward the communicator.

Furthermore, by investigating the moderating role of PSA appeal types, we contribute to the nuanced understanding of how emotional appeals can enhance the perceived mind in virtual influencers, thereby improving their effectiveness in PSA communication [57–60]. This aligns with resent research suggesting that incorporating sensory cues in descriptions can attenuate the negative effect of virtual (vs. human) influencers on marketing effectiveness [23]. Similarly, emotional appeal in PSAs may enhance the perceived mind of virtual influencers, particularly in terms of the "experience" dimension, leading to increased PSA communication effectiveness. This insight is particularly valuable for designing influencer-based PSA strategies that maximize impact through tailored appeal types.

In sum, our research provides a comprehensive analysis of virtual versus human influencers in the context of PSA communications, enriching the theoretical landscape of influencer marketing and public service advertising communication.

4.2. Managerial Implications

By comparing virtual and human influencers, our research reveals insights into how each can be strategically used to enhance PSA communications and encourage responsible and prosocial behaviors among consumers. Our findings offer important practical implications for different stakeholders, including PSA marketers and virtual influencers.

For PSA marketers, our findings suggest that virtual influencers can be as effective as human influencers in gaining consumer acceptance of PSA messages. This implies that marketers should consider leveraging virtual influencers, particularly when aiming to introduce novelty and capture consumer attention in crowded media environments. However, due to the lower mind perception associated with virtual influencers, strategies that enhance this perception, such as the inclusion of emotional appeals in messages, may help improve the effectiveness of virtual influencers in PSAs. Thus, marketers should

carefully craft the content delivered by virtual influencers to include emotional elements that can foster a sense of mind, authenticity, and relatability.

For virtual influencers, PSA communications offer an excellent opportunity to construct a positive identity and image. By participating in campaigns that promote societal well-being, virtual influencers can transcend traditional endorsements and be perceived as responsible and ethically engaged figures. This can enhance their credibility and appeal, especially among audiences that value corporate social responsibility. Virtual influencers should focus on maintaining their novelty by adopting innovative content and continuously engaging with topics of public concern, thereby solidifying their position as influential figures in digital media.

4.3. Limitations and Directions for Future Research

Although insightful, the current research has several limitations, which also open avenues for future research. Here, we outline these limitations and propose potential directions to address them in subsequent investigations.

Firstly, our research primarily focused on consumers' attitudes and behavioral intentions when interacting with virtual versus human influencers in public service announcements. However, it is crucial to acknowledge that behavioral intentions may not always translate directly into actual behaviors. This gap can lead to discrepancies in understanding the true impact of influencer type on public service communication effectiveness. Additionally, our study did not explore other consequential outcomes that might emerge from virtual influencers' PSA communications, such as trust in the message or changes in social norms. Future studies could further measure actual behavioral changes post-exposure to influencer-endorsed PSAs and investigate additional psychological or social impacts that these endorsements might catalyze.

Secondly, the current research primarily revealed the underlying mechanism regarding mind perception and novelty in influencers' PSA communications, and offered one strategy (emotional appeal) based on the mind-perception mechanism to enhance the PSA effectiveness of virtual influencers' PSA communications. Delving deeper into the question of how virtual influencers can be strategically employed to maximize PSA effectiveness, future research could examine other conditions where virtual influencers might outperform human influencers, perhaps considering factors such as the complexity of the message. Additionally, it would be beneficial to investigate how the characteristics of virtual influencers, such as their design, follower size [62–64], and specific emotions (e.g., negative vs. positive) [65], as well as the characteristics of contexts, such as the metaverse [66–69] and live-streaming platforms [70], can influence their effectiveness in public service communications.

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Institutional Review Board Statement: Ethical review and approval were waived for this study due to the minimal risk involved, according to Article 32 of the Measures for Ethical Review of Life sciences and Medical Research Involving Human Beings that issued by the National Health Commission, Ministry of Education, Ministry of science and Technology, and Bureau of Traditional Chinese Medicine on 18 February 2023.

Informed Consent Statement: Informed consent was obtained from all subjects involved in this study.

Data Availability Statement: The dataset is available on request from the authors.

Conflicts of Interest: The authors declare no conflicts of interest.

Appendix A. Stimuli in Study 1

Figure A1. Influencer-type manipulation stimuli in Study 1.

Appendix B. Stimuli in Study 2

Figure A2. Influencer-type manipulation stimuli in Study 2.

Appendix C. Stimuli in Study 3

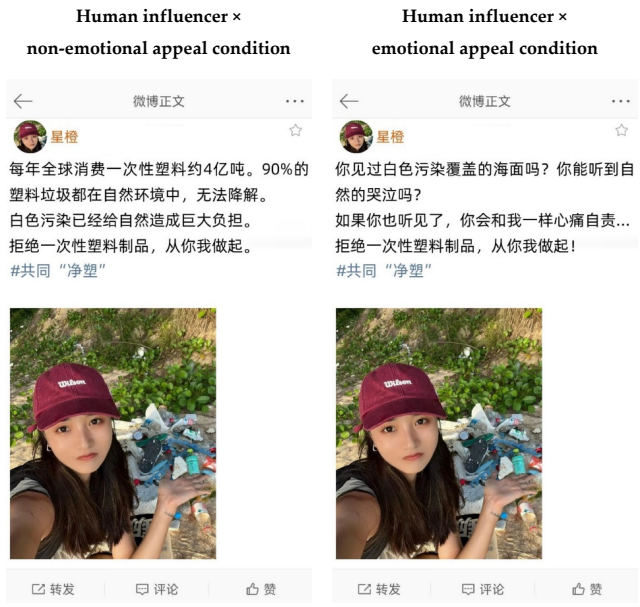
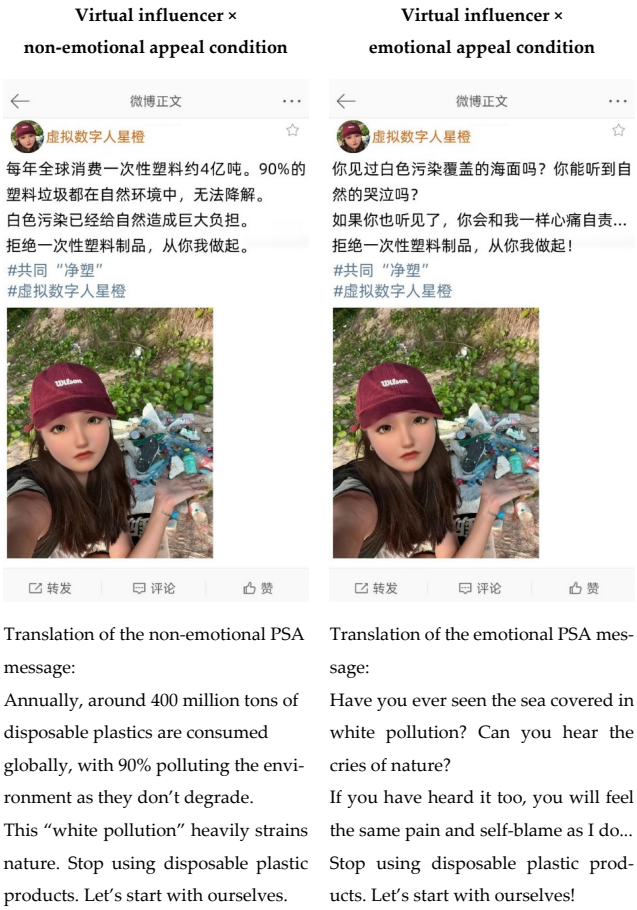


Figure A3. *Cont.*



Translation of the non-emotional PSA message:
Annually, around 400 million tons of disposable plastics are consumed globally, with 90% polluting the environment as they don't degrade.
This "white pollution" heavily strains nature. Stop using disposable plastic products. Let's start with ourselves.

Translation of the emotional PSA message:
Have you ever seen the sea covered in white pollution? Can you hear the cries of nature?
If you have heard it too, you will feel the same pain and self-blame as I do...
Stop using disposable plastic products. Let's start with ourselves!

Figure A3. Influencer-type and PSA appeal type manipulation stimuli in Study 2.

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