

From human–human to human–VTuber collaboration: Effects of different livestreamer collaboration types on consumers' purchase intention

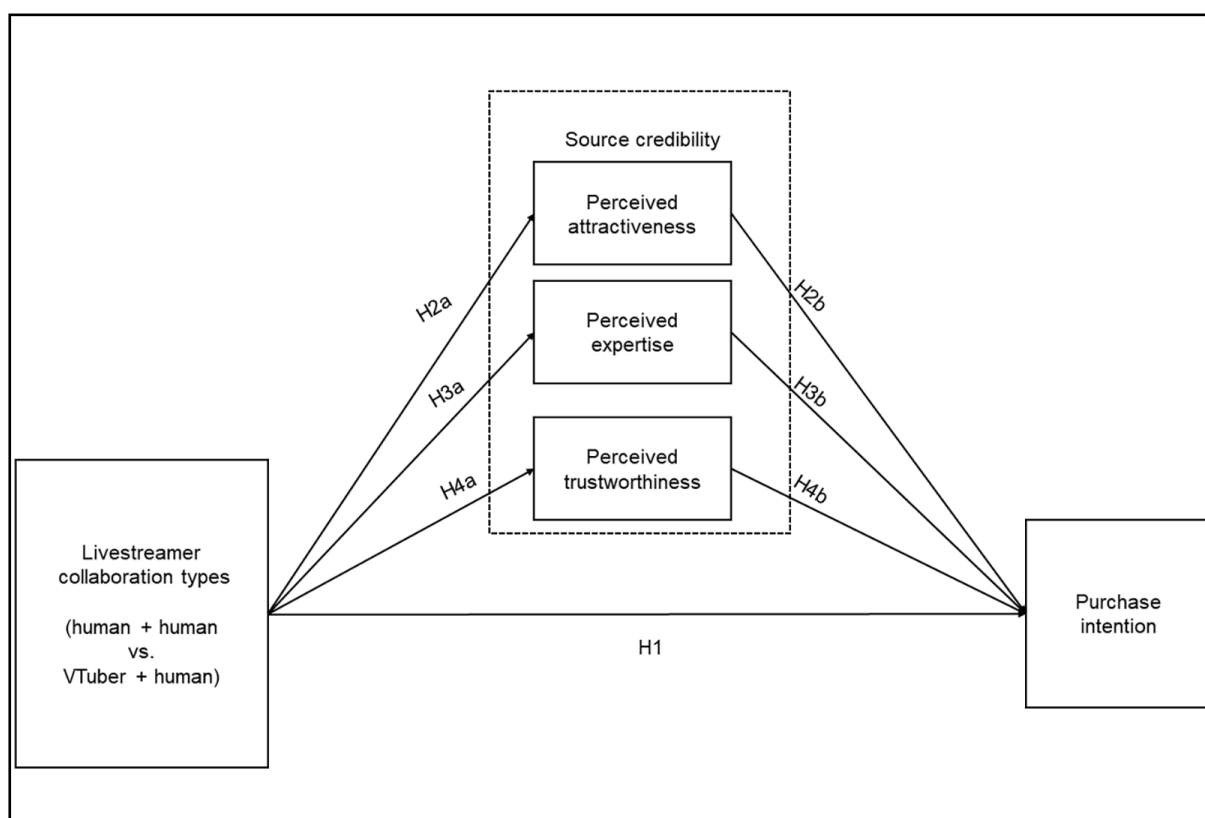
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Graphical abstract



This is the hypothesis test result of this study, in which two hypotheses, H4a and H4b, are not supported.

Public summary

- As one of the pioneering empirical studies on VTuber collaborations with other livestreamers, this study addresses the impact of collaboration among livestreamers on consumers' purchase intentions.
- This study extends the application of source credibility theory and explores the persuasive effects of non-traditional information sources such as VTubers.
- The findings provide theoretical support for managers to foster collaboration among livestreamers and construct outstanding livestreaming teams.

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Cite This: *JUSTC*, 2026, 56(5): 0502 (10pp)



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Abstract: The influence of virtual YouTubers (VTubers) in the e-commerce live streaming sector is increasingly significant. However, few scholarly works have systematically investigated the collaborative effectiveness between VTubers and conventional human livestreamers. With its foundation in source credibility theory (SCT), this study employs a series of experiments to perform a comparative analysis of the impact of two streaming collaboration configurations (human–human and human–VTuber) on consumers’ purchase intention. The findings indicate that consumers’ perceived attractiveness, perceived expertise, and purchase intention are all significantly higher in Vhuman–Tuber collaboration than in human–human collaboration. Nevertheless, the two forms of collaboration show no significant difference in perceived trustworthiness. Additionally, perceived attractiveness and perceived expertise mediate the relationship between the type of streaming collaboration and consumers’ purchase intention. This research is the first to address the impact of collaboration among livestreamers on consumers’ purchase intention. The conclusions have theoretical and practical value for managers aiming to comprehend the value of VTubers, foster collaboration among livestreamers, and construct outstanding streaming teams.

Keywords: VTuber; live streaming; human–machine collaboration; source credibility theory

CLC number: F713.55; F724.6

Document code: A

1 Introduction

E-commerce live streaming, a novel “product-plus-service” model transcending traditional commodity marketing^[1], is swiftly becoming a dominant channel in online retail^[2]. Pre-eminent global e-commerce platforms, such as Taobao and Amazon, have introduced live shopping features, giving rise to a diverse array of Internet celebrity e-commerce livestreamers, represented by Austin Li. These livestreamers not only present product introductions and engage in interactive Q&A sessions within their streams but also provide entertainment for consumers. This revolutionary sales approach significantly stimulates consumers’ purchase desire.

For an extended period, human livestreamers have maintained a dominant position in the realm of live streaming. However, with the maturation of digital technologies such as AR, VR, and AI, the live streaming landscape is once again being disrupted. Owing to the constraints associated with human livestreamers, including costs, streaming duration, and personal capabilities^[3], more brands are opting for more innovative approaches utilizing AI livestreamers or virtual YouTubers (VTubers). This shift aims to redefine consumer-brand relationships within interactive marketing and enhance the online shopping experience^[4]. As a complement to human livestreamers, AI livestreamers can enable real-day live

streaming. However, existing algorithmic technology constrains their interactive capabilities and cannot entirely substitute for human abilities of empathy and emotional expression.

Recognizing the shortcomings of both human and AI livestreamers, VTubers—a new form of livestreamer that combines the attributes of both human and AI livestreamers—are gaining favor among brands and consumers. A VTuber is a digital character whose actions, expressions, and voice are controlled by a human^[5]. This innovative method of interaction not only overcomes the physical limitations of human livestreamers and their virtual images but also bridges the emotional communication gap between AI livestreamers and their human operators. With their distinctive allure and technological innovation, VTubers have achieved initial success in commercial applications. For example, Kizuna, a VTuber utilizing facial capture technology, has garnered over six million subscribers on YouTube. The advent of VTubers has diversified the types of livestreamers and changed the industry landscape of live streaming. However, despite their notable rise in commerce, scholars have overlooked the impact of these types on consumers. Current research primarily focuses on the influence of human livestreamers^[6] as well as the performance brought by AI livestreamers^[3,7]. Only a few case studies have identified the application of VTubers in commercial practices^[5,8], yet empirical research on how

VTubers affect consumer behavior remains scarce.

Concurrently, business practices have begun to explore collaborations between VTubers and humans to optimize the shopping experience for consumers. For instance, during the 2022 Nanjing International Consumer Festival live stream, collaboration between a human livestreamer and a VTuber emerged as a highlight, addressing the industry's dilemma of livestreamer homogenization and the sales growth challenges faced by businesses. In the academic realm, while research has underscored the synergistic benefits of integrating diverse types of employees^[9], the collaborative effects of multiple livestreamers in livestream settings lack thorough investigation, especially collaborations between humans and VTubers. Considering that selecting the appropriate live-streaming team can significantly increase sales, the gap between industrial applications and insufficient relevant research has created an urgent need for managers to seek effective theoretical and practical guidance when selecting VTubers and human livestreamers.

Therefore, grounded in source credibility theory (SCT)^[10], through a set of experiments, this study analyzes the impact of two different livestreamer collaboration types—"human-human" and "human-VTuber"—on consumers' purchase intention and their mediating mechanisms. Specifically, this research proposes and validates the following research questions: ① What are the differential effects of two livestreamer collaboration types, "human-human" and "human-VTuber", on consumers' purchase intention? ② What are the mediating roles of perceived attractiveness, perceived expertise, and perceived trustworthiness in the influence of livestreamer collaboration types on purchase intention?

The contributions of this study are as follows. First, the study focuses on the impact of different types of livestreamer collaboration on consumers' purchase intention and innovatively examines the emerging collaborative approach between VTubers and human livestreamers. Second, the study extends the application of SCT to explore the persuasive effects of nontraditional information sources, such as VTubers. It highlights the unique effects of integrating VTubers into multiperson live streaming scenarios and their potential influence on viewers' purchasing behavior. This provides theoretical support for merchants constructing livestreamer teams and improve the sales performance of live commerce.

The remainder of this paper is structured as follows. Section 2 reviews the relevant literature. Section 3 develops the hypotheses. Section 4 describes the methodology. Section 5 presents the results. Section 6 concludes with theoretical contributions, managerial implications, and research limitations.

2 Review and theoretical model

2.1 E-commerce livestreamers

E-commerce livestreamers are service providers in the live streaming industry^[11]. They introduce product features and usage, engage in real-time interactions with consumers, and offer personalized services^[6]. Currently, the market predominantly features three types of livestreamers: human, AI, and VTubers. As the e-commerce live streaming market

flourishes, the attributes and characteristics of livestreamers not only ensure consumer service experiences but also play a crucial role in driving consumer purchasing behavior^[12].

In the realm of e-commerce live streaming, human livestreamers, pioneers in the industry, possess qualities such as humor, expertise, warmth, passion, and credibility^[11,13], which is why they have remained the backbone of e-commerce live streaming. However, as consumers' demand for personalized experiences increases, traditional human livestreamers have begun to experience limitations. They may lack sufficient appeal due to ordinary appearances or homogenized live streaming skills^[11] or, upon gaining popularity, may encounter conflicts with companies over profit distribution^[14]. Additionally, such infractions as tax evasion can lead to their downfall^[15], subsequently tarnishing brand reputation and diminishing consumers' purchase intention^[16]. For brands, the unpredictability of human behavior inherent in human livestreamers leads to increased potential management costs^[3]. Meanwhile, AI livestreamers struggle to gain widespread adoption owing to the lack of interactivity, a core element of live streaming^[6].

Amid such industry challenges, the advent of VTubers has introduced a novel solution to the e-commerce live streaming domain. VTubers are digital characters that human operators control in real time through motion capture and facial devices^[15]. Their vibrant and novel personas cater to audiences' curiosity^[7]. Unlike human livestreamers, VTubers' virtual images are under the company's control, enabling them to mitigate incidents that could negatively impact the brand's reputation^[15]. Unlike AI livestreamers, the human operators behind VTubers can provide emotional engagement, offering a natural interactive experience^[8] and thereby stimulating user interest^[5]. VTubers merge the problem-solving skills of humans with the advantages of digital personas, enhancing consumer service experiences and purchase intention^[17].

Research has shown that curiosity, entertainment, and creativity are the main motivations for viewers to watch VTubers; VTubers exhibit rich media elements and social cues that foster interaction, such as fashionable clothing, appropriate backgrounds, and facial expressions; nevertheless, some users do not like the excessive uncanniness of VTubers^[5]. In recognition of this, scholars emphasize the importance of a comprehensive investigation into the impact of human-controlled virtual staff on consumer behavior and their transformative potential in the future of the service industry^[18]. However, technological limitations have led to a lack of research on VTubers, with only a few studies using interviews to investigate audience experiences^[5,8]. Existing research has not yet fully explored the impact of VTubers on consumers as well as the underlying reasons for this impact.

Given that VTubers' unique attributes can compensate for the shortcomings of human livestreamers, this study suggests that it is necessary to introduce VTubers in multistreamer live streaming scenarios to achieve optimal effectiveness through collaboration with diverse types of livestreamers.

2.2 Human-machine collaboration in marketing

Livestreamer collaboration refers to the joint efforts of two livestreamers within an e-commerce live streaming context,

who showcase products and collaborate closely on sales and service endeavors. This complementary collaboration model has attracted widespread attention in practice. However, this topic remains largely unexplored within academia.

In the field of marketing, scholars have focused more on studying human-machine collaboration. Existing studies have underscored the benefits of AI-human collaboration^[9], demonstrating that such partnerships can enhance consumers' positive attitudes toward technology^[19]. Moreover, the efficiency of human-machine cooperation has attracted a larger customer base^[20], displaying significant advantages over single service agents in service delivery. Assigning human and AI workers to distinct yet complementary roles can achieve an optimal combination of human-machine performance^[21]. Both academics and industry experts commonly believe that the most effective types of service provider cooperation often involve human-machine collaboration^[9].

While existing research has focused on the collaboration between humans and AI workers, the current body of work overlooks the potential impact of human-machine hybrids (e.g., VTubers) on collaborative outcomes. Only a few scholars have discovered through interviews that performances by multiple VTubers on a virtual stage can create an engaging viewing experience^[5]. In live streaming practice, an increasing number of businesses are employing VTubers alongside human livestreamers to form livestreamer teams, thereby breaking down barriers between livestreamers and offering consumers an innovative live shopping experience. Thus, inspired by the distinctive advantages of human-machine collaboration, this study—to the best of our knowledge—represents the first empirical investigation into the effects of livestreamer collaboration on consumers' purchase intention. By introducing VTubers into a human-machine collaborative scenario, this study aims to compare and analyze whether

collaboration between VTubers and humans is more effective than traditional cooperation among human livestreamers. This research also explores the impact mechanisms of different livestreamer combinations, significantly contributing to the field of human-machine collaborative research.

2.3 Source credibility theory (SCT)

Endorser research frequently applies SCT^[22]. This theory explicates how the attributes of the information source can engender psychological identification in individuals, thereby influencing their attitudes toward others^[23]. Ohanian^[10] posited three central dimensions of source credibility: attractiveness, expertise, and trustworthiness. These dimensions are crucial metrics for assessing persuasive effects and can impact purchasing intentions and attitudinal changes^[10,13]. This provides a theoretical foundation for evaluating the influence of livestreamer attributes on consumers' purchase intention in e-commerce live streaming.

In the context of e-commerce live streaming, livestreamers act as information sources and endorsers^[13], transmitting messages through real-time interactions with consumers, thereby enhancing the persuasiveness of product promotions^[6]. During the interaction process, livestreamers have the opportunities to showcase attributes such as attractiveness, expertise, and trustworthiness, which are key elements that constitute consumer purchasing decisions^[24].

In this light, the present study establishes a model diagram (as shown in Fig. 1) based on SCT. Within this model, the type of livestreamer collaboration (human-human vs. human-VTuber) is the information source, whose attributes (attractiveness, expertise, trustworthiness) can independently or collectively mediate the impact of livestreamer collaboration types on consumers' purchase intention.

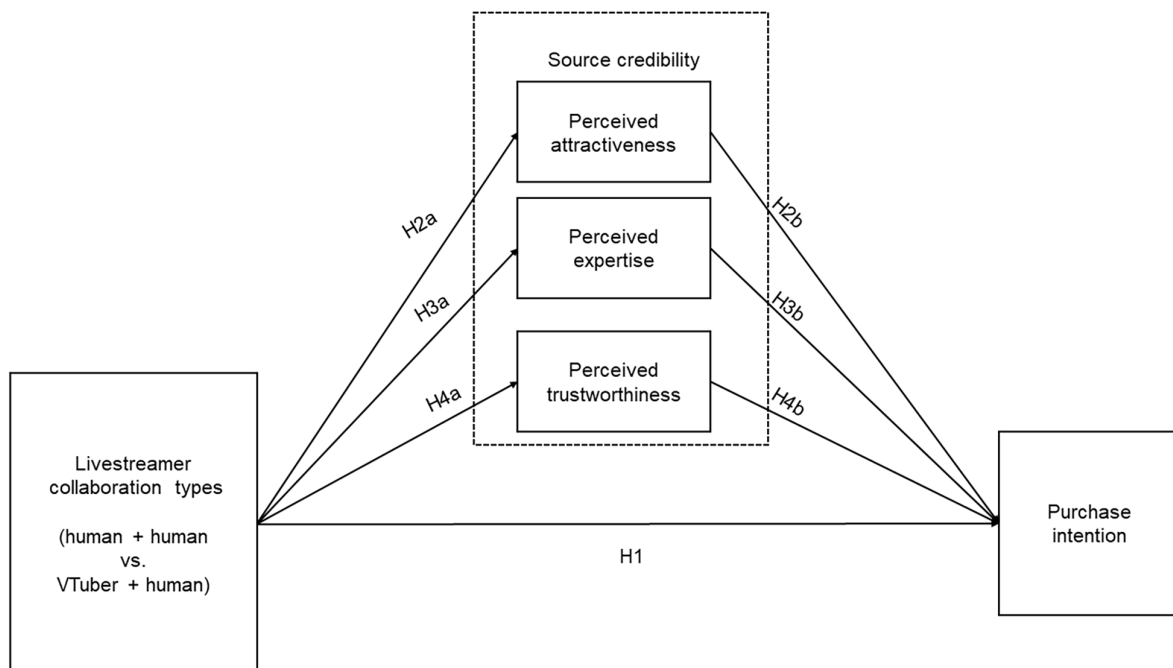


Fig. 1. Proposed model.

3 Hypothesis development

3.1 Main effect

Studies have indicated that virtual agents in online shopping enhance consumer satisfaction with retailers, thereby fostering stronger purchase intention^[25]. This is because such new technology has the potential to fulfill user needs by providing personalized services, heightening emotional engagement, and optimizing the shopping experience^[25].

As highly interactive virtual employees, VTubers positively impact the experiential value for viewers^[3], potentially bridging the psychological distance between consumers and virtual staff^[26]. This can lead to increased consumer satisfaction^[25]. Moreover, the highly anthropomorphized virtual image can stimulate impulsive purchasing behavior in consumers^[27]. Combining lifelike virtual representation with a human voice can establish a greater sense of trust in consumers, thereby elevating their purchase intention^[28]. Consequently, we propose the following hypothesis:

H1. Human-VTuber collaboration leads to a stronger purchase intention than human-human collaboration.

3.2 Mediation effects

3.2.1 Perceived attractiveness

Attractiveness refers to the physical appeal of the spokesperson^[29], as well as the degree of elegance, sexiness, and beauty^[30]. The attractiveness of a livestreamer acts as an important stimulant in the live commerce industry. An attractive livestreamer is akin to a charming performer, capable of arousing the audience's excitement and emotional uplift^[31], effectively altering attitudes^[30], and thereby enhancing sales-related outcomes^[32]. Attractiveness is a crucial factor influencing consumer purchasing behavior^[33]. Consumers tend to form positive impressions of attractive spokespersons^[30]; furthermore, the more appealing the information source is, the greater consumers' willingness to buy^[34].

The collaboration between a VTuber and a human livestreamer can create a novel viewing experience. The human livestreamer is responsible for the depth of content, while the VTuber enhances interactivity through its virtual persona, thus improving overall attractiveness. As the homogenization of e-commerce livestreamers gradually becomes prevalent, cultivating unique personal traits is an effective way for livestreamers to stand out and increase their attractiveness^[11]. Popularity is a significant advantage of VTubers^[35]; users who interact with popular VTubers perceive them as friendly and pleasant^[36]. Unlike traditional human livestreamers with a fixed appearance, VTubers can customize various styles of virtual personas to serve as hedonic elements that increase the entertainment value for consumers and satisfy the desire for personalization, thereby boosting attractiveness^[37].

Furthermore, when humans wearing motion-capture suits control VTubers, the latter attain a high degree of behavioral realism, allowing consumers to experience emotional value that enhances the service experience during the shopping process^[38]. Additionally, this technology leads consumers to believe that they are interacting with another entity that

possesses social attributes^[15]. The human operator exhibiting empathy can help reduce interaction uncertainties and increase the sense of social presence^[39], thereby augmenting attractiveness. The anthropomorphic qualities and audiovisual features of VTubers are crucial for reinforcing their attractiveness^[40]. The unique interactive experience of VTubers suggests that human-VTuber collaborations have greater attractiveness than collaborations consisting solely of human livestreamers. Thus, we propose the following hypotheses:

H2a. Human-VTuber collaboration leads to greater perceived attractiveness than human-human collaboration.

H2b. Perceived attractiveness mediates the relationship between livestreamer collaboration types and purchase intention.

3.2.2 Perceived expertise

Expertise is the extent to which a person is experienced and knowledgeable^[30]. Livestreamers with strong professional abilities can enhance audiences' attitude and purchase intention^[41]. Livestreamers communicate with audiences in real time, answer questions, and provide product information. When audience members perceive livestreamers' expertise, they easily become immersed, thereby promoting a quasisocial interactive experience^[42]. Most studies have found that expertise significantly impacts purchase intention^[10,41].

Compared to human-human collaboration, when a VTuber collaborates with a human livestreamer, the human can utilize his or her knowledge and experience to showcase his or her expertise, while the VTuber allows consumers to experience virtual technology, offering high-quality services through the human operator behind the scenes. This combination of human capabilities and digital technology will likely enhance overall professionalism. Research indicates that through precise motion-capture equipment, VTubers accurately replicate human movements, and their highly anthropomorphic behavior exceeds consumer expectations for traditional virtual employees^[43]. When virtual employees display behaviors indistinguishable from those of humans, they are not only virtual entities but also intelligent and reliable conveyors of information, leading to heightened consumer evaluations of their professionalism^[44].

Moreover, the virtual image of a VTuber enables personalized service. Consumers may feel that the information they receive is tailor-made for them, and this customized experience further strengthens the perceived professionalism of the service^[38]. The higher the anthropomorphism level of virtual images, the more likely consumers are to attribute capabilities and expertise to them^[45], with these factors collectively exerting positive influences on consumers' purchasing and persuasion processes^[25]. Accordingly, we propose the following hypotheses:

H3a. Human-VTuber collaboration leads to higher-level of perceived expertise than human-human collaboration.

H3b. Perceived expertise mediates the relationship between livestreamer collaboration types and purchase intention.

3.2.3 Perceived trustworthiness

Trustworthiness encompasses perceptions of honesty,

credibility, and integrity^[30]. Given the uncertainties of online shopping, a credible livestreamer can assure product quality and share honest insights about products^[11]. Trustworthiness can influence others' beliefs, attitudes, and behaviors^[10], positively affecting persuasion^[46]. A series of studies has shown that livestreamers' trustworthiness positively impacts purchase intention^[13,47].

VTubers have a dual impact on source credibility. While anthropomorphic design increases trust in VTubers as virtual employees^[48], it also introduces potential risks. Scholars have found that consumers generally have less trust in virtual staff^[15]. In contrast, consumers attribute their trust in human livestreamers to authenticity^[11]. The presence of human livestreamers provides stability and authority; customers may think that human livestreamers who show their faces are less likely to commit fraud. Although collaborations between VTubers and humans also include human endorsements, traditional human-human collaborations have an edge in terms of trustworthiness. Thus, we propose the following hypotheses:

H4a. Human-human collaboration leads to higher-level perceived trustworthiness than human-VTuber collaboration.

H4b. Perceived trustworthiness mediates the relationship between livestreamer collaboration types and purchase intention.

4 Methodology

4.1 Experimental materials

To test the research hypotheses, this study crafted a sales dialog set against the backdrop of e-commerce live streaming, wherein two livestreamers collaborate to promote products. Considering the importance of interactive functions in live streaming services, the dialog included not only product explanations but also content for interactive engagement with audiences via the chat feature. Therefore, the dialog would replicate a genuine e-commerce live streaming scenario, and we enlisted four industry experts' participation in the dialog-creation process.

We intentionally omitted price information from the dialog to enable it to serve as a controlled variable in the study. Additionally, to minimize the impact of varying product

preferences, we selected apples, a widely popular product, as the item for sale. We also managed the script length for both livestreamers to within five characters to prevent service time from affecting consumer perception and repeatedly measured their speaking speed to maintain consistency in live streaming duration. Moreover, the gender of the livestreamers was standardized to male.

Subsequently, we recruited two volunteers to record the experimental videos. Based on the prearranged dialog, they recorded two sets of videos, each lasting 80 s, which demonstrated the complete live sales process. Regarding the independent variable (collaboration types), the first set of videos depicted collaboration between two human livestreamers, while the second set featured collaboration between a human livestreamer and a VTuber (see Fig. 2).

Finally, we conducted a pretest to ensure that participants could accurately differentiate between types of livestreamers. We selected thirty subjects (15 men and 15 women) at random and divided them into two groups for the test. The results indicated that all participants could correctly identify the distinction between human livestreamers and VTubers, confirming the successful manipulation of our independent variable. Thus, we deemed the experimental materials suitable for subsequent formal research.

4.2 Procedure

We conducted an online experiment to collect the data. We embedded the experimental videos into an online questionnaire and recruited participants through the Wenjuanxing (SurveyMars) platform. During the data collection process, we directed participants to a webpage where they first answered the following question: "Have you ever watched e-commerce live streaming?" This served as a screening question aimed at selecting individuals with experience watching e-commerce live streaming; those without such experience were not included in the subsequent research. Then, we randomly assigned participants with e-commerce live streaming experience to one of two groups to watch the experimental videos. To ensure that participants focused on the viewing, a timer on the webpage was set to match the duration of the video.

After watching the video, the participants had to answer a series of questions to assess their ability to correctly identify

Grouping	Livestreamer on the left	Livestreamer on the right	Screenshot of the experiment screen
1	Human	Human	
2	Human	VTuber	

Fig. 2. Experimental grouping.

the type of livestreamers. For example, “Is the voice of the livestreamer on the left a real person’s voice or AI-synthesized?” and “Is the appearance of the livestreamer on the left real or virtual?” Participants who answered incorrectly were excluded as invalid samples. We used a binary approach to test the classification accuracy based on the livestreamers’ visual and vocal characteristics. The results indicated that participants could correctly recognize different types of livestreamers, thus validating the success of our experimental manipulation.

Next, we employed scales to measure participants’ perceptions of the attractiveness, expertise, and trustworthiness of the livestreamers in the videos, as well as participants’ purchase intention. To ensure the authenticity of the responses, we included lie-detection questions throughout the survey.

Finally, we collected participant demographic information. Previous research has shown that gender, age, educational background, income, and frequency of watching live shopping may influence consumers’ purchase intention^[49]. Therefore, during the analysis process, we included these variables as control variables.

4.3 Sample

We distributed a total of 280 questionnaires. After excluding invalid samples that lacked e-commerce live streaming experience or failed the survey deception-detection questions, we ultimately retained 240 valid questionnaires, resulting in an effective response rate of 85.7%. Table 1 presents the participants’ demographic information. According to the data analysis on the characteristics of Chinese virtual livestreamer

Table 1. Demographic information.

Variable	Category	Frequency	Percentage
Gender	Male	115	47.9%
	Female	125	52.1%
Age	18–24	50	20.8%
	25–30	76	31.7%
	31–35	66	27.5%
	36–40	24	10.0%
	Above 40	24	10.0%
Education	High school or below	9	3.8%
	Junior college	19	7.9%
	Undergraduate	182	75.8%
	Postgraduate or above	30	12.5%
Monthly income	5000 CNY or below	58	24.2%
	5001–10000 CNY	109	45.4%
	10001–15000 CNY	50	20.8%
	More than 15000 CNY	23	9.6%
Frequency of watching e-commerce live streaming	Less than once a week	17	7.1%
	1–2 times a week	81	33.8%
	3–4 times a week	88	36.7%
	5–6 times a week	27	11.3%
	At least once a day	27	11.3%

audience released by iMedia Consulting in 2023^[50], the major audience of virtual livestreamers falls within the 22-to-40-year-old age bracket. Participants within this age range account for 90% of our sample, demonstrating the good representativeness of the collected data.

4.4 Measures

We adopted well-established scales from prior literature for our measurements. Specifically, drawing from the source credibility literature, we employed the scale developed by Yuan et al.^[22] to measure perceived attractiveness, the scale from Wu et al.^[51] to assess perceived expertise, and the scale from Ohanian^[10] to gauge perceived trustworthiness. Additionally, we adapted the scale for purchase intention from live-shopping studies of Chen et al.^[52] and Zhang et al.^[47] to better fit the research scenario of this study. Participants rated each item using a five-point Likert scale, with scores ranging from 1 (strongly disagree) to 5 (strongly agree).

5 Results

5.1 Reliability and validity

We utilized Amos 25.0 software to assess the reliability of the scales. As shown in Table 2, all item factor loadings were above 0.7. Along with the Cronbach’s α values for each variable, the composite reliabilities (CRs) exceeded 0.8, indicating a high level of internal consistency and structural reliability of the scales. The data— $\chi^2/df = 1.265$, RMSEA = 0.033, GFI = 0.941, TLI = 0.982, and CFI = 0.985—suggested an overall satisfactory model fit.

Furthermore, the average variance extracted (AVE) for each factor was greater than 0.55, demonstrating that the scales possessed good convergent validity. Moreover, as presented in Table 3, the square root of the AVE for each

Table 2. Loading, construct reliability, and validity results.

Variables	Items	Loadings	Cronbach’s α	AVE	CR
Perceived attractiveness	AT1	0.799	0.867	0.5672	0.8674
	AT2	0.724			
	AT3	0.744			
	AT4	0.766			
	AT5	0.730			
Perceived expertise	EX1	0.810	0.846	0.5796	0.8463
	EX2	0.729			
	EX3	0.751			
	EX4	0.753			
Perceived trustworthiness	TW1	0.713	0.835	0.5605	0.8359
	TW2	0.738			
	TW3	0.775			
	TW4	0.767			
Purchase intention	PI1	0.834	0.852	0.6615	0.8542
	PI2	0.782			
	PI3	0.823			

AVE: average variance extracted; CR: composite reliability.

Table 3. Discriminant validity.

Variables	Perceived attractiveness	Perceived expertise	Perceived trustworthiness	Purchase intention
Perceived attractiveness	0.753			
Perceived expertise	0.543	0.761		
Perceived trustworthiness	0.241	0.337	0.749	
Purchase intention	0.454	0.540	0.392	0.813

Numbers in bold on the diagonal indicate the square root of the AVE, and numbers within the diagonal are correlation coefficients.

factor was greater than the correlation values, indicating that each latent variable had good discriminant validity.

5.2 Hypotheses examination

We performed independent samples *t* tests using SPSS to compare the purchase intention of the two types of collaborations (see Fig. 3). The results aligned with our hypothesized expectations. The purchase intention for human–VTuber collaboration was significantly greater than that for human–human collaboration ($M_{\text{human-VTuber}} = 4.1500$, $SD = 0.7306$; $M_{\text{human-human}} = 3.7944$, $SD = 0.7336$, $t(238) = 3.762$, $p < 0.001$). Thus, Hypothesis H1 is supported. Subsequently, we compared the perceived source credibility of the two collaborative types. The findings indicated that human–VTuber collaboration had significantly greater perceived attractiveness

than human–human collaboration ($M_{\text{human-VTuber}} = 4.1030$, $SD = 0.5166$; $M_{\text{human-human}} = 3.7670$, $SD = 0.7592$, $t(238) = 4.016$, $p < 0.001$). Similarly, human–VTuber collaboration had significantly greater perceived expertise than human–human collaboration ($M_{\text{human-VTuber}} = 4.2479$, $SD = 0.5954$; $M_{\text{human-human}} = 3.9438$, $SD = 0.6661$, $t(238) = 3.729$, $p < 0.001$), supporting Hypotheses H2a and H3a.

However, in terms of perceived trustworthiness, there was no significant difference between the two types of collaboration ($M_{\text{human-VTuber}} = 4.1479$, $SD = 0.6478$; $M_{\text{human-human}} = 4.0708$, $SD = 0.5337$, $t(238) = 1.006$, $p > 0.05$), failing to support Hypothesis H4a.

5.3 Mediation analysis

Next, we employed the PROCESS macro to test the mediating effects of source credibility on purchase intention while controlling for demographic variables. We selected a sample size of 5000 with a 95% confidence interval. The mediation analysis results are presented in Table 4, revealing that perceived attractiveness mediates the relationship between livestreamer collaboration type and purchase intention ($\beta = 0.1407$, $CI = [0.0648, 0.2323]$, which does not include zero), supporting hypothesis H2b. Perceived expertise also mediates the relationship between livestreamer collaboration type and purchase intention ($\beta = 0.1503$, $CI = [0.0506, 0.2666]$, which does not include zero), supporting hypothesis H3b. However, perceived trustworthiness does not mediate the relationship between collaboration type and purchase intention

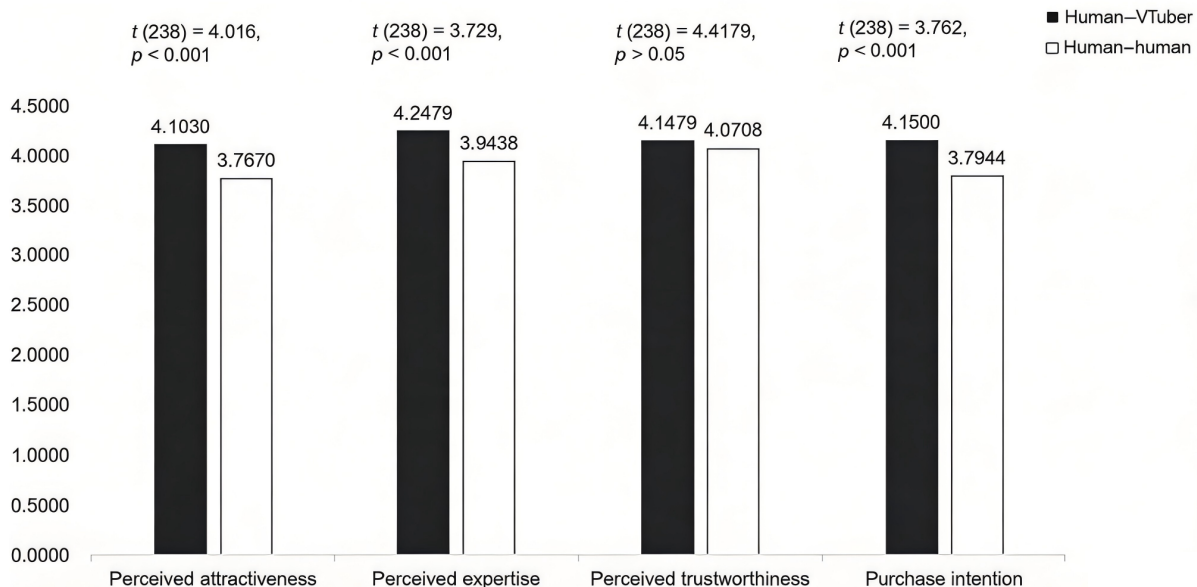


Fig. 3. Results of the independent sample *t* test.

Table 4. Mediating-effect results (PROCESS macro, 95% CI).

The path of mediation effect	Direct effect	95% CI		Indirect effect	95% CI	
		BootLLCI	BootULCI		BootLLCI	BootULCI
Collaboration types→ Perceived attractiveness→ Purchase intention	0.2563	0.0690	0.4437	0.1407	0.0648	0.2323
Collaboration types→ Perceived expertise→ Purchase intention	0.2467	0.0681	0.4253	0.1503	0.0506	0.2666
Collaboration types→ Perceived trustworthiness→ Purchase intention	0.3582	0.1772	0.5392	0.0388	−0.0340	0.1147

($\beta = 0.0388$, $CI = [-0.0340, 0.1147]$, which includes zero); therefore, hypothesis H4b was not supported.

6 Conclusions

6.1 Theoretical contributions

This study examines how two types of livestreamer collaboration (human-human vs. human-VTuber) differentially affect consumers' purchase intention. We conduct lab experiments to compare the two configurations and to test the mediating roles of perceived attractiveness, perceived expertise, and perceived trustworthiness.

First, our study identified significant differences in consumer perceptions of attributes and purchase intention toward various types of livestreamer collaborations. Specifically, we found that the perceived attractiveness, perceived expertise, and purchase intention were greater for "human-VTuber" collaborations than for "human-human" collaboration. This may be attributable to the novel image of VTubers and their unique interactive experience, which results in greater appeal. It also suggests that as technology advances, expertise can be demonstrated not only by human practitioners but also by virtual agents. Despite VTubers becoming a dominant force in livestream commerce, scholars have overlooked the unique attributes of VTubers and the impact of their collaborative types. As one of the pioneering empirical studies on VTuber collaboration with other livestreamers, our research underscores the distinctive value of VTubers and enriches the literature on human-machine collaboration.

Second, our study revealed no significant differences between the two types of livestreamer collaboration in terms of perceived trustworthiness. This may be because real humans ultimately drive both VTubers and human livestreamers; allowing consumers to sense this authenticity endows VTubers with an endorsement efficacy equal to that of humans. Other studies have reached comparable conclusions, demonstrating that human-machine collaboration can reduce uncertainty in the product recommendation process^[53]. In our research, collaboration between VTubers and human livestreamers effectively mitigates potential trust issues. This finding challenges the conventional notion that virtual personas cannot establish the same sense of trust as real humans, thereby offering new insights into trust-building mechanisms, which are crucial for understanding the role of VTubers in e-commerce.

Finally, we discovered the mediating role of source credibility. Specifically, perceived attractiveness and perceived expertise played a mediating role between livestreamer collaboration and consumers' purchase intention, while the mediating effect of perceived trustworthiness was not significant. This finding indicates that attractiveness and expertise are key factors in explaining why human-VTuber collaboration is more effective at promoting purchase behavior than traditional human-livestreamer collaboration. By applying SCT to the context of VTuber live streaming, our study extends the application of the theory, uncovering the potential persuasive enhancement effects of nontraditional information sources on consumers and offering new insights into consumer behavior when confronting emerging technologies.

6.2 Managerial implications

Our study revealed that introducing VTubers into multi-streamer live streaming scenarios can serve as an effective strategy for improving sales. As the market for livestreamers becomes increasingly saturated and homogenized, standing out in competition and enhancing sales has become a significant challenge for merchants. Our findings indicate that compared to traditional all-human livestreamer teams, a collaborative model incorporating both humans and VTubers can more effectively enhance consumers' willingness to purchase. We have proposed a novel marketing paradigm and suggested that merchants should consider breaking away from conventional livestreamer team configurations by actively integrating VTubers as team members, thereby creating a unique shopping experience and increasing market competitiveness.

Second, despite concerns about the credibility of virtual staff in the industry, our research revealed that when VTubers collaborate with human livestreamers, they can achieve the same high level of trust as traditional human-human collaboration. This finding indicates that in the digital age, non-traditional mediums can effectively convey a sense of trustworthiness. This offers businesses a novel solution, i.e., partnering virtual staff with human livestreamers to tap into new market spaces.

Finally, this study revealed the unique attributes of VTubers in collaborative streaming scenarios. In the current traffic-driven market environment, the collaboration between VTubers and human livestreamers creates a fresh interactive experience that can effectively draw more attention, thereby bringing businesses more potential customers. We suggest that businesses pay attention to the unique allure of VTubers and design more interactive segments in live streams to increase consumer exposure to VTubers, thereby enhancing participation and sale conversion rates.

6.3 Limitations and future research

This study selected apples as the product for live streaming sales, which may limit our ability to generalize across different product categories. However, this also raises an intriguing topic regarding the match between virtual spokespersons and various product types. Future research could further investigate which categories of products—including tech-related products and fashion merchandise—are better suited for VTuber-based endorsement.

Additionally, this study did not address the types of collaboration involving AI livestreamers. This was due to current technological limitations that result in AI livestreamers lacking the interactivity that e-commerce live streaming requires. Nevertheless, the development of advanced AI models has enhanced the potential of AI livestreamers. Future studies could consider incorporating AI livestreamers with advanced interactive capabilities into collaborative scenarios to assess their effectiveness.

Finally, our findings offer a snapshot that reflects the phenomena under investigation at a specific point in time. Future research could employ a longitudinal study design to track and assess changes in consumer behavior over time. Moreover, as our study is grounded in China's cultural context, we encourage future researchers to conduct similar

studies in different cultural contexts to further test and refine our findings.

Conflict of interest

The authors declare that they have no conflict of interest.

Biographies

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