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Shaping and Optimizing the Image of Virtual City Spokespersons Based on Factor Analysis and Entropy Weight Methodology: A Cross-Sectional Study from China

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Abstract: With the continuous development of digital technology, the widespread use of virtual spokespersons to promote city images is becoming increasingly prevalent. This study responds to this trend by employing a factor analysis and entropy weight methodology to explore the different dimensions and priorities in shaping the image of virtual city spokespersons in China. The aim is to offer insights into the design strategies and directions for shaping the image of virtual city spokespersons. For the research, we first conducted a literature review and semi-structured interviews to investigate the requirements of users in mainland China and Hong Kong regarding the image shaping of virtual city spokespersons. Building upon this groundwork, a questionnaire was designed and distributed, and it successfully gathered 512 valid responses. Subsequently, a factor analysis was utilized to identify eight key dimensions in shaping the images of Chinese virtual city spokespersons: "Design elements", "Anthropomorphism", "Evolutionary", "Emotionalization", "Narrativity", "Culturalism", "Interactivity", and "Reliability". Then, the entropy weighting method was applied to analyze the weights of each indicator within these dimensions. The results revealed that "Design elements" have the highest priority in shaping the image of virtual city spokespersons, followed by "Anthropomorphism", "Emotionalization", "Evolutionary", "Culturalism", "Narrativity", "Reliability", and "Interactivity". Based on these findings, a series of design optimization strategies are proposed, including but not limited to shaping visually appealing images aligned with user perceptions, establishing emotional connections with users, and meeting the functional experience needs of users. These strategies not only contribute to the image shaping of virtual city spokespersons, but also provide vital guidance for innovative directions in promoting the publicity and marketing of Chinese cities.

Keywords: virtual spokesperson; city image; image shaping; factor analysis; entropy weighting

Citation: Chen, J.; Pan, L.; Zhou, R.; Jiang, Q. Shaping and Optimizing the Image of Virtual City Spokespersons Based on Factor Analysis and Entropy Weight Methodology: A Cross-Sectional Study from China. *Systems* **2024**, *12*, 44. https://doi.org/10.3390/systems12020044

Academic Editors: Carlos de las Heras-Pedrosa, Francisco Javier Paniagua-Rojano and Dolores Rando-Cueto

Received: 13 December 2023
Revised: 25 January 2024
Accepted: 26 January 2024
Published: 29 January 2024

1. Introduction

City image is considered an asset for enhancing competitive advantage in the context of globalization [1], and the digital sector brings significant opportunities for city promotion and marketing [2–4]. Particularly under the influence of the Internet revolution, the city image, influenced by urban communication, holds numerous innovative prospects in city marketing and positioning. Given that users often struggle to form impressions of city images without actual experiences, the interactive functionality of online multimedia adds a fresh dimension to city image promotion and advertising [5]. Compared to traditional promotional methods, digital technology enables city images to gain visibility on a global scale. Through various media channels such as social media, websites, and popular applications, the city's culture and distinctive features can be effectively disseminated, attracting a broader audience [6]. With the continuous development and updates in virtual technology, how city image is communicated undergoes constant innovation, providing users with novel experiences [7]. Virtual spokespersons have emerged as pioneers in

disseminating city images [8]. Cities can not only avoid the potential negative impacts associated with real human endorsements by utilizing virtual spokespersons [9], but they can also break through temporal and spatial limitations and reduce costs in the form of virtual spokespersons [10,11]. Virtual spokespersons are gradually becoming a crucial means for innovatively conveying city images.

Virtual city spokespersons are defined as fictitious characters with distinct personalities, strategically chosen or designed by businesses to achieve profit-oriented goals such as brand promotion or product marketing intentions [12–15]. Many scholars define virtual spokespersons as nonhuman characters, including animals, fictional figures, etc. These anthropomorphized visual images are specifically created for selling products or services and are utilized to promote products or brands [8,10,13,14,16–20]. They can symbolically convey the attributes, benefits, or personalities of a brand [21], and even the corporate image [22,23]. However, virtual spokespersons are not merely prominent symbols of brands or products; they should also convey deeper content, such as cultural values, personalities, and brand connotations [16,21,24–26]. As a significant intangible and tangible asset [27], virtual spokespersons have made substantial contributions to the development of cities. The subject of this study is virtual city spokespersons, which we define as virtual humans specifically designed for the promotion and publicity of a particular city or region. These virtual city spokespersons promote the city's cultural and spiritual essence by attracting user attention and engaging in positive interactions, thereby fostering the city's visibility and image.

City image is an interpretation of a series of adjectives describing a city [28], and it is spontaneously associated with specific stimuli (physical and social) that continuously trigger a series of associations in individuals, forming what is known as "City image [29]". The chain or network of associations established by stimuli accumulated over time shapes the image of the city's material entity [30], including elements such as roads, boundaries, areas, nodes, and landmarks initially reflecting the city's appearance and features [31]. As time progresses, the city image evolves beyond the limitations of the city's material entities. It increasingly manifests as a cognitive image of creative content reaching the psychological aspects of the masses, including peoples' perceptions of the city's emotions, culture, history, society, and other city-related aspects [32]. This becomes a fundamental prerequisite for establishing and better understanding the direct or indirect relationships between different target groups' perceptions of the city [30]. In this process, virtual spokespersons play an irreplaceable role in the construction and dissemination of the city's image. Therefore, shaping an outstanding virtual city spokesperson is deemed essential [8].

Currently, academia widely recognizes the importance of virtual spokespersons in the communication of city images [8,33]. Some existing cases of virtual spokespersons [34] have revealed issues such as a lack of awareness and the failure to convey the distinctiveness and culture of a city [8,33]. These problems have, to some extent, hindered the dissemination of city image. Therefore, there is an urgent need to create outstanding virtual city spokespersons to facilitate the communication of city images and meet the development of cities.

Although many studies have focused on the image shaping of virtual spokespersons [17,21,35–39] and proposed relevant design principles, few have comprehensively explored the importance of each element in shaping the image of virtual city spokespersons. Therefore, this study aims to provide a reliable directional reference for the design of virtual city spokespersons by using a factor analysis and entropy weighting method to deeply analyze the shaping requirements.

The value of this research lies in its in-depth analysis of the requirements of virtual spokespersons in the communication of city images, clarifying the importance of different factors in the shaping of virtual city spokespersons. Through the factor analysis and the entropy weighting method, we have established weights for these factors, assisting designers in determining the priority options in shaping the image of city virtual spokespersons. We

hope that this research can leverage the roles of virtual spokespersons in the communication of city images, further promoting the positive dissemination of city images.

2. Research Status

With the advancement of digital media technology, virtual spokespersons have become a focal point of research [16,40–44]. Renowned experts and scholars have extensively studied virtual spokespersons over the past few decades.

2.1. Spokespersons

Spokespersons are specialized individuals employed by enterprises or organizations to disseminate information to achieve their objectives. Their mission is to leverage the influence of spokespersons to convey a positive brand image, shaping the attitudes and emotions of the advertising audience [45]. When selecting spokespeople, several factors are deemed crucial, including the individual qualities of the spokesperson, such as their reputation, credibility, and charisma [46].

Spokespersons can be categorized into four types: celebrities, experts, typical consumers, and high-level executives within organizations [47]. If the primary goal of advertising is to enhance consumer awareness of a product, the use of celebrities proves most effective [47]. Celebrities, with their extensive recognition, possess a unique influence [48], while experts lend their professional knowledge and skills to endorse brands or products [49]. Typical consumers represent the voices and attitudes of the general public [50]. As business leaders, CEOs bring an authoritative influence, persuading consumers, and are thus included in the spokesperson category [47]. In addition to these categories, third-party endorsements are gaining prominence, including evaluation institutions and professional organizations. These third-party entities, with their objectivity and expertise, serve as brand endorsers, providing consumers with independent and objective information that influences their purchasing decisions [51].

Celebrities exhibit significant effectiveness as spokespersons, primarily because consumers universally perceive them as trustworthy, reliable, persuasive, and popular [52]. Adopting a celebrity endorsement strategy not only helps in establishing and maintaining consumer attention to advertising and products [53], but also allows advertisements to stand out in the complex information environment by eliminating unnecessary noise during the communication process, enhancing communication effectiveness [54].

However, utilizing real human spokespersons is a double-edged sword [55]. Negative information about celebrities attracts more attention than positive information and is more likely to be remembered [56]. When real human spokespersons begin to face various negative issues or when consumers dispute the statements or actions of these spokespersons, the products or brands they endorse will also be adversely affected [57]. To mitigate potential risks, virtual spokespersons are gradually being integrated into the realm of spokespersons [58].

2.2. Virtual Spokespersons

From an object perspective, virtual spokespersons can be categorized into cartoon characters and virtually real individuals. In terms of quantity, virtual spokespersons can be divided into single-character endorsements and multiple-character endorsements. Additionally, considering the ownership perspective, virtual spokespersons can be categorized as proprietary character spokespersons and authorized spokespersons. Compared to other forms of advertising, virtual spokespersons play a positive role in influencing consumer brand preferences [59]. This is because virtual spokespersons not only earn consumers' trust but also effectively stimulate purchasing desires [13]. Simultaneously, virtual spokespersons can alter consumer choices regarding brands, aiding in brand management [24]. The use of virtual spokespersons in advertising brings about more positive advertising effects, including attitudes toward advertisements, brand attitudes, and the willingness to purchase the brand [60].

To clarify the concept of virtual spokespersons, we meticulously distinguish terms such as spokespersons, virtual representatives, spokes characters, and virtual humans. Figure 1 illustrates the relationships among these concepts.

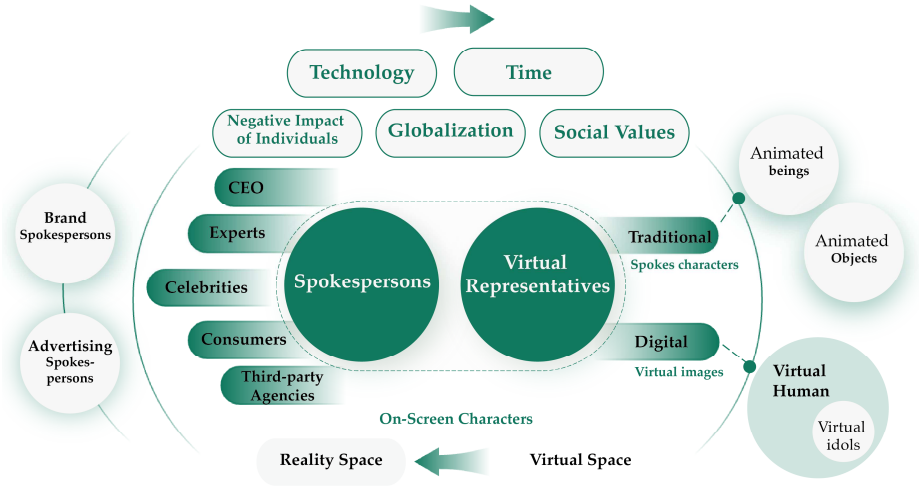

Figure 1. Distinction and connection between virtual spokesperson concepts.

A spokesperson is a tangible individual representing a particular group or organization. Spokespersons encompass a variety of categories, including but not limited to celebrity endorsements, expert endorsements [61], top-level management of enterprises [49], consumer advocates [50], and some third-party endorsement agencies [51]. Among them, brand spokespersons are the most common. They are individuals hired by a brand to convey consistent information about the company to the public [61]. When they appear in marketing videos or advertisements, they are referred to as advertising spokespersons [62].

Virtual representatives can be classified into traditional spokes characters and digital virtual images [63]. In traditional spokes characters, the characters are usually played by animated characters or objects [12,13], used for promoting products, services, or ideas. As representatives of digital virtual images, virtual humans are three-dimensional models generated by simulating the structure of real human bodies using virtual reality technology [64]. Virtual idols, like typical virtual humans, are virtual entities that perform on virtual stages or in real scenes using Internet technology [65].

Real (human) spokespersons focus on shaping their image in the reality space, primarily being applied in traditional media such as television and print advertising. With advances in digital media technology, virtual representatives, virtual characters, and virtual humans emphasize the establishment of an image in virtual spaces, presented as on-screen characters through social media and networks.

Compared to traditional city spokespersons, virtual city spokespersons exhibit significant advantages. Firstly, virtual city spokespersons are typically created by city officials or relevant institutions, better reflecting the city's image. Secondly, virtual city spokespersons, not being real individuals, avoid the negative issues that real persons might face, such as moral controversies or unethical behaviors, effectively maintaining the positive image of the city. Thirdly, the production and maintenance of virtual city spokespersons are relatively economical, significantly reducing the costs of advertising and promotion [66]. Fourthly, the image and content of virtual city spokespersons can be flexibly adjusted according to the development needs of the city [67]. Finally, and most importantly, virtual city spokespersons can establish emotional connections with users, transferring the users' fondness, identification, and support for virtual personas to the city itself, helping to build positive emotions and a sense of belonging to the city among the public [58].

Overall, the official, controllable, low-cost, flexible, and malleable nature of virtual city spokespersons constitutes unique attributes that traditional city spokespersons cannot

replace, providing an effective means for garnering greater attention and recognition in the competitive development of cities.

2.3. Characteristics of Virtual Spokespersons

In the digital age, the shaping of city virtual spokespersons can draw upon the design experiences of other categories of virtual spokespersons. Consequently, researchers have conducted an in-depth analysis of the characteristics of virtual spokespersons, laying the groundwork for shaping the image of virtual city spokespersons.

Research indicates that three characteristics of virtual spokespersons—relevance, professionalism, and cuteness [16,24,68,69]—have become crucial criteria for evaluating virtual spokespersons [39]. When designing virtual spokespersons, it is essential to adhere to the principle of relevance, closely integrating the brand's values, historical background, and brand culture with the virtual spokespersons to maximize advertising effectiveness [10,16,17,27,39,70]. Simultaneously, attention should be given to the professionalism of the virtual spokespersons, ensuring that they possess knowledge and skills in design [10,16,17,24,39,71]. To emphasize the cuteness of the virtual spokespersons, popular animation languages can be combined to improve their cuteness [17], as spokespersons with specific motions and sounds can leave a lasting impression on consumers [72].

Additionally, factors such as the likability [68], anthropomorphic image design [17], humanized functionality [21], and interaction between consumers and virtual spokespersons [10] significantly influence the image shaping of virtual spokespersons [73,74]. The design of virtual spokespersons can also focus on five aspects: creating a complete character image, aligning with youthful esthetics, emphasizing costume design, drawing inspiration from animated characters, and highlighting specific talents [17]. Importantly, virtual spokespersons should not only represent contemporary trends but should also reflect traditional culture and values [34]. In the digital age, the shaping of virtual spokespersons must leverage modern technology, including virtual technologies such as VR, AR, etc., by matching images and sounds that align with the characteristics of the times and incorporating digital storylines to present the inner essence of virtual spokespersons [75,76]. These standards, principles, and recommendations hold significant reference value and inspiration for shaping the image of city virtual spokespersons.

2.4. Review of Research

Current research on virtual spokespersons predominantly encompasses two dimensions: research content and research methods. In terms of research content, the focus is primarily on the characteristics of virtual spokespersons.

Diverging from real human spokespersons, virtual spokespersons possess distinctive features and potential applications. Serving as representatives for products or services, virtual spokespersons exhibit a distinct personality and consistent appearance [77]. Their uniqueness lies in extending the product lifecycle, reducing costs, shaping brand characteristics, and enhancing controllability [10]. Virtual spokespersons are unaffected by consumer behavior or speech [78], enabling customers to easily form brand associations through their images. Moreover, virtual spokespersons aid in alleviating the normalization of visual experiences, contributing to the establishment of brand uniqueness and the enhancement of the consumer experience [34]. On another note, research has also explored the impact of certain characteristics of virtual spokespersons on consumer purchasing intentions [19,20,79–81], advertising effectiveness [24,35], brand awareness [60], and brand recognition [82].

In terms of research methods, scholars have presented various tools and techniques to conduct in-depth research on the different directions of virtual spokespersons. Some studies conduct literature reviews to analyze papers related to the characteristics of virtual spokespersons, aiming for a more comprehensive and accurate understanding of these characteristics [17]. Other research, like adopting empirical research, employs in-depth interviews and qualitative analyses to comprehend the impact of virtual spokesperson characteristics on consumer brand attitudes [16]. Additionally, there are studies utilizing

models and data to explore the socioeconomics of virtual spokespersons on the construction and dissemination of city images [8].

While existing research has provided valuable insights into virtual spokespersons, our observation reveals a predominant focus on exploring virtual spokespersons from the perspective of management studies. There is a noticeable scarcity of attention from the field of design in shaping the image of virtual city spokespersons. Additionally, factors influencing the image shaping of virtual spokespersons may be affected by developments in digital media technology, the passage of time, globalized communication, and potential negative impacts from real human endorsements. Consequently, these factors may not universally apply to the image shaping of virtual city spokespersons, and even if they are considered relevant, their importance in the context of city image promotion may vary significantly.

Therefore, our study raises pivotal questions: how do we shape virtual city spokespersons, and how can these elements be distributed in shaping the image of virtual city spokespersons? To address these questions, this research initiates a literature review, summarizing the existing factors influencing the image shaping of virtual spokespersons, as presented in Table 1. The diverse characteristics derived from the literature review assist in elucidating that beyond the factors, an examination of specific user segments and their corresponding concerns and preferences regarding shaping the image of virtual city spokespersons is imperative. This insight forms the foundational basis for our research framework. Next, based on the sequence of shaping the image of virtual city spokespersons and the actual situation in the city image dissemination process, this study consolidates and categorizes elements from the literature and experiments based on their importance. The aim is to provide more targeted and professional guidance, thereby facilitating the image shaping of virtual city spokespersons.

Table 1. Factors influencing the shaping of virtual spokespersons.

No.	Projects	References
1	I believe that the virtual spokespersons look very cute.	[68]
2	I think the virtual spokespersons are humorous and interesting.	[68]
3	I feel the virtual spokespersons look like experts.	[16,27,68]
4	I think the virtual spokespersons are experienced.	[16,27,68]
5	I perceive the virtual spokespersons are knowledgeable.	[16,27,68]
6	I think the virtual spokespersons look very capable.	[16,27,68]
7	I think the virtual spokespersons look very skilled.	[16,27,68]
8	It is appropriate for a virtual spokesperson to endorse this brand.	[16,69]
9	Generally, I believe that the virtual spokespersons match the brand's product.	[16,69]
10	I think the virtual spokespersons are like good friends.	[83–85]
11	I find the virtual spokespersons to be quite familiar and relatable.	[83–85]
12	To highlight the likability of virtual spokespersons, we can combine popular animation languages to improve the cuteness of virtual endorsers.	[17]
13	It is necessary to first have a complete human form of virtual spokespersons.	[17]
14	The shape of virtual spokespersons should conform to the esthetic taste of young people.	[17]
15	The costume design of the virtual spokespersons is also relatively elegant.	[17]
16	Some animation images that have appeared in the past can be selected to design the virtual spokespersons, which can arouse emotional resonance.	[17]
17	I have a sense that the virtual spokespersons can perceive and understand my thoughts.	[83–85]
18	Virtual spokesperson's Ren appears placid, harmonious, benevolent, domestic, and sweet.	[86]

Table 1. *Cont.*

No.	Projects	References
19	Virtual spokesperson's Zhi appears professional, authoritative, trustworthy, leadership, sedate, expert, mature, responsible, rigorous, innovative, and literate.	[86]
20	Virtual spokesperson's Yong appears majestic, rugged, strong, decisive, and brave.	[86]
21	Virtual spokesperson's Ya appears elegant, romantic, tasteful, decent, style, and charming.	[86]
22	Virtual spokesperson's Le appears joyous, auspicious, optimistic, and confident.	[86]
23	Virtual spokespersons have a human-like appearance and activities.	[87]
24	Virtual spokespersons are based on real human beings.	[38]
25	Virtual spokespersons can have some humanized functions and interact with consumers.	[10,21]
26	Virtual spokespersons should highlight traditional culture and values.	[34]
27	Virtual spokespersons should have storylines.	[75,76]

3. Methodology

3.1. Research Framework

The overall research framework of this study is illustrated in Figure 2, primarily consisting of three stages: semi-structured interviews, questionnaire survey, and data analysis.

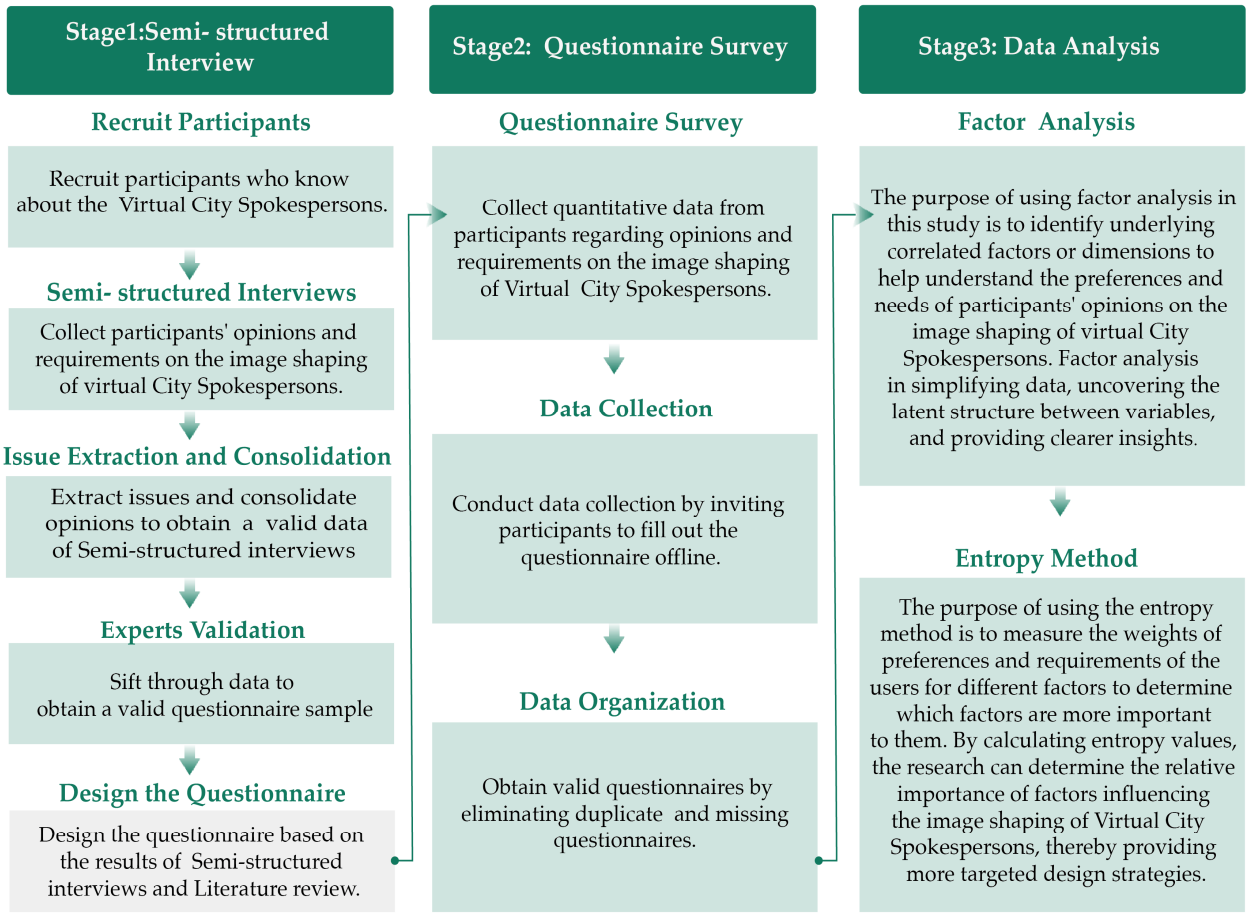

Figure 2. Overall research framework.

The first phase involves collecting qualitative data through semi-structured interviews to gain in-depth insights into participants' opinions and preferences regarding the shaping of virtual city spokespersons. Subsequently, we will organize the collected data through

question extraction and consolidation. The literature review and semi-structured interview data will be merged, and an expert validation will be conducted to refine and prioritize the set of questions (questions marked in blue in Table 1 represent those retained after expert selection).

The second phase consists of a questionnaire survey designed based on the extracted and integrated questions from the interviews and literature review. The questionnaire includes basic participant information (such as gender and age) and test items related to virtual city spokespersons. Participants will use Likert scales to quantitatively rate these items. This phase also involves data collection and cleansing.

The final phase entails data analysis using statistical techniques. Factor analysis will be employed to explore potential factors influencing the image shaping of virtual city spokespersons. Additionally, the entropy method will be utilized to determine the relative importance of these variables. The results obtained from the analysis will be interpreted to form the basis for the conclusions and recommendations of this study.

3.2. Semi-Structured Interviews

Semi-structured interviews serve as a pivotal method for collecting key data in this study. We invited 30 ordinary participants from cities including Beijing, Shanghai, Wuxi, and Hong Kong, as well as 10 experts with relevant research backgrounds. The aim is to gain in-depth insights into their viewpoints and requirements regarding the shaping of virtual city spokespersons. Subsequently, the design, implementation, and analysis process of the semi-structured interviews will be detailed. Relevant information about the interviewees can be found in Tables 2 and 3.

Table 2. Information of ordinary participants.

Sociodemographic Variables	Category	Number
Gender	Man	13
	Woman	17
Age	18–25	6
	26–34	16
	35–54	5
	Over 55	3
Education	High school or technical secondary school and below	2
	Undergraduate or junior college	10
	Graduate and above	18
Occupation	Student	10
	Product manger	6
	Designer	11
	Others	3

Table 3. Information of experts.

No.	Gender	Age	Occupation	Years in Profession
1	Woman	48	Visual culture and communication	25
2	Man	48	Digital media design	26
3	Man	54	Visual communication design	30
4	Man	49	Digital media design	24
5	Man	46	Virtual reality interaction	22
6	Man	42	Visual communication design	18
7	Women	52	Visual communication design	29
8	Woman	37	Visual communication design	9
9	Man	35	User experience	10
10	Man	32	Visual communication design	8

3.2.1. Interview Design

In the design of the semi-structured interviews, we initially clarified the research objective, which is to understand users' requirements and viewpoints on the shaping of virtual city spokespersons. Key steps in the design phase included the selection of target interviewees and the formulation of the interview guide. Our target interviewees were individuals with a familiarity with virtual spokespersons (even if they already had some knowledge, we still invited them to watch some videos related to virtual city spokespersons), aiming to gather robust opinions regarding their design requirements. Simultaneously, we crafted an interview guide containing a series of open-ended questions designed to guide the interviewees in discussing their views and experiences with city virtual spokespersons. The specific guide can be found in Table 4.

Table 4. Semi-structured interview guide.

No.	Questions
1	What are your views on virtual city spokespersons?
2	What are your impressions of the visual characteristics of the virtual city spokespersons?
3	What specific characteristics and qualities do you think a city's virtual spokesperson should possess?
4	Are you familiar with the stories of virtual city spokespersons?
5	What aspects do you think need to be improved in the image shaping of virtual city spokespersons?

3.2.2. Interview Implementation

Semi-structured interviews were conducted to obtain information through in-depth conversations with the interviewees. The implementation phase includes the following steps:

1. Face-to-face interviews: We engaged in face-to-face communication with participants or conducted interviews through remote communication tools such as video calls, depending on the geographical location and convenience of the participants. Face-to-face interviews provided more nonverbal information, while remote interviews allowed for interaction with interviewees from different locations.
2. Open-ended question guidance: At the beginning of the interview, we used open-ended questions to guide the conversation. These questions encouraged interviewees to freely express their opinions and experiences, for example: "What are your views on the virtual city spokespersons?" or "What role do you think the virtual city spokespersons play in urban development?"
3. Probing and in-depth exploration: Based on the interviewee's answers, we used probing questions or an in-depth exploration of specific topics to obtain more detailed information. This helped clarify viewpoints, unearth deeper perspectives, and ensured the comprehensiveness of the interviews.

3.2.3. Interview Analysis

Following the data collection through interviews, we transcribed the recorded sessions and utilized a content analysis to process this data. The specific steps involved the following:

1. Coding and categorization: We coded the transcribed text, categorizing different themes and viewpoints. These codes and categories were based on the participants' answers, reflecting their relevant opinions and perspectives on the image shaping of virtual city spokespersons.
2. Pattern recognition: We invited three graduate students unrelated to this study to identify recurring themes and viewpoints. This helped uncover the commonalities and differences among various conclusions, contributing to the identification of key findings and trends.

3. Data interpretation: We interpreted the results of the analysis to understand participants' feedback, identify their main viewpoints, and provide guidance for subsequent questionnaire design and data analysis.

Semi-structured interviews are a crucial method in this study, providing valuable insights. This method not only assists in a deeper comprehension of participants' perspectives, but also establishes the foundation for subsequent questionnaire design and data analysis. Ethical considerations, ensuring participant privacy and informed consent, were thoroughly taken into account during the application of this method.

3.3. Questionnaire Survey

As a crucial data collection method in this study, the questionnaire survey aims to obtain quantitative data about virtual city spokespersons, reflecting users' opinions. Based on the results and concept extraction from the semi-structured interviews and literature review, we constructed the final questionnaire. The questionnaire comprises two sections: the first part includes basic information about the participants (such as gender and age), and the second part consists of 8 dimensions with 26 test items, primarily representing users' concerns and expectations of virtual city spokespersons. The specific content is outlined in Table 5. Each test item employs a Likert seven-point scale, with scores ranging from 1 (strongly disagree) to 7 (strongly agree).

Table 5. Test items of questionnaire.

No.	Test Items	Sources
Q1	Materials for virtual city spokespersons should aim to create a realistic look and feel.	[17]
Q2	The body proportions of virtual city spokespersons should be coordinated and consistent with esthetic standards.	[17]
Q3	The appearance of a virtual city spokesperson could be based on a real person.	[38]
Q4	The personality of virtual city spokespersons should be friendly.	[83–85]
Q5	The behavior of virtual city agents could mimic human activities.	[87]
Q6	Virtual city spokespersons could undergo ongoing physiological maturation.	[86]
Q7	Virtual city spokespersons should understand the emotional needs of different groups.	[83–85]
Q8	The narrative of the virtual city spokesperson should be fresh.	[75,76]
Q9	Virtual city spokespersons could promote and disseminate the city's traditional culture.	[34]
Q10	Virtual city spokespersons should convey the cultural values and spirit of the city.	[34]
Q11	Virtual city speakers should have interactive Q&A capabilities.	[10,21]
Q12	Virtual city spokespersons should have professional knowledge related to the city.	[16,27,68]
Q13	Virtual city spokespersons should have the ability to convey information accurately.	[16,27,68]
Q14	The appearance of the virtual city spokesperson should match the characteristics of the city to gain recognition.	Interview
Q15	Virtual city representatives should adapt to both dynamic and static environments.	Interview
Q16	The color choice of the virtual city spokesperson should reflect the city's characteristics and traditions.	Interview
Q17	The choice of language for a virtual city spokesperson may involve the use of a local dialect.	Interview
Q18	Virtual city spokespersons should gradually develop psychologically and cognitively.	Interview
Q19	Virtual city spokespersons should continually develop and improve their capabilities within their area of expertise.	Interview
Q20	Virtual city speakers can express emotions through facial expressions, tone of voice, and movement.	Interview

Table 5. *Cont.*

No.	Test Items	Sources
Q21	Virtual city spokespersons should have good communication skills.	Interview
Q22	The narrative of the virtual city spokesperson should be related to the history and memory of the city.	Interview
Q23	The story of a virtual city spokesperson should resonate with a specific group of people.	Interview
Q24	Virtual city spokespersons can embody the cultural elements, symbols, and meanings of the city.	Interview
Q25	Virtual city spokespersons can interact through various media channels.	Interview
Q26	Virtual city spokespersons may consider providing links to resources for public information.	Interview

4. Data Analysis

4.1. Descriptive Statistics

The questionnaire survey for this study was conducted from June 2023 to November 2023. We conducted the survey online, and the basic information of the participants is presented in Table 6. Participants were invited to complete the questionnaire. (We asked if they were familiar with virtual spokespersons, and if they had obtained any detailed information about virtual spokespersons from the Internet, including images and videos. Only participants who indicated a familiarity with virtual spokespersons and obtained information from the Internet were included in the survey. This also included participants who had heard about virtual spokespersons but did not have a complete understanding). All participants filled out informed consent forms, and we paid the corresponding testing fee after the questionnaire. We received a total of 630 responses, and after excluding the invalid responses (which included trap questions with different answers and some samples with missing answers), the final sample size was 512, approaching 20 times the number of analysis items (26). This sample size meets the requirements for a structural equation modeling (SEM) analysis [88].

Table 6. The basic information of questionnaire participants.

Sample	Category	Percentage
Gender	Man	47.270%
	Woman	52.730%
Age	Below 18	5.660%
	18–25	36.330%
	26–30	39.260%
	31–40	5.660%
	41–50	4.690%
	51–60	5.660%
	Over 60	2.730%
Education	Secondary school and below	5.270%
	High school or technical secondary school	16.020%
	Junior college	33.590%
	Undergraduate	31.840%
	Graduate and above	13.280%
City	First-tier cities	46.876%
	Second-tier cities	38.671%
	Third-tier cities	14.453%

4.2. Exploratory Factor Analysis

This study employed an exploratory factor analysis to investigate the relevant viewpoints on the shaping of virtual city spokespersons, aiming to identify the potential relationships among measurement items.

A total of 512 valid samples were considered in the factor analysis, and the sample size met the applicable standards for conducting a factor analysis [89,90].

Firstly, a Kaiser–Meyer–Olkin (KMO) test was conducted, with the result indicating a KMO value of 0.988. Bartlett's test of sphericity produced an approximate chi-square of 11,917.618, with 325 degrees of freedom (df) and a significance level of 0.000. This demonstrates that the correlation of the sample is suitable for the factor analysis, providing support for exploring the research questions. In the factor analysis presented in Table 7, we extracted eight factors with eigenvalues of 3.397, 3.012, 2.714, 2.633, 2.454, 2.4, 2.332, and 1.716, respectively. The rotated variances explained by these factors were 13.065%, 11.584%, 10.438%, 10.128%, 9.438%, 9.231%, 8.968%, and 6.6%. The total cumulative variance explained reached 79.452%. Further details can be found in Table 8.

Table 7. Variance explanation rates.

Factor Number	Variance Explanation Rates before Rotation			Variance Explanation Rates after Rotation		
	Eigenvalue	Variance Explanation Rates %	Cumulative %	Eigenvalue	Variance Explanation Rates %	Cumulative %
Factor 1	16.889	64.957	64.957	3.397	13.065	13.065
Factor 2	0.684	2.631	67.588	3.012	11.584	24.649
Factor 3	0.619	2.380	69.967	2.714	10.438	35.087
Factor 4	0.555	2.133	72.100	2.633	10.128	45.215
Factor 5	0.535	2.058	74.158	2.454	9.438	54.653
Factor 6	0.473	1.821	75.979	2.400	9.231	63.884
Factor 7	0.464	1.784	77.762	2.332	8.968	72.852
Factor 8	0.441	1.698	79.460	1.716	6.600	79.452

Furthermore, we evaluated the internal consistency of the overall scale through Cronbach's α coefficient. The result showed a Cronbach's α coefficient of 0.979 for the entire scale, indicating an excellent internal consistency among the test items [91].

4.3. Confirmatory Factor Analysis

A confirmatory factor analysis (CFA) was employed in this study as a tool to assess the test model, ensuring its validity and discriminant validity. The aim was to evaluate the relationships between the factors and test items, ensuring an adequate degree of connection among them. Additionally, we calculated the average variance extracted (AVE) for each factor and further assessed the differences between the factors. Moreover, we observed the values of composite reliability (CR) to further evaluate the model's fit.

In Table 9, we summarized the results of the factor loading coefficients, which demonstrate the strength of the association between the test items and their corresponding factors. We found that all standardized loading coefficients were greater than 0.6 [92,93], indicating a significant correlation between the test items and their corresponding factors. Additionally, the AVE values were all above 0.5 [94], and the CR values were all above 0.8, confirming the internal consistency of the test items within each factor [95]. Therefore, the results indicate that the test model has sufficient validity and discrimination overall. We validated the discriminant validity between factors by examining the square root of the AVE values in Table 10. The diagonal in the table represents the square root of the AVE, while the other entries represent correlation coefficients.

Table 8. Factor loading coefficients after rotation.

Encoding	Factor Loading Coefficients								Commonality
	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8	
Q14	0.459	0.217	0.18	0.362	0.317	0.188	0.224	0.373	0.747
Q1	0.575	0.269	0.268	0.224	0.222	0.31	0.169	0.278	0.776
Q15	0.677	0.306	0.254	0.135	0.199	0.234	0.256	0.111	0.807
Q2	0.68	0.218	0.257	0.25	0.265	0.125	0.289	0.121	0.822
Q16	0.611	0.217	0.262	0.344	0.211	0.217	0.132	0.271	0.789
Q3	0.287	0.48	0.215	0.205	0.285	0.235	0.278	0.357	0.743
Q4	0.234	0.615	0.236	0.258	0.286	0.137	0.178	0.328	0.795
Q5	0.225	0.652	0.305	0.198	0.213	0.221	0.259	0.13	0.787
Q17	0.303	0.695	0.235	0.272	0.189	0.236	0.151	0.097	0.828
Q6	0.268	0.354	0.235	0.563	0.129	0.26	0.309	0.138	0.77
Q18	0.277	0.23	0.233	0.63	0.247	0.232	0.166	0.253	0.787
Q19	0.231	0.246	0.256	0.676	0.243	0.244	0.198	0.13	0.811
Q20	0.217	0.171	0.7	0.205	0.288	0.142	0.164	0.294	0.825
Q21	0.259	0.333	0.67	0.203	0.184	0.254	0.129	0.101	0.793
Q7	0.305	0.259	0.649	0.24	0.119	0.197	0.3	0.089	0.789
Q8	0.238	0.272	0.224	0.215	0.268	0.656	0.103	0.328	0.848
Q22	0.289	0.246	0.197	0.326	0.288	0.54	0.296	0.099	0.762
Q23	0.231	0.209	0.275	0.299	0.199	0.623	0.316	0.125	0.805
Q24	0.263	0.261	0.186	0.256	0.531	0.302	0.35	0.172	0.762
Q9	0.261	0.241	0.257	0.224	0.682	0.208	0.233	0.185	0.839
Q10	0.337	0.304	0.25	0.216	0.605	0.31	0.169	0.118	0.82
Q11	0.247	0.345	0.239	0.162	0.15	0.32	0.393	0.494	0.787
Q25	0.307	0.232	0.27	0.297	0.221	0.248	0.234	0.585	0.817
Q12	0.291	0.247	0.279	0.19	0.231	0.297	0.616	0.182	0.815
Q13	0.371	0.25	0.209	0.269	0.226	0.255	0.552	0.156	0.762
Q26	0.227	0.217	0.217	0.301	0.394	0.098	0.543	0.279	0.774

Note: darker colors indicate higher values.

Table 9. Factor loading coefficients.

Latent Variable	Encoding	Unstandardized Factor Loadings	Standard Error	CR	*p*	Standardized Factor Loadings	AVE	CR
Factor 1	Q14	1.000	-	-	-	0.827	0.699	0.921
	Q1	1.062	0.045	23.849	0.000	0.851		
	Q15	0.975	0.043	22.536	0.000	0.821		
	Q2	1.035	0.044	23.348	0.000	0.840		
	Q16	1.060	0.045	23.410	0.000	0.841		
Factor 2	Q3	1.000	-	-	-	0.839	0.690	0.899
	Q4	0.979	0.042	23.413	0.000	0.834		
	Q5	0.971	0.042	22.903	0.000	0.822		
	Q17	0.970	0.042	23.132	0.000	0.827		
Factor 3	Q6	1.000	-	-	-	0.831	0.682	0.865
	Q18	0.989	0.044	22.538	0.000	0.825		
	Q19	0.996	0.045	22.334	0.000	0.821		
Factor 4	Q20	1.000	-	-	-	0.808	0.667	0.858
	Q21	1.006	0.048	20.935	0.000	0.820		
	Q7	1.022	0.049	21.022	0.000	0.823		
Factor 5	Q8	1.000	-	-	-	0.826	0.689	0.869
	Q22	1.049	0.046	22.824	0.000	0.836		
	Q23	1.027	0.046	22.472	0.000	0.828		

Table 9. *Cont.*

Latent Variable	Encoding	Unstandardized Factor Loadings	Standard Error	CR	*p*	Standardized Factor Loadings	AVE	CR
Factor 6	Q24	1.000	-	-	-	0.843	0.715	0.883
	Q9	1.033	0.044	23.742	0.000	0.839		
	Q10	1.031	0.042	24.499	0.000	0.855		
Factor 7	Q11	1.000	-	-	-	0.832	0.702	0.825
	Q25	1.026	0.044	23.276	0.000	0.843		
Factor 8	Q12	1.000	-	-	-	0.840	0.682	0.865
	Q13	1.010	0.043	23.379	0.000	0.831		
	Q26	0.945	0.043	22.233	0.000	0.806		

Table 10. Discriminant validity test results.

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8
Factor 1	**0.836**							
Factor 2	0.829	**0.831**						
Factor 3	0.821	0.806	**0.826**					
Factor 4	0.793	0.788	0.759	**0.817**				
Factor 5	0.81	0.799	0.81	0.752	**0.83**			
Factor 6	0.827	0.809	0.79	0.752	0.81	**0.846**		
Factor 7	0.805	0.797	0.775	0.743	0.785	0.777	**0.838**	
Factor 8	0.835	0.808	0.797	0.76	0.809	0.82	0.795	**0.826**

Note: the bold numbers along the diagonal represent the square roots of the Average Variance Extracted (AVE) values for each construct; darker colors indicate higher values.

These data indicate that the correlation coefficients between factors are significantly lower than the square root of the AVE, suggesting a substantial distinction between the factors [94]. The results of the confirmatory factor analysis consolidate our model and validate the effectiveness and discriminant validity between test items and factors.

4.4. Entropy Method

In this study, we first determined the weights of the subindicators under different dimensions by calculating the weight coefficients for each dimension. These weight coefficients were normalized after the rotated variance explanation rate. We calculated the weight coefficients for Factor 1 to Factor 8, which are 0.1644, 0.1458, 0.1314, 0.1275, 0.1188, 0.1162, 0.1129, and 0.0831, respectively. These weight coefficients play a crucial role in the entropy calculation method.

To achieve this, we applied the entropy method to consider the weights of a total of 26 secondary indicators across various dimensions. In the calculation process outlined below, X'ij represents the value of the j-th indicator of the i-th sample, n denotes the sample size, and m represents the number of indicators, based on the data normalization Formula (1), indicator weight calculation Formula (2), indicator entropy calculation Formula (3), indicator difference coefficient calculation Formula (4), and indicator weight calculation Formula (5). We obtained the entropy value e_j, difference coefficient g_j, and indicator weight W_j for the subindicators under each dimension. Finally, the product of the weight coefficients for each dimension and corresponding subindicator was considered as the final weight of each indicator. Detailed data can be found in Tables 11 and 12.

$$X'_{ij} = \frac{x_{ij} - min(x_{1j}, x_{2j} \ldots, x_{nj})}{max(x_{1j}, x_{2j} \ldots, x_{nj}) - min(x_{1j}, x_{2j} \ldots, x_{nj})} \quad (1)$$

$$P_{ij} = \frac{X'_{ij}}{\sum_{i=1}^{n} X'_{ij}}, (i = 1, 2, 3 \ldots, n, j = 1, 2, 3 \ldots, m) \quad (2)$$

$$e_j = -k\sum_{i=1}^{n} P_{ij} ln(P_{ij}), k > 0, k = \frac{1}{ln(n)}, e_j \geq 0 \quad (3)$$

$$g_j = 1 - e_j \quad (4)$$

$$W_j = \frac{g_j}{\sum_{j=1}^{m} g_j} \quad (5)$$

Table 11. Summary of calculation results using entropy weight method.

	Items	Entropy	Discriminant Coefficient	Weight Coefficient
Factor 1	Q14	0.9837	0.0163	0.1917
	Q1	0.9819	0.0181	0.2123
	Q15	0.9842	0.0158	0.1859
	Q2	0.9823	0.0177	0.2085
	Q16	0.9828	0.0172	0.2015
Factor 2	Q3	0.9824	0.0176	0.2567
	Q4	0.9828	0.0172	0.2514
	Q5	0.9833	0.0167	0.2437
	Q17	0.9830	0.0170	0.2481
Factor 3	Q6	0.9846	0.0154	0.3179
	Q18	0.9838	0.0162	0.3362
	Q19	0.9833	0.0167	0.3459
Factor 4	Q20	0.9827	0.0173	0.3404
	Q21	0.9832	0.0168	0.3314
	Q7	0.9833	0.0167	0.3282
Factor 5	Q8	0.9829	0.0171	0.3228
	Q22	0.9817	0.0183	0.3461
	Q23	0.9825	0.0175	0.3311
Factor 6	Q24	0.9840	0.0160	0.3205
	Q9	0.9828	0.0172	0.3446
	Q10	0.9833	0.0167	0.3349
Factor 7	Q11	0.9838	0.0162	0.3280
	Q25	0.9828	0.0172	0.3472
Factor 8	Q12	0.9839	0.0161	0.3248
	Q13	0.9826	0.0174	0.5140
	Q26	0.9836	0.0164	0.4860

Table 12. Final weighted results.

Primary Indicator		Secondary Indicator		Final Weight
Factor 1	0.1644	Q14	0.1917	0.0315
		Q1	0.2123	0.0349
		Q15	0.1859	0.0306
		Q2	0.2085	0.0343
		Q16	0.2015	0.0331
Factor 2	0.1458	Q3	0.2567	0.0374
		Q4	0.2514	0.0367
		Q5	0.2437	0.0355
		Q17	0.2481	0.0362
Factor 3	0.1314	Q6	0.3179	0.0418
		Q18	0.3362	0.0442
		Q19	0.3459	0.0455

Table 12. *Cont.*

Primary Indicator		Secondary Indicator		Final Weight
Factor 4	0.1275	Q20	0.3404	0.0434
		Q21	0.3314	0.0423
		Q7	0.3282	0.0418
Factor 5	0.1188	Q8	0.3228	0.0383
		Q22	0.3461	0.0411
		Q23	0.3311	0.0393
Factor 6	0.1162	Q24	0.3205	0.0372
		Q9	0.3446	0.0400
		Q10	0.3349	0.0389
Factor 7	0.1129	Q11	0.3280	0.0370
		Q25	0.3472	0.0392
Factor 8	0.0831	Q12	0.3248	0.0367
		Q13	0.5140	0.0427
		Q26	0.4860	0.0404

5. Discussion

Through the factor analysis and confirmatory factor analysis, this study elucidated eight primary factors in shaping the image of the virtual city spokespersons. These factors encompass three main aspects: visual, emotional, and functional dimensions, reflecting the primary concerns of users in the image shaping of virtual city spokespersons. Simultaneously, the confirmatory factor analysis indicates the association of these factors with various indicators and the discriminant validity between them.

5.1. Visual Aspects of Virtual City Spokespersons

Factor 1, named "Design Elements", comprises a set of items such as Q14 (the appearance of the virtual city spokesperson should match the characteristics of the city to gain recognition), Q1 (materials for virtual city spokespersons should aim to create a realistic look and feel), Q15 (virtual city representatives should adapt to both dynamic and static environments), Q2 (the body proportions of virtual city spokespersons should be coordinated and consistent with esthetic standards), and Q16 (the color choice of the virtual city spokesperson should reflect the city's characteristics and traditions). This factor might relate to the users' visual perceptions [96]. Vision plays a crucial role in information acquisition [97], acting as an initial factory processing physical objects and organizing them into meaningful visual images, concepts [98,99], and design elements including materials, shapes, colors, etc. [100]. Research has found that humans have significant abilities in perceiving materials, not only recognizing and categorizing them but also presenting unique and diverse visual phenomena [101–103]. Visual perception also involves recognizing the direction, depth, and surface curvature in object shapes, as well as understanding the potential roles represented by shapes [104]. Moreover, the color tone, saturation, and brightness are also specific visual perceptions [105]. Therefore, design elements are closely tied to visual perception and serve as crucial factors influencing visual images. For instance, a virtual city spokesperson lacking uniqueness might struggle to be remembered and identified, while one with an unrealistic feel may make users feel distant. A virtual city spokesperson with body proportions that do not meet esthetic standards may make users feel uncoordinated.

In response to the factor "design elements", the design strategy for virtual city spokespersons should focus on "material", "proportion", and "color" to better meet the users' visual perception needs. The choice of material for virtual city spokespersons should achieve a more realistic appearance and tactile sensation. The proportions of the body should be coordinated and meet esthetic standards. Meanwhile, the color selection should be comfortable and perceptible to users. The appearance should integrate with city charac-

teristics, creating a unique recognizability, and the presentation should not be limited to static environments but should also adapt to dynamic environments.

In summary, by considering the above factors comprehensively, the design objective is to create a virtual city spokesperson with high recognizability in line with the users' visual perceptions.

5.2. Emotional Aspects of Virtual City Spokespersons

Factor 2, named "Anthropomorphism", includes a series of items such as Q3 (the appearance of a virtual city spokesperson could be based on a real person), Q4 (the personality of virtual city spokespersons should be friendly), Q5 (the behavior of virtual city agents could mimic human activities), and Q17 (the choice of language for a virtual city spokesperson may involve the use of a local dialect). Factor 3, labeled "Evolutionary", comprises items like Q6 (virtual city spokespersons could undergo ongoing physiological maturation), Q18 (virtual city spokespersons should gradually develop psychologically and cognitively), and Q19 (virtual city spokespersons should continually develop and improve their capabilities within their area of expertise). Factor 4, named "Emotionalization", includes items such as Q21 (virtual city spokespersons should have good communication skills) and Q7 (virtual city spokespersons should understand the emotional needs of different groups). Factor 5, termed "Narrativity", comprises items like Q20 (virtual city speakers can express emotions through facial expressions, tone of voice, and movement), Q22 (the narrative of the virtual city spokesperson should be related to the history and memory of the city), and Q23 (the story of a virtual city spokesperson should resonate with a specific group of people). Factor 6, named "Culturalism", consists of items such as Q24 (virtual city spokespersons can embody the cultural elements, symbols, and meanings of the city), Q9 (virtual city spokespersons could promote and disseminate the city's traditional culture), and Q10 (virtual city spokespersons should convey the cultural values and spirit of the city). These factors are likely related to the users' emotional experiences as emotions are increasingly becoming a sensitive requirement in design [106]. Anthropomorphism refers to endowing nonhuman objects with emotional characteristics so that users can better understand the object, as people unconsciously derive emotional stability from things similar to themselves [107]. There is a complex and interesting relationship between narrativity and user emotions [108], and engaging stories have the power to motivate, evoke emotions, change behavior, and inspire self-reflection [109]. Additionally, users have a more accurate recognition of emotional contexts in a similar cultural background [110]. Therefore, the relationships of "Anthropomorphism", "Emotionalization", "Narrativity", and "Culturalism" with the users' emotional perceptions are crucial. For instance, virtual city spokespersons in the form of anime characters may fail to create a sense of closeness with users, while those lacking narrativity and cultural connotations may not evoke an emotional resonance and memory in users.

The key to shaping the emotional aspects of virtual city spokespersons lies in the "Anthropomorphism" design, where the appearance of the virtual city spokesperson should consider using real humans as a reference and their personality should be affable. Factors like "Emotionalization" and "Evolutionary" involve understanding the emotional needs of different groups and possessing good communication skills. Physiological features can mature over time, and psychological and cognitive levels can gradually improve. Factors like "Culturalism" and "Narrativity" involve promoting and propagating the traditional culture of the city, conveying the cultural values and spirit of the city, and creating stories related to the city's history and memory that possess the trait of resonating with certain groups.

Overall, the design objective is to ensure that virtual city spokespersons can evoke an emotional resonance, enhancing the emotional connection between users and the virtual city spokespersons.

5.3. Function Aspects of Virtual City Spokespersons

Factor 7 is named "Interactivity", and includes items such as Q11 (virtual city speakers should have interactive Q&A capabilities) and Q25 (virtual city spokespersons can interact through various media channels). Factor 8 is named "Reliability", and includes items such as Q12 (virtual city spokespersons should have professional knowledge related to the city), Q13 (virtual city spokespersons should have the ability to convey information accurately), and Q26 (virtual city spokespersons may consider providing links to resources for public information). These two factors may be related to the users' functional experiences, as the user experience emphasizes the users' attention to functional needs [111]. For example, if a virtual city spokesperson lacks interactive functionality, it may reduce the users' sense of participation and experience, making it difficult for users to evaluate and provide feedback to the virtual city spokesperson through interaction. Therefore, in the functional shaping of virtual city spokespersons, it is necessary to consider how they interact and engage with the external environment. Additionally, it is crucial to assess what users perceive through these virtual city spokespersons.

In designing the functionality of virtual city spokespersons, we first consider the "Reliability" factor. The spokesperson should provide users with accurate information and possess professional knowledge and skills related to the city. This ensures that the information is reliable and provides public resource information through links. In the "Interactivity" factor, virtual city spokespersons can be equipped with precise Q&A interactive functions to address the users' basic questions and meet their functional needs. Additionally, virtual city spokespersons can actively interact with users on various media platforms, participate in discussions, and increase their engagement and influence.

To sum up, by considering the above factors comprehensively, the design goal is to establish a connection between virtual city spokespersons and external users, fostering a sense of trust in users and satisfying their experiential needs for the functionality of virtual city spokespersons.

5.4. Priority in Shaping

According to the analysis results of the entropy method, the weights of the eight factors in the first-level indicators are as follows: 0.1644 (design elements), 0.1458 (anthropomorphism), 0.1314 (emotionalization), 0.1275 (evolutionary), 0.1188 (culturalism), 0.1162 (narrativity), 0.1129 (reliability), and 0.0831 (interactivity). Therefore, in the process of shaping the image of virtual city spokespersons, attention should primarily be directed towards "Design Elements", followed by "Anthropomorphism", "Emotionalization", "Evolutionary", "Culturalism", "Narrativity", and finally, "Reliability" and "Interactivity". These factors involve the visual, emotional, and functional aspects of virtual city spokespersons and can be used as a sequence for user research and design.

Furthermore, the weight results provide useful information. The indicator with the highest weight is Q7, reaching 0.0455. Subsequently, the weights for Q21, Q6, Q11, Q18, Q19, Q20, Q9, Q25, and Q22 are 0.0442, 0.0434, 0.0427, 0.0423, 0.0418, 0.0418, 0.0411, 0.0404, and 0.0400, respectively. Following these are Q10, Q13, Q23, Q24, Q3, Q8, Q12, Q26, Q4, Q17, and Q5, with weights of 0.0393, 0.0392, 0.0389, 0.0383, 0.0374, 0.0372, 0.0370, 0.0367, 0.0367, 0.0362, and 0.0355, respectively. The weights for Q1, Q2, Q16, Q14, and Q15 are all below 0.0350, with weights of 0.0349, 0.0343, 0.0331, 0.0315, and 0.0306. These weight results aid in determining the primary focus for shaping the image of city virtual spokespersons, prioritizing Q7, followed by Q21, Q6, Q11, Q18, Q19, Q20, Q9, Q25, and Q22, and subsequently Q10, Q13, Q23, Q24, Q3, Q8, Q12, Q26, Q4, Q17, and Q5, and finally, Q1, Q2, Q16, Q14, and Q15. This ensures that design strategies align more closely with user expectations and precisely meet their needs.

5.5. Comparison with Previous Studies

This study introduces new considerations for shaping the image of virtual city spokespersons through interviews, and the specific reasons are outlined below.

1. Advancements in digital media technology: With the rapid development of digital media technology, the design of virtual city spokespersons is no longer confined to traditional appearances and voices but instead, extends to more digital technologies, including AR, VR, and more complex animation and special effects. In Factor 1, "Design Elements", the appearance of virtual city spokespersons considers factors such as the alignment with city characteristics and recognizability. The morphological design includes showcasing dynamic and static environments, and color choices reflect the city's features and traditions. In Factor 2, "Anthropomorphism", regarding language, the virtual city spokespersons can consider choosing local dialects. In Factor 5, "Emotionalization", virtual city spokespersons should possess good communication skills. These factors enable virtual city spokespersons to present a higher degree of modernization and personalization in terms of appearance, form, and interactivity, meeting the expectations of audiences in the digital age.
2. Changing social values: Over time, changes in social values may lead to shifts in people's expectations of city images and virtual city spokespersons. In Factor 3, "Evolutionary", we consider the gradual development and improvement of spokespersons' psychology and cognition, as well as changes and enhancements in their abilities in professional fields. This reflects society's new demands and expectations for virtual city spokespersons, emphasizing the need for them to stay current and better adapt to social development.
3. Negative impacts of real human spokespersons: Faced with the negative impacts that real human spokespersons may encounter, virtual spokespersons have become a more popular and controllable choice. In Factor 8, "Reliability", we consider virtual city spokespersons providing resource links for public information. This emphasizes their advantage in city information and image shaping, addressing concerns related to the reliability of human spokespersons.
4. Globalization and multimedia era: The globalization and multimedia era require city images to be more widely conveyed, taking into account the acceptance of different cultures. Therefore, in Factor 6, "Culturalism", we consider virtual city spokespersons as integral components of city culture by reflecting cultural elements and symbols. In Factor 4, "Narrativity", spokespersons express emotions through expressions, tones, and actions, and their stories are related to the city's history and memories, possessing the ability to evoke resonance. These considerations enable virtual city spokespersons to better reflect the city's culture and convey its spiritual essence. In Factor 7, "Interactivity", virtual city spokespersons interact more widely with residents and visitors by providing interaction through various media channels and adapting to multimedia communication.

6. Conclusions and Future Research

6.1. Conclusions

This study systematically analyzed the requirements for shaping the image of city virtual spokespersons through a factor analysis and the entropy method. The aim is to guide the design of virtual city spokespersons, meeting the perceptions and experiential needs of users in the digital information era. Through a literature review and semi-structured interviews, the factors influencing the shaping of virtual city spokesperson images were determined. A factor analysis was then used to identify key factors in shaping the image of virtual city spokespersons. The entropy method was employed to analyze the weights of each factor in shaping the image of city virtual spokespersons. Based on the results of the data analysis, corresponding design strategies were proposed, leading to the following conclusions:

- This study identified 8 key factors through the factor analysis, namely "Design Elements", "Anthropomorphism", "Emotionalization", "Evolutionary", "Narrativity", "Culturalism", "Interactivity", and "Reliability".

- In shaping the image of virtual city spokespersons, priority should be given to "Design Elements", followed by "Anthropomorphism", "Emotionalization", "Evolutionary", "Culturalism", and "Narrativity". "Reliability" and "Interactivity" should be addressed last. The creation of a realistic appearance and tactile sensation in "Design Elements" is of utmost importance, followed by ensuring that the body proportions conform to esthetic standards. Among other factors, "Anthropomorphism" should be based on the prototype of real humans, "Emotionalization" requires understanding the emotional needs of different groups, "Evolutionary" involves focusing on the continuous maturation of physiological features, "Culturalism" should consider traditional cultural promotion, and "Narrativity" should be associated with the city's historical memory. Finally, "Reliability" necessitates the accurate transmission of information, and "Interactivity" can set up interactive Q&A functions.

6.2. Theoretical Contributions

This study has made multifaceted theoretical contributions to the field of virtual spokesperson image shaping, significantly impacting the theoretical framework and practices of virtual spokesperson design. The main theoretical contributions of this study are outlined as follows:

- Refinement of the factor analysis model for virtual city spokesperson design: Through a factor analysis, this study successfully identified key factors that users consider crucial in shaping the image of virtual city spokespersons. These factors include "Design Elements", "Anthropomorphism", "Emotionalization", "Evolutionary", "Narrativity", "Culturalism", "Interactivity", and "Reliability". This factor analysis model provides a more specific and detailed dimension for evaluating different types of virtual spokespersons.
- Emphasis on the importance of user perception: This study places a focus on the "Design Elements" factor, emphasizing the significance of user visual perception in shaping the image of virtual city spokespersons. This finding extends the virtual spokesperson design theory, integrating user perception characteristics into the core of the design process.
- Detailed refinement of user requirements: This research thoroughly elucidates user preferences for shaping the image of virtual city spokespersons, including aspects such as appearance, material, color, and more. It helps to better design and shape the image of virtual city spokespersons, meeting user expectations.

In summary, the theoretical contributions of this study not only expand the knowledge in the field of virtual spokesperson design, but also provide researchers and designers with additional information regarding user perception and requirements. This research propels the development of virtual spokesperson design theory and practices, offering comprehensive support and guidance for the further promotion and dissemination of city images through virtual spokespersons in the digital information age.

6.3. Practical Significance

This study holds significant practical implications in the field of virtual city spokespersons, bringing positive impacts to developers, designers, users, and society as a whole. The primary practical significance of this study includes the following:

- Enhancing competitiveness in the digital market: The design of virtual spokespersons can enhance market attractiveness and competitiveness, effectively expanding the digital product market. Developers, by taking into consideration user needs, can broaden the user base of their products, thereby gaining a competitive advantage in the business sphere.
- Providing design experience for digital products: The series of design strategies proposed for virtual city spokespersons in this study offers valuable insights for designers, serving as a reference for future design endeavors involving similar virtual spokespersons or digital products.

- Improving user experience with virtual city spokespersons: The research provides a range of design strategies for virtual city spokespersons, aiming to enhance the users' perceptions and experiences with these spokespersons, meeting user demands and preferences for shaping the image of virtual city spokespersons.
- Promoting sustainable social development: Through the design of virtual city spokespersons, these representatives disseminate city tourism and cultural information through social platforms, elevating the city's visibility and enhancing its online appeal. This, in turn, provides support for the city's sustainable development.

6.4. Limitations and Future Research

Although this study provides valuable insights and strategies for virtual city spokesperson design, it also has some research limitations. Future research could focus on improving and exploring the following aspects: Firstly, participants in this study were not differentiated based on age groups. Future research could compare users across different age segments to gain a more comprehensive understanding of the impact of virtual city spokespersons on various age groups. Secondly, participants were from several major cities, and regional differences were not taken into account. Future research could expand the samples to cover a broader range of geographical and cultural backgrounds, providing more comprehensive data. Lastly, while this study proposed virtual city spokesperson design strategies, the actual effectiveness of these strategies was not verified. Future research could involve user testing and evaluation to validate the practical impact of these strategies.

In terms of future research recommendations, this study suggests adopting a multidisciplinary approach, encompassing cognitive psychology, human–computer interactions, sociology, and other relevant fields to comprehensively understand user demands for digital experiences. Additionally, emphasizing the diversities of different urban areas, including cultural and customary differences, is crucial to ensure that the virtual city spokesperson design is adaptable to users from various cultural backgrounds.

In conclusion, despite limitations, this study provides a beneficial foundation for future research. Particularly, with the rapid development of artificial intelligence, advanced visual image generation techniques and computer graphics offer crucial support for shaping the image of virtual city spokespersons. Through these technologies, we can intricately craft the appearance of virtual city spokespersons, making them more realistic. Simultaneously, AI algorithms analyzing and understanding esthetic preferences across different demographic groups can contribute to creating virtual spokespersons with unique personalities tailored to various cities. In terms of emotions, AI's emotion recognition technology enhances the intelligence of virtual spokespersons, enabling better understanding and responses to human emotions. By leveraging machine learning algorithms, virtual spokespersons can adapt to diverse situations and user emotional states, further enhancing the interactive experience with users. Regarding functionality, virtual spokespersons can fully utilize natural language processing and speech recognition technologies, providing more efficient and personalized information services.

In the future, it is hoped that research will focus on how artificial intelligence influences the shaping of virtual city spokespersons, providing more profound insights and guidance for the design of virtual spokespersons. Research in this field not only contributes to advancing virtual spokesperson design, but also opens up new possibilities for innovative urban development and social interaction.

Author Contributions: Conceptualization, J.C. and Q.J.; methodology, Q.J.; formal analysis, Q.J.; investigation, J.C. and R.Z.; data curation, J.C., R.Z. and L.P.; writing—original draft preparation, J.C.; writing—review and editing, J.C. and Q.J.; visualization, J.C. and L.P.; supervision, Q.J.; and project administration, Q.J. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

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

Data Availability Statement: Data are available on request to the corresponding author.

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

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