

Article

An Evaluation Model for the Influence of KOLs in Short Video Advertising Based on Uncertainty Theory

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Abstract: In the era of rapid growth in the short video industry, it is very important to find more accurate suitable advertising promoters, namely Key Opinion Leaders, to promote the development of short video commerce. A mathematical method is needed to grade and evaluate KOL's abilities. Only in this way can advertisers better determine the value of KOL and determine whether it is suitable for promoting its products. Moreover, in the hierarchical evaluation of KOL, there is not only structured and quantifiable information, but also a large amount of unstructured and linguistic non-quantifiable information. Therefore, this article regards unquantifiable information as an uncertain variable and uses a comprehensive evaluation method based on uncertainty theory to handle subjective uncertainty in the evaluation process. Among them, all uncertain variables are symmetric. The main contribution of this article is the provision of a new evaluation method for KOL grading. Firstly, a two-level evaluation index system for KOL was established. Secondly, the importance and annotation of the Index set are set as uncertain variables, and the KOL evaluation model is constructed. Finally, two KOLs on TikTok were selected for comparative analysis to determine the importance ranking and KOL scores of each level of indicator, verifying the effectiveness and practicality of this method.

Keywords: uncertainty theory; KOL; social media; short video; advertising; evaluation model



Citation: Jin, M.; Ning, Y.; Liu, F.; Zhao, F.; Gao, Y.; Li, D. An Evaluation Model for the Influence of KOLs in Short Video Advertising Based on Uncertainty Theory. *Symmetry* **2023**, *15*, 1594. <https://doi.org/10.3390/sym15081594>

Academic Editor: José Carlos R. Alcántud

Received: 21 July 2023

Revised: 4 August 2023

Accepted: 14 August 2023

Published: 17 August 2023



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1. Introduction

Driven by social reality and technology, social media is becoming increasingly commercialized. The marketing mode has also changed from traditional marketing based on TV commercials and celebrity endorsements to social-media-based KOL advertising promotion and live promotions. Among them, KOL advertising promotion is the distribution of product content from KOL users. In particular, KOL advertising is essentially based on short videos. Compared with Firm Generated Content (FGC), consumers tend to pay more attention to User Generated Content (UGC), and they think that user information on social media is more reliable than information forwarded directly by companies. Therefore, as social media technology advances, companies need to create reliable FGC for consumers to engage with social media through UGC to generate subsequent value. And for UGC, content generated by KOLs is much more effective for marketing than content generated by regular users.

Short video marketing is the main way of marketing today. In traditional TV advertising, advertisers choose celebrities and other spokespersons for promotion. Similarly, in short video marketing, KOLs are also selected in advertisements for advertising promotion. Therefore, advertisers need to estimate the influence of KOLs on fans, so as to judge their

promotion ability and the benefits they bring to manufacturers. In such cases, it is important to study the influence of KOLs.

In the current study, academics focused on KOL identification and impact analysis, while research related to KOL competency assessment is rather lacking. On the one hand, after identifying KOLs, we still need to position and score them to determine the strength of their capabilities. On the other hand, the previous analysis of the influencing factors of KOLs is limited to the tendency of factors to influence KOLs, etc., and does not classify and integrate multiple factors, and then establish a systematic grading and evaluation system. In addition, Jin et al. [1] pointed out that KOL advertising promotion decision optimization is the optimization of selection planning for each level of KOLs. Therefore, in order to obtain a better advertising promotion decision, we should not only establish a set of KOL grading evaluation system, but also fully consider the uncertain phenomenon in the KOL evaluation process and take effective measures to eliminate the influence of uncertainty.

The main contributions of this paper can be summarized as follows.

- In previous related studies, scholars generally consider only a few factors, which lack systematization. In contrast, we integrate and classify various factors to build a systematic KOL evaluation system, which includes 5 primary evaluation indicators and 18 secondary evaluation indicators.
- Considering that the importance of evaluation indicators and comments are not quantifiable, uncertainty theory is introduced to deal with it. Then, we build a KOL evaluation framework. This is a new KOL evaluation method, which effectively reduces the influence of subjective factors in the evaluation process and lays a research foundation for the optimization of advertising promotion decision.
- We select two KOLs on TikTok to conduct two empirical studies, derive the weight ranking of indicators at all levels, determine their ranking, and finally compare the results of the two cases. We can find that using this evaluation model, each KOL can be analyzed in a targeted manner to obtain differentiated evaluation results.

The rest of this paper is organized as follows. Section 2 provides a review of the literature and highlights problems with existing research. Section 3 presents the evaluation index system for KOLs. Section 4 describes the applied uncertain composite evaluation method, and introduces the basis for the selection of the evaluation method. In Section 5, we conduct empirical studies on KOLs based on TikTok to assess their promotion levels and grades. Finally, concluding remarks are presented in Section 6.

2. Literature Review

KOL is a highly influential user group on social media platforms. Product advertising and promotion through KOL can effectively promote product sales. After reading and sorting out the related literature around KOL, we found that the main focus is on KOL influence [2] and KOL identification [3,4], etc.

2.1. KOL Influence

KOL influence is reflected in all aspects of social life. Research has shown that engaging KOLs among caregivers in direct-to-consumer initiatives to address adolescent anxiety is an effective strategy for increasing caregiver demand for Cognitive Behavioral Therapy (CBT) [5]. The KOLs in caregiving can be involved in direct-to-consumer initiatives. KOLs in medical caregiving can improve health promotion activities, which indicates greater patient recognition and trust as KOLs. Researchers in [6] explored the moderating effects of sustainability brands and KOLs on international students' intention to study in the U.S. and found that sustainability brands positively influenced students' intention to study in the U.S., but KOLs did not have a significant effect on this decision. Specifically, in terms of social media marketing, KOLs also lead to better word-of-mouth communication, e.g., Tobon et al. scholars [7] found that KOL's online word-of-mouth influences consumers' online decisions with positive word-of-mouth efficacy. Xiao and Lei [8] found that KOLs

can stimulate consumers' purchase intention based on a survey study of WeChat group shoppers. Therefore, there is a great need for research on KOLs.

In addition, with the popularity of social media that promotes interpersonal interactivity, an increasing number of organizations are relying on KOLs to interact with potential customers on various social media for branding purposes. First, in the context of skin care brands, scholars such as Xiong [9] explored how the characteristics of KOLs impact the effectiveness of KOLs and the outcome of skincare branding. In terms of educational knowledge, scholars such as Sherbino [10] explored how Canadian KOLs describe the philosophy and practice of Competency-Based Medical Education (CBME), and found heterogeneity in Canadian KOLs' definitions of CMBE. Furthermore, to promote KOL motivation, scholars such as López [11] analyzed different incentives to encourage KOLs to spread their messages on social media and found that KOLs respond differently to monetary and non-monetary incentives. Finally, from the perspective of super-influencers, who are more powerful and influential than general opinion leaders, noting the opinion distortion triggered by super-influencers, and considering the characteristics of super-influencers and the controversial messages posted by super-influencers that would cause heated discussions on social platforms, Wei and Meng constructed an extended model to model the opinion evolution process on social platforms [12].

2.2. KOL Identification

KOL occupies a key position in online communities [13] that can guide community consumers in their consumption behavior. Therefore, the research on the identification of KOLs is also particularly important. The research in this area mainly focuses on the improvement of algorithms and models. On the one hand, existing KOL identification algorithms mainly focus on static social graphs, ignoring temporal features. Therefore, scholars such as Oueslati [14] proposed a new approach to detect KOLs based on analyzing online community interactions and dealing with the dynamic aspects of social networks. Yang [15] used a new closeness evaluation algorithm to identify KOL nodes in online social networks, and Jain [16] detected KOL nodes using a whale optimization algorithm. On the other hand, from a model-based perspective, Xiao [17] proposed a natural reversal dynamics model based on KOL opinions. Wang et al. [18] proposed a KOL identification method based on integrated influence and sentiment features. An et al. [19] proposed a high-influential user profiling method based on topic consistency and sentiment support in the context of public events. In addition, for the Large Scale Group Decision Making Problem (LSGDM), Li et al. [20] proposed a new viewpoint evolution-based framework to study the consensus reaching process in large scale group decision making problem, and constructed a two-stage consensus model based on opinion dynamics and social power evolution.

2.3. Review

In response to the analysis of the above literature, we can find the following problems. First of all, in the analysis of KOL influence, scholars focus on whether KOLs have positive influence or factors that affect KOLs' tendencies. However, the factors are not integrated to form a system. In addition, scholars also propose and improve the recognition algorithm and model of KOLs. However, when multiple KOLs are identified, is there a difference between the different KOLs? Therefore, this paper integrates and classifies a variety of factors, and then constructs a systematic KOL evaluation system to analyze the difference between different factors on KOL ability and the ranking between KOLs.

3. KOL Grading Evaluation Index System

3.1. Selection of Evaluation Indicators

With the rise of social media platforms, product advertising promotion as well as marketing has basically shifted from traditional media to social media. Unlike traditional media, there are generally two ways to promote advertising in the context of social media,

one is vertical advertising stream (similar to traditional TV commercials, which are placed directly to the audience), and the other is KOL promotion. The first promotion method has the characteristics of directness and simplicity, while the purpose of audiences using social media is mainly social, so the directness of advertising implantation is likely to cause resentment among audiences. In contrast, KOLs generally intersperse the advertising content into the storyline when promoting, which is easy to resonate with the audience. In addition, KOLs are often influential people in their fields and can influence and drive users' content output (comments) and dissemination (retweets). Therefore, the second promotion method is softer and easier to be accepted by the audience, so as to better achieve the purpose of product promotion. Therefore, the current product promotion mainly adopts the second promotion method. However, different KOLs may have different promotion ability and therefore bring different promotion effect. The following is an analysis of what factors affect the promotion ability of KOLs in social media advertising and the degree of influence of different factors.

KOLs on social media is a category of users with strong influence [21]. They have a large number of followers and have a certain degree of conviction to their fans, which in turn can influence their consumption decisions. Therefore, choosing the right KOLs for advertising is an effective way to promote products. At the same time, although the number of KOL fans is large, the quality of fans varies and may contain some paid Internet trolls, so the number of KOL fans does not necessarily have a positive relationship with the quality of fans and the credibility of fans. In addition, the degree of fit between KOLs and the promoted product is also an inevitable factor that affects its promotion ability. For example, choosing celebrities from other countries and Chinese celebrities to endorse products of Chinese brands will have different effects, and choosing national celebrities to endorse the products will generally produce better promotion effects than choosing celebrities from other countries. This is because most Chinese people hold patriotic feelings, and localized celebrity endorsement can better mobilize the national perception of the brand [22]. There are various modes of KOL advertising promotion, mainly including evaluation, popular science, collection and inventory, etc. Different promotion modes have different requirements for KOL and different effects on the promotion effect, therefore, they have different effects on the level of KOL promotion ability.

When KOLs advertise, different products have different requirements for KOLs, so the promotion ability of KOLs needs to be re-graded for different products. Moreover, the universality of products, brand background and brand characteristics have a certain degree of influence on the promotion ability of KOLs. Among them, the applicability of social media advertising differs from product to product. For example, if the same KOL advertises wine online and winery tourism business, the final promotion effect is different [23]. In addition, the difference in brand backgrounds can be a direct result. And, the difference in brand background can directly affect the user's loyalty to the brand [24] which in turn creates a word-of-mouth effect [25]. For example, Mengniu and Yili, as the Olympic Games brands, are the most popular brands. For example, Mengniu and Yili, as Olympic brands, have a strong brand background and therefore have a stronger brand effect. Finally, the category to which a brand belongs, i.e., brand characteristics, is the most significant feature that distinguishes it from other brands, and is also a factor that impacts the grading of KOL promotion ability.

In addition to the promotion of products by the ads, the degree of creativity of the ad content, the promotion effect of similar videos in the past, the length of the ad message and the time of placement are all important factors that impact the effect of ad promotion, and therefore are also influential factors in the grading of KOL's promotion ability. As it is widely known, the essence of advertising promotion by KOL is to influence fans' consumption decisions by delivering positive product information. Research shows that effective use of social media platforms to communicate messages can stimulate users' enthusiasm for advertised brands and increase their willingness to purchase [26,27]. The research shows that effective use of social media platforms for messaging can generate

enthusiasm for advertised brands and increase users' purchase intentions. In particular, effective communication requires KOLs to present product information in a form that resonates easily with users, thus enhancing the promotion effect and increasing consumers' desire to purchase [28]. By using six types of advertising content to promote social media advertising for hotel marketing, it was found that the best promotion effect was obtained when the product information was represented in the form of pictures. The degree of creativity varies from one advertising format to another. Gautam et al. [29] in the context of promoting luxury fashion brands, found that different forms of promotion based on social media have a certain degree of influence on consumers' propensity to purchase through the survey. In addition, based on the video recommendation algorithm of Tik Tok, videos with higher completion rates are more likely to be pushed to more users. If the video is too long, the completion rate will be too low, which will lead to the video being restricted and not achieving a good advertising effect. Finally, placing videos at different times will also affect the number of video plays and likes. It is not difficult to understand that the number of people online on social media platforms during break time is significantly higher than that during working hours. Therefore, if you choose to post videos during break time, you can get better promotion effect, which in turn affects the promotion ability of KOLs.

Different social media platforms have different network attributes (social attributes, economic attributes, etc.), and perceived critical mass (the number of user recognition). Among them, the network attributes of media platforms include various attributes such as social attributes (QQ, WeChat, etc.) and economic attributes (Taobao, Jingdong, etc.). The types of users of social media platforms with different network attributes are also different, and therefore the implementation capability of their product promotion is also different. Then, advertising promotion in different media platforms has different effects. Further, advertising promotion by the same KOL on media platforms with different network attributes also has an impact on its promotion ability grading. In addition, the perceived critical quality of media platforms refers to the number of user recognition [30]. When it reaches the perceived level, adoption tends to happen. The perceived critical mass of a platform determines the influence of the platform. The level of platform influence represents the level of user recognition of the platform, which has a positive effect on both marketing and promotion [31]. At the same time, the ability to use social media for promotion anytime and anywhere instantly enhances information sharing with users, which in turn facilitates advertising promotion. In other words, the network stability of the media platform also determines the progress of advertising promotion. To sum up, compared with media platforms such as Taobao and JD, which are mainly purchase—sales, platforms such as Tik Tok and Quick Hand, which are entertaining and interactive [32], combine social and economic attributes. Tik Tok and Quick Hand, on the other hand, are more capable of promoting and stimulating consumers' purchasing behavior [33], thus becoming a platform for more advertisers to promote their products.

Consumer trust is a prerequisite for online consumer purchase decisions [34]. Trust can strengthen the cooperative relationship between individuals. Whether it is between consumers and KOLs or promotional platforms, trust plays an intermediary role [35]. It influences the user's desire to buy. Studies have shown that consumer satisfaction has a significant positive impact on the loyalty of e-commerce websites [36]. In particular, consumer satisfaction with the platform, individual or promotional and sales content determines trust, which in turn determines the effectiveness of product promotion and the rating of KOL's promotional ability. In addition, there is an interaction between customers' brand engagement and the platform's brand marketing and promotion activities [37]. The interaction between brand engagement and brand marketing activities on the platform also exists. Brand engagement can strengthen brand awareness and brand knowledge [38] and brand awareness affects promotion performance [39].

In summary, through in-depth analysis of KOL promotion and combining the characteristics of KOL, promotional products, promotional advertisements, promotional platforms and users, we constructed an index system for grading evaluation of KOLs' promotion

ability. In order to facilitate the subsequent evaluation of KOLs' promotion ability, we divided the influencing factors into five primary evaluation indexes at the level of KOL individual, promotion product, advertisement, platform and user, and divided 18 secondary evaluation indexes under the primary evaluation indexes. Based on this, the evaluation index system was constructed as shown in Table 1.

Table 1. Evaluation indexes of KOL promotion ability.

Primary Indicators	Secondary Indicators	References
KOL level	Number of fans	[40,41]
	Fan quality	[42]
	Promotion mode	[28]
	Word-of-Mouth effect	[25]
	Fit with the product	[22]
Advertising product level	Product universality	[43]
	Brand background	[44]
	Brand identity	[43]
Advertising level	Ad creativity	[29,45]
	Past promotion results	[1]
	Ad placement time	[45,46]
	Duration of advertising video	[45]
Platform level	Web properties	[32,33]
	Perceived critical mass	[30]
	Network bottlenecks	[47]
User level	Users' trust in the platform	[36]
	User recognition of the ad	[37]
	Users' brand engagement	[38]

3.2. Meaning of Evaluation Indicators

3.2.1. KOL Individual Level

(1) Number of fans

The number of followers represents the popularity of a KOL. For Twitter users, their followers are called Follower, i.e., followers. For Facebook, their followers can be expressed as Friend, i.e., friends. For users of platforms such as Weibo and Tik Tok, their followers are Followers. Then, following a Twitter account, considering a Facebook user as a Friend, and following a MicroBlog or Tik Tok account are all expressions of recognition and becoming its Follower. Generally speaking, the higher the number of followers, the greater the influence of the person being followed. There is a propagation relationship between the pollinated users and the fans, so the number of fans is one of the factors that determine the promotion ability of KOL.

(2) Fan quality

The quality of fans can be measured according to the level of fan stickiness. As it is widely known, some platform users will adopt some operation means to increase the attention, such as sending gifts. This kind of behavior will make the account increase the number of fans in the short term, but the stickiness of these fans is low, and once the activity is over, they may take off, so the quality of fans is low. Retaining followers and converting them into loyal fans is the only way to play a real role in advertising and promotion. Therefore, the quality of fans has a certain degree of influence on the promotion ability of KOL. Generally speaking, the higher the quality of fans, the stronger the promotion ability of KOLs, and therefore the higher the rank.

(3) Promotion mode

KOL-based advertising promotion mode mainly includes evaluation and science popularization, etc. Different promotion modes have different effects. Evaluation means testing and assessment, and the KOL will test the promoted products in advance, and then release evaluation videos to point out the advantages and disadvantages, so that fans can make self-judgment and rational choice. Science popularization is the popularization of science, where the KOL shows the knowledge of product characteristics and principles of action in a scientific way. Different users have different preferences, so if you choose the promotion mode that is more acceptable to the fans, you can get better promotion effect.

(4) Word-of-Mouth effect (KOLs' credibility)

When brands cannot get efficient returns from "self-promotion", KOL is a credible third party, a group with appeal, influence and credibility in its field, which can influence fans' consumption decisions. Generally speaking, when the satisfaction of KOL is high, its credibility will be stronger, and then the promotion effect of advertising will be higher.

(5) Fit with the product

KOLs can be actors, artists, athletes, or even grassroots netizens. If consumers see a very famous person using or praising a product, they will be more likely to be "amused", i.e., to approve of the product. This phenomenon is known as the celebrity effect. However, consumers also have their own sense of judgment and standards, and do not necessarily follow them blindly. When KOL's individual brand image does not match the characteristics of the product, for example, when a dark-skinned KOL promotes a whitening product and does not show significant improvement, the KOL's own image is not compatible with the product, so the promotion effect is poor. By the same token, if the KOL and the promoted product have a high degree of fit, the promotion effect will be relatively better.

3.2.2. Advertising Product Level

(1) Product universality

The degree of universality of a product means the number of groups to which the product can be adapted. Generally speaking, products with higher universality will get better promotion results under the same conditions. In addition, when the universality of the product changes, it will also cause differences in the promotion effect. For example, the original keyboard is only applicable to the computer is also applicable to cell phones and other devices after adjustment, so that the keyboard's universality increased, the number of groups and purchase demand increased, so the same promotional conditions will also have a certain degree of promotional effect.

(2) Brand background

Brand background refers to the background factors that can promote the operation of brand equity and increase the degree of branding. There are two main forms: sponsored brands and certified brands. For example, Mengniu and Yili brand milk are Olympic products with strong backgrounds, which have a certain degree of promotion effect on brand influence. For certified brands, for example, the certification of "China Well-known Trademark" determines the competitiveness of the product. Moreover, each industry has its own certification brand, such as green food certification in the food industry, pure wool certification in the garment industry, and environmental certification in the automotive industry, all of which have a high impact value. In addition, the brand background of the promoted products, in addition to the strength of the company, also includes the strength of the brand spokesman and government support, etc.

(3) Brand identity

The brand characteristics of the advertised products are the types of products, such as beauty and skin care, office supplies, game tools, etc. The brand characteristics of the promoted products are different, and they have different consumer groups. If the consumer

groups are different, then the size of the consumer groups also have differences, so there is a certain degree of influence on the effectiveness of product promotion and the strength of KOL promotion ability.

3.2.3. Advertising Level

(1) Ad creativity

It is not difficult to understand that advertising messages with a high degree of creativity will be more attractive to users. One of the classic examples of creative advertising is the Red Bull beverage advertisement. A simple advertising line—“Drink Red Bull when you are tired and sleepy”—reflects the product’s characteristics of refreshment and mental focus, but is also very simple, clear and unique, leading to consumers’ deep memory of the product. Therefore, advertising creativity influences the diffusion effect of advertising information released by KOL to a certain extent, which in turn affects the promotion ability of KOL.

(2) Past promotion results

In the context of Tik Tok and Quick Hand, the promotion effect of advertising video information is a comprehensive reflection including the number of likes, completion rate, number of collections, number of retweets, etc. The better the past promotion effect of KOL represents the higher satisfaction of users. When a consumer buys an item on a shopping platform, he or she will generally check the evaluation record of the product, and if the evaluation is better, the higher the possibility of buying. Similarly, when an ordinary user or a new fan is not sure whether he or she should trust the KOL, he or she will generally check the satisfaction of the product he or she promoted before, i.e., the past promotion effect. If the promotion effect is good, the higher the user trusts the KOL, the more likely he or she will buy the product promoted by the KOL. Therefore, the past promotion effect of the advertisement also affects the promotion effect of its new products to a certain extent.

(3) Ad placement time

As it is widely known, achieving better advertising results requires more views. Since the number of people who are online at different times of the day is different, the number of views of the ad message is different, and thus the effectiveness of the placement is different. For example, the number of people online during working hours is relatively low, so the promotion effect is poor. If the ad message is placed during a time when the uptake rate is high, it will receive more views and thus have a higher chance of gaining better promotion results. Therefore, the time of advertising message placement has an impact on the diffusion effect of advertising messages.

(4) Duration of advertising video

Each social media platform has its own recommendation algorithm based on its own characteristics. Take Tik Tok as an example, the higher the completion rate of a video, the more likely it is to be recommended and thus have more placements or views. Generally speaking, for videos that are too long, it is likely that users will row away before the end of the video, so the completion rate of the video will be relatively low and not easy to be recommended.

3.2.4. Platform Level

(1) Web properties

The platforms are different and their network attributes have different focuses. The network attributes of platforms include media attributes, social attributes, economic attributes, etc. Some major events will be announced through the microblogging platform, so the media attribute of microblogging is relatively strong; while WeChat is more of a link between friends, so the social attribute is stronger; shopping platforms (like JD, Taobao, etc.) are mainly for profit, so the economic attribute is relatively strong; while the

more popular social media platforms nowadays, such as TikTok and Quick Hand, are both communication platforms between friends and can also be shopping platforms, so social and economic attributes are integrated. The promotion effect of choosing social media platforms with different network attributes for advertising differs, so the degree of influence on KOL promotion ability rating also differs.

(2) Perceived critical mass

Consumer perceived quality refers to the abstract and subjective evaluation of a product or service made by customers according to their own purpose of use and demand for the product by analyzing all relevant information available in the market through formal or informal means. The perceived critical mass of a media platform is the degree of user recognition of the media platform. Before consumers consume a product, they usually collect information about it through various channels, and they will only buy it when their evaluation of the product exceeds the perceived critical mass. Similarly, users will choose to consume on the platform only when their evaluation of the platform exceeds the perceived critical quality, and thus they will approve of the advertising promotion based on the social media platform, which will increase their trust in the promoter and enhance the promotion effect.

(3) Network bottlenecks

Network bottleneck refers to some related factors that affect the transmission performance and stability of the network, which is a prerequisite for KOL to implement advertising promotion. When the network bottleneck causes network paralysis, lagging and other phenomena, the advertising video cannot be played normally, which affects the promotion.

3.2.5. User Level

(1) Users' trust in the platform

Trust is the main factor that influences users to make consumption behavior. The authority of the platform determines the level of trust users have in the platform. Different social media platforms have different focuses, such as Tmall and WeChat. Tmall is mainly for marketing purposes, while WeChat is mainly for social purposes. Since the stores on Tmall platform have qualification guarantee, users have higher trust in Tmall platform; while most of the stores on WeChat do not have guarantee, so it is difficult for users to develop trust. Therefore, the level of trust of KOL is different when the product links promoted on social media platforms are Tmall stores or WeChat accounts. To sum up, KOL's promotion and marketing effects on products differ according to the different trust levels of users in the platforms.

(2) Users' recognition of the ad

Influenced by factors such as education, users have different cognitive abilities. Based on their own cognition, users have certain criteria for judging advertising information and do not trust them blindly. When the content of advertising information released by KOL is exaggerated, users will also question the content of the advertisement based on their own cognition, and then question the promoted products. Therefore, users' recognition of the advertisement also affects the promotion effect to a certain extent.

(3) Users' brand engagement

Users' brand engagement is the degree of emotional or rational attachment formed between the user and the brand [38]. It is the degree of emotional or rational attachment formed between the user and the brand. If users have a high level of engagement with the brand, they will be more likely to recognize and drive other users to recognize the product when they receive promotion from KOLs, which in turn will drive the promotion effect.

4. KOL Evaluation Model

The following describes the specific steps of constructing an uncertain comprehensive evaluation model for grading KOLs based on their promotion ability.

4.1. Determining the Evaluation Set and Weight Set

The metric system for evaluating a KOL’s advertising ability consists of m primary level metric u_i , denoted as $U = \{u_1, u_2, \dots, u_m\}$.

Suppose each primary indicator u_i has n secondary indicators u_{ij} , which can be expressed as $u_i = \{u_{i1}, u_{i2}, \dots, u_{in}\}$.

The weight of each indicator is determined by expert voting. It is assumed that the importance of each indicator D is expressed as $D = \{d_1, d_2, \dots, d_l\}$, and the importance of d_k decreases with the increase of k . Since the importance of the evaluation index d_k is subjectively determined by the experts, it can be expressed by the uncertain variable ξ_k and ξ_k is independent of each other, where $k = 1, 2, \dots, l$. Assuming that the total number of weight-rating experts is R and the number of experts who select the secondary indicator u_{ij} and the weight rating is $d_k r_{ijk} (i = 1, 2, \dots, m; j = 1, 2, \dots, n; k = 1, 2, \dots, l)$, then

$$r_{ij1} + r_{ij2} + \dots + r_{ijl} = R. \tag{1}$$

Therefore, the weights of the secondary indicators u_{ij} can be expressed as

$$\omega_{ij} = \left(\frac{r_{ij1}}{R} \xi_1 + \frac{r_{ij2}}{R} \xi_2 + \dots + \frac{r_{ijl}}{R} \xi_l \right). \tag{2}$$

The number of experts who selected the first level indicator u_i and the weighting level d_k is $r_{ik} (i = 1, 2, \dots, m; k = 1, 2, \dots, l)$, and meet

$$r_{i1} + r_{i2} + \dots + r_{il} = R. \tag{3}$$

Therefore, the weights of the primary indicators u_i can be expressed as

$$\omega_i = \left(\frac{r_{i1}}{R} \xi_1 + \frac{r_{i2}}{R} \xi_2 + \dots + \frac{r_{il}}{R} \xi_l \right). \tag{4}$$

Then, the expectation of the secondary indicator weights is

$$\begin{aligned} E[\omega_{ij}] &= E[(\omega_{i1}, \omega_{i2}, \dots, \omega_{in})] \\ &= (E[\omega_{i1}], E[\omega_{i2}], \dots, E[\omega_{in}]). \end{aligned} \tag{5}$$

where E is the expected value [44], and

$$\begin{aligned} E[\omega_{ij}] &= E\left[\frac{r_{ij1}}{R} \xi_1 + \frac{r_{ij2}}{R} \xi_2 + \dots + \frac{r_{ijl}}{R} \xi_l\right] \\ &= \frac{r_{ij1}}{R} E[\xi_1] + \frac{r_{ij2}}{R} E[\xi_2] + \dots + \frac{r_{ijl}}{R} E[\xi_l]. \end{aligned} \tag{6}$$

The expectation of the weight of the primary level indicators is

$$\begin{aligned} E[\omega] &= E[(\omega_1, \omega_2, \dots, \omega_m)] \\ &= (E[\omega_1], E[\omega_2], \dots, E[\omega_m]) \end{aligned} \tag{7}$$

where

$$\begin{aligned} E[\omega_i] &= E\left[\frac{r_{i1}}{R} \xi_1 + \frac{r_{i2}}{R} \xi_2 + \dots + \frac{r_{il}}{R} \xi_l\right] \\ &= \frac{r_{i1}}{R} E[\xi_1] + \frac{r_{i2}}{R} E[\xi_2] + \dots + \frac{r_{il}}{R} E[\xi_l]. \end{aligned} \tag{8}$$

Finally, the final set of weights of the primary indicators is normalized to $P = (p_1, p_2, \dots, p_l)$, where $p_1 + p_2 + \dots + p_l = 1$. And, the final set of weights of the second level indicators is expressed as, where $P_i = (p_{i1}, p_{i2}, \dots, p_{il}), p_{i1} + p_{i2} + \dots + p_{il} = 1$.

4.2. Determination of Rubric Set and Evaluation Results

The set of comments is $V = (v_1, v_2, \dots, v_n)$, which can be expressed as uncertain variables $\eta_1, \eta_2, \dots, \eta_n$.

The uncertainty evaluation formula for the primary indicator u_i is

$$\begin{aligned} Q_i &= P_i S_i \\ &= (p_{i1}, p_{i2}, \dots, p_{in}) \begin{bmatrix} s_{i11}\eta_1 & s_{i12}\eta_2 & \cdots & s_{i1l}\eta_l \\ s_{i21}\eta_1 & s_{i22}\eta_2 & \cdots & s_{i2l}\eta_l \\ \vdots & \vdots & \ddots & \vdots \\ s_{in1}\eta_1 & s_{in2}\eta_2 & \cdots & s_{inl}\eta_l \end{bmatrix} \\ &= \left(\sum_{j=1}^n p_{ij}s_{ij1}\eta_1, \sum_{j=1}^n p_{ij}s_{ij2}\eta_2, \dots, \sum_{j=1}^n p_{ij}s_{ijl}\eta_l \right) \\ &= (q_{i1}\eta_1, q_{i2}\eta_2, \dots, q_{il}\eta_l). \end{aligned} \quad (9)$$

Among them, $q_{ik}\eta_k = \sum_{j=1}^n p_{ijk}s_{ijk}\eta_k = \sum_{j=1}^n p_{ijk} \frac{r_{ijk}}{R} \eta_k, k = 1, 2, \dots, l$ are uncertain variables.

The uncertainty evaluation formula for the whole evaluation system is

$$\begin{aligned} Q &= PS \\ &= (p_1, p_2, \dots, p_m) \begin{bmatrix} s_{11}\eta_1 & s_{12}\eta_2 & \cdots & s_{1l}\eta_l \\ s_{21}\eta_1 & s_{22}\eta_2 & \cdots & s_{2l}\eta_l \\ \vdots & \vdots & \ddots & \vdots \\ s_{m1}\eta_1 & s_{m2}\eta_2 & \cdots & s_{ml}\eta_l \end{bmatrix} \\ &= \left(\sum_{i=1}^m p_i s_{i1}\eta_1, \sum_{i=1}^m p_i s_{i2}\eta_2, \dots, \sum_{i=1}^m p_i s_{il}\eta_l \right) \\ &= (q_1\eta_1, q_2\eta_2, \dots, q_l\eta_l). \end{aligned} \quad (10)$$

Among them, $q_{ik}\eta_k = \sum_{j=1}^n p_{ijk}s_{ijk}\eta_k = \sum_{j=1}^n p_{ijk} \frac{r_{ijk}}{R} \eta_k, k = 1, 2, \dots, l$ are uncertain variables.

The combined results of the assessment are obtained by deriving

$$\begin{aligned} E[Q] &= E[(q_1\eta_1, q_2\eta_2, \dots, q_l\eta_l)] \\ &= (q_1E[\eta_1], q_2E[\eta_2], \dots, q_lE[\eta_l]). \end{aligned} \quad (11)$$

According to the principle of maximum affiliation, if $q_k E[\eta_k] = \max\{q_i E[\eta_i]\}$, then the evaluation capability generally belongs to the k level.

4.3. Selection Reason of the Evaluation Method

Comprehensive evaluation refers to making a global and holistic evaluation of a multi-attribute system, which is a systematic and complex work, one of the important means for people to know things, understand things and influence things, a management cognitive process and a management decision-making process. Management and decision making based on comprehensive evaluation method aims to serve the practical work of management, improve the management process, optimize management measures, and then enhance the management effect.

Comprehensive evaluation is the decision basis for ranking and preferring evaluation objects, and comprehensive evaluation of KOLs is to better serve advertising promotion decisions. In the grading evaluation of KOL, not only deterministic information such as structured and quantifiable information, but also a large amount of unstructured, linguistic and other uncertain information must be dealt with. In order to deal with the deterministic and uncertain information existing in the evaluation process, a large number of researches have been generated, including multivariate statistical analysis method [48], fuzzy hierarchical analysis method [49], fuzzy comprehensive evaluation method [43] as well as based

on gray system theory [50] and rough set theory [51]. The evaluation methods based on gray system theory and rough set theory, etc.

All of the above studies have given a great impetus to promote the development of comprehensive evaluation theory and practice with a certain degree of applicability, but they are not good solutions to the uncertainties that exist in the KOL grading and evaluation process. For example, multivariate statistical analysis is based on the theory of probability theory, which requires a large enough sample size, and there are problems such as insufficient data in the KOL grading evaluation process, so it is not suitable for the application of multivariate hierarchical analysis. In addition, fuzzy measures lack the law of ranking and contradiction, and gray system and rough set theory also take probability as the measure, which are not suitable for solving the uncertainty problem in KOL grading evaluation. In order to better deal with such uncertainties, Liu [44] proposed a confidence-based uncertainty theory, which well solves the subjective uncertainty problem. Therefore, this study selects the comprehensive evaluation method based on uncertainty theory for KOL grading evaluation research.

5. Numerical Cases

Based on the analysis of the influencing factors in the process of advertising promotion in this paper, the main influencing factors of KOL promotion ability grading are divided into five primary intensity evaluation indexes, namely, KOL individual level, advertising product level, advertising level, platform level and user level. As shown in Table 1, on this basis, it is further divided into 18 s-level intensity evaluation indexes, and an evaluation index table of KOL advertising promotion ability grading is constructed. Then, as shown in the appendix, this paper divides the importance of evaluation indicators into five evaluation levels: very important, more important, important, not very important, and unimportant.

In addition, after data screening, 36 experts were finally selected for evaluation. All experts have bachelor degree or above, and have rich experience in purchasing products on social media platforms. Most importantly, the experts selected knew the two KOLs very well.

On the basis of the above work, we chose “Zhu Xiaohan” and “Fang Qikiki” on TikTok as the research objects. Then, two KOLs are evaluated according to the KOLs grading method constructed in Section 3. Finally, according to the evaluation results, the two KOLs were compared and analyzed. Based on the results of the analysis, we can determine which factors are more heavily influenced and which factors are less affected by different KOLs. We can then focus on the heavier impact factors so that we can find improvements for KOLs more accurately and quickly at a lower cost. In addition, we can also synthesize all indicators to get the final evaluation results to evaluate the improvement potential of the KOL.

5.1. Case 1

Zhu Xiaohan is currently a short video creator on TikTok. She is also a KOL. She mainly shoots videos complaining about the relationship between father and daughter, which has attracted the attention of many netizens. The variety of products that choose Zhu Xiaohan for advertising is diverse, including cosmetics, clothing, daily necessities, etc.

5.1.1. Determine the Set of Evaluation Indicators and Weight Set

The experts first voted on the impact of various evaluation indicators on improving the KOL's ability with “Zhu Xiaohan” as the research object. And the results are shown in Figure 1 and Table 2. In Figure 1, the KOL individual level is A, the advertising product level is B, the advertising level is C, the platform level is D, and the user level is E. Among them, for A, the number of not important is 0, the not very important is 1, the important is 2, the more important is 17, and the very important is 16. And, others are similar. Looking at Figure 1, experts generally agree that all five levels are more important. Based on the data

alone, experts rate KOLs highly at the individual and user level. Among them, 16 experts believe that the KOL individual level is very important.



Figure 1. Distribution of evaluative data of primary level indicators for Zhu Xiaohan.

Table 2. Statistical table of secondary evaluation index weights.

Secondary Indicators	Very Important	More Important	Important	Not Very Important	Not Important
Number of fans (A_{11})	20	14	2	0	0
Fan quality (A_{12})	13	14	5	3	1
Promotional mode (A_{13})	11	20	3	2	0
Word-of-mouth effect (A_{14})	21	9	5	1	0
Fit with product (A_{15})	13	11	7	5	0
Product universality (B_{21})	9	13	8	4	2
Brand background (B_{22})	8	15	10	3	0
Brand identity (B_{23})	10	16	8	2	0
Ad creativity (C_{31})	12	16	5	3	0
Past promotion results (C_{32})	16	12	6	2	0
Ad placement time (C_{33})	7	13	8	6	2
Duration of advertising video (C_{34})	9	13	8	5	1
Web properties (D_{41})	9	15	6	5	1
Perceived critical mass (D_{42})	16	12	6	2	0
Network bottlenecks (D_{43})	13	9	10	4	0
Users' trust in the platform (E_{51})	17	11	7	1	0
Users' recognition of the ad (E_{52})	14	15	4	2	1
Users' brand engagement (E_{53})	11	13	5	6	1

In this paper, the importance level of evaluation indicators is classified as very important, more important, important, not very important, and not important. Since the classification options are all uncertain language, this paper chooses to use Zigzag uncertain variables for representation. Among them,

$$\xi_1 \sim Z(0.85, 0.9, 1.0),$$

$$\xi_2 \sim Z(0.8, 0.85, 0.9),$$

$$\xi_3 \sim Z(0.6, 0.7, 0.85),$$

$$\xi_4 \sim Z(0.3, 0.5, 0.65),$$

$$\xi_5 \sim Z(0, 0.1, 0.15).$$

And, $E[\xi_1] = 0.9125, E[\xi_2] = 0.85, E[\xi_3] = 0.7125, E[\xi_4] = 0.4875, E[\xi_5] = 0.0875.$

According to the results of experts' votes to calculate the weight of the primary indicators, the number of experts' votes for the importance of the primary evaluation indicators in Figure 1 is counted, and the weight of the i th primary indicators $d_i (i = 1, 2, \dots, 5)$ is

$$\omega_i = \left(\frac{r_{i1}}{R} \xi_1 + \frac{r_{i2}}{R} \xi_2 + \dots + \frac{r_{i5}}{R} \xi_5 \right). \tag{12}$$

The expected values of the weights of the primary level evaluation indicators are

$$\begin{aligned} E[\omega_i] &= E\left[\frac{r_{i1}}{R} \xi_1 + \frac{r_{i2}}{R} \xi_2 + \dots + \frac{r_{i5}}{R} \xi_5\right] \\ &= \frac{r_{i1}}{R} E[\xi_1] + \frac{r_{i2}}{R} E[\xi_2] + \dots + \frac{r_{i5}}{R} E[\xi_5]. \end{aligned} \tag{13}$$

It is calculated that

$$E[\omega_1] = 0.8601, E[\omega_2] = 0.7910, E[\omega_3] = 0.8309, E[\omega_4] = 0.8076, E[\omega_5] = 0.8233, \tag{14}$$

and,

$$\begin{aligned} E[\omega] &= E[(\omega_1, \omega_2, \dots, \omega_5)] \\ &= (E[\omega_1], E[\omega_2], \dots, E[\omega_5]) \\ &= (0.8601, 0.7910, 0.8309, 0.8076, 0.8233). \end{aligned} \tag{15}$$

Through normalization, the primary level evaluation index weights can be transformed into

$$P = (0.2068, 0.1926, 0.2030, 0.1969, 0.2007). \tag{16}$$

The data in Table 2 is visualized as shown in Figure 2. We can clearly find that the word-of-mouth effect and the number of fans are scored higher. The second is the promotion mode. Moreover, experts would hardly agree that the indicators in Table 2 would be not important.

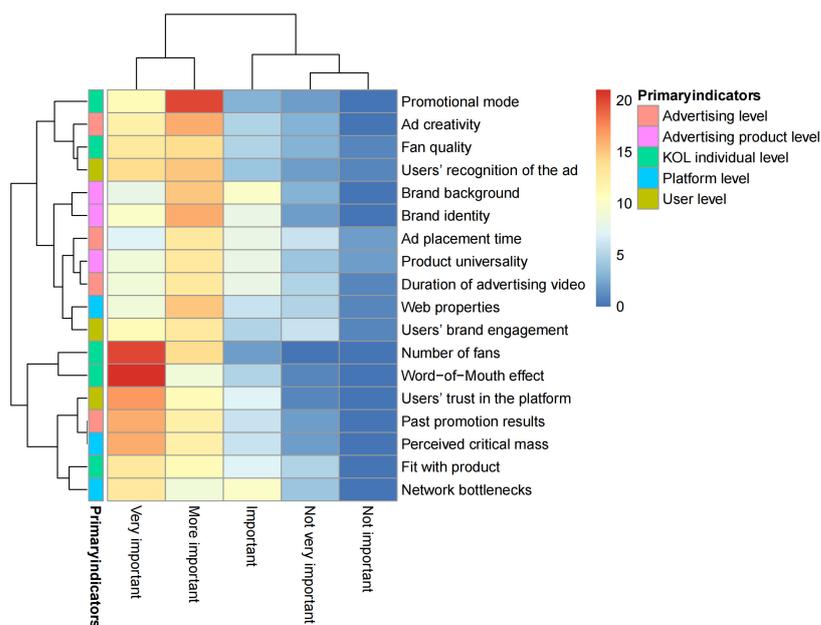


Figure 2. Distribution of evaluative data for secondary level indicators.

According to the expert voting results in Table 2, we can get the weight set expectation of the secondary evaluation index μ_{1j} ($j = 1, 2, \dots, 5$) under the primary index A .

$$\begin{aligned} E[\omega_A] &= E[(\omega_{11}, \omega_{12}, \omega_{13}, \omega_{14}, \omega_{15})] \\ &= (E[\omega_{11}], E[\omega_{12}], E[\omega_{13}], E[\omega_{14}], E[\omega_{15}]) \\ &= (0.8771, 0.8021, 0.8375, 0.8573, 0.7955). \end{aligned} \quad (17)$$

The expected weight set of the secondary evaluation indicator μ_{2j} ($j = 1, 2, 3$) under the primary index B is

$$\begin{aligned} E[\omega_B] &= E[(\omega_{21}, \omega_{22}, \omega_{23})] \\ &= (E[\omega_{21}], E[\omega_{22}], E[\omega_{23}]) \\ &= (0.7524, 0.7955, 0.8167). \end{aligned} \quad (18)$$

The expected weight set of the secondary evaluation indicator μ_{3j} ($j = 1, 2, 3, 4$) under the primary index C is

$$\begin{aligned} E[\omega_C] &= E[(\omega_{31}, \omega_{32}, \omega_{33}, \omega_{34})] \\ &= (E[\omega_{31}], E[\omega_{32}], E[\omega_{33}], E[\omega_{34}]) \\ &= (0.8215, 0.8347, 0.7288, 0.7635). \end{aligned} \quad (19)$$

The expected weight set of the secondary evaluation indicator μ_{4j} ($j = 1, 2, 3$) under the primary index D is

$$\begin{aligned} E[\omega_D] &= E[(\omega_{41}, \omega_{42}, \omega_{43})] \\ &= (E[\omega_{41}], E[\omega_{42}], E[\omega_{43}]) \\ &= (0.7712, 0.8347, 0.7941). \end{aligned} \quad (20)$$

The expected weight set of the secondary evaluation indicator μ_{5j} ($j = 1, 2, 3$) under the primary index E is

$$\begin{aligned} E[\omega_E] &= E[(\omega_{51}, \omega_{52}, \omega_{53})] \\ &= (E[\omega_{51}], E[\omega_{52}], E[\omega_{53}]) \\ &= (0.8427, 0.8177, 0.7684). \end{aligned} \quad (21)$$

By normalization, the weight sets of the secondary evaluation indicators is

$$\begin{aligned} P_1 &= (0.2104, 0.1924, 0.2009, 0.2056, 0.1907) \\ P_2 &= (0.3182, 0.3364, 0.3454) \\ P_3 &= (0.2609, 0.2651, 0.2315, 0.2425) \\ P_4 &= (0.3213, 0.3478, 0.3309) \\ P_5 &= (0.3470, 0.3367, 0.3163). \end{aligned} \quad (22)$$

5.1.2. Determination of Rubric Set, Evaluation Matrix, and Evaluation Results

The degree of enhancement of the secondary evaluation index was divided into five levels: very strong, strong, strong, not very strong, and not strong, and the statistical table of 36 experts' votes on the degree of enhancement of the secondary evaluation index is shown in Table 3.

Table 3. Statistical table of enhancement degree evaluation.

Primary Evaluation Indicators	Secondary Evaluation Indicators	Very Strong	Stronger	Strong	Not Very Strong	Not Strong
A	$A_{11}, A_{12}, A_{13}, A_{14}, A_{15}$	9, 11, 13, 9, 8	13, 13, 15, 14, 10	10, 7, 6, 7, 14	4, 3, 2, 5, 4	1, 2, 0, 1, 0
B	B_{21}, B_{22}, B_{23}	5, 7, 7	10, 11, 9	14, 13, 12	6, 5, 8	1, 0, 0
C	$C_{31}, C_{32}, C_{33}, C_{34}$	6, 11, 4, 8	11, 12, 11, 13	16, 10, 13, 9	3, 2, 8, 6	0, 1, 0, 0
D	D_{41}, D_{42}, D_{43}	9, 5, 4	11, 13, 9	13, 17, 19	3, 1, 3	0, 0, 1
E	E_{51}, E_{52}, E_{53}	9, 11, 9	15, 15, 9	10, 4, 11	2, 6, 7	0, 0, 0

Creating a rubric V , which concludes very strong, strong, strong, not very strong, not strong, for the intensity level of the KOL' promotion. Assuming that these five intensity levels are consistent with the Zigzag distribution, they are set as Zigzag uncertainty variables.

Among them, let the advertising promotion data be uncertain variables with

$$\eta_1 \sim Z(0.8, 0.9, 1.0),$$

$$\eta_2 \sim Z(0.7, 0.8, 0.9),$$

$$\eta_3 \sim Z(0.5, 0.6, 0.8),$$

$$\eta_4 \sim Z(0.3, 0.4, 0.5),$$

$$\eta_5 \sim Z(0, 0.2, 0.3).$$

Therefore, $E[\eta_1] = 0.900$, $E[\eta_2] = 0.800$, $E[\eta_3] = 0.625$, $E[\eta_4] = 0.400$, $E[\eta_5] = 0.175$.

Table 3 represents the selection of the intensity level of each indicator by 36 experts in the field, and according to Equation (9) and based on the statistical data in Table 3, it is possible to calculate the evaluation matrix Q of the primary level evaluation indicator Q_i , $i = 1, 2, 3, 4, 5$.

Then,

$$\begin{aligned}
 Q_1 &= P_1 S_1 = (0.2777\eta_1, 0.3621\eta_2, 0.2435\eta_3, 0.1003\eta_4, 0.0222\eta_5) \\
 Q_2 &= P_2 S_2 = (0.1768\eta_1, 0.2775\eta_2, 0.3604\eta_3, 0.1765\eta_4, 0.0088\eta_5) \\
 Q_3 &= P_3 S_3 = (0.2041\eta_1, 0.3264\eta_2, 0.3338\eta_3, 0.1283\eta_4, 0.0074\eta_5) \\
 Q_4 &= P_4 S_4 = (0.1654\eta_1, 0.3065\eta_2, 0.4549\eta_3, 0.0640\eta_4, 0.0092\eta_5) \\
 Q_5 &= P_5 S_5 = (0.2687\eta_1, 0.3640\eta_2, 0.2304\eta_3, 0.1369\eta_4, 0\eta_5).
 \end{aligned} \tag{23}$$

Expected values are

$$\begin{aligned}
 E[Q_1] &= (0.2499, 0.2897, 0.1522, 0.0401, 0.0039) \\
 E[Q_2] &= (0.1591, 0.2220, 0.2253, 0.0706, 0.0015) \\
 E[Q_3] &= (0.1837, 0.2611, 0.2086, 0.0051, 0.0013) \\
 E[Q_4] &= (0.1489, 0.2452, 0.2843, 0.0256, 0.0016) \\
 E[Q_5] &= (0.2418, 0.2912, 0.1440, 0.0548, 0.0000).
 \end{aligned} \tag{24}$$

According to Equation (10), the whole KOL promotion ability evaluation matrix can be obtained as

$$\begin{aligned}
 Q &= PS \\
 &= (p_1, p_2, p_3, p_4, p_5)(Q_1, Q_2, Q_3, Q_4, Q_5)^T \\
 &= (0.2068, 0.1926, 0.2030, 0.1969, 0.2007) \\
 &\quad \begin{pmatrix} 0.2777\eta_1 & 0.3621\eta_2 & 0.2435\eta_3 & 0.1003\eta_4 & 0.0222\eta_5 \\ 0.1768\eta_1 & 0.2775\eta_2 & 0.3604\eta_3 & 0.1765\eta_4 & 0.0088\eta_5 \\ 0.2041\eta_1 & 0.3264\eta_2 & 0.3338\eta_3 & 0.1283\eta_4 & 0.0074\eta_5 \\ 0.1654\eta_1 & 0.3065\eta_2 & 0.4549\eta_3 & 0.0640\eta_4 & 0.0092\eta_5 \\ 0.2687\eta_1 & 0.3640\eta_2 & 0.2304\eta_3 & 0.1369\eta_4 & 0\eta_5 \end{pmatrix} \\
 &= (0.2194\eta_1, 0.3280\eta_2, 0.3233\eta_3, 0.1209\eta_4, 0.0096\eta_5).
 \end{aligned} \tag{25}$$

Therefore, the overall expectation value of the comprehensive evaluation is

$$\begin{aligned}
 E[Q] &= E[(q_1\eta_1, q_2\eta_2, q_3\eta_3, q_4\eta_4, q_5\eta_5)] \\
 &= (q_1E[\eta_1], q_2E[\eta_2], q_3E[\eta_3], q_4E[\eta_4], q_5E[\eta_5]) \\
 &= (0.1975, 0.2624, 0.2021, 0.0484, 0.0017).
 \end{aligned} \tag{26}$$

5.1.3. Analysis of Results

According to the constructed evaluation model, the order of importance of the primary evaluation indexes can be known by the ranking of their weights as

$$KOL\ individual\ level > Advertising\ level > User\ level > Platform\ level > Ad\ product\ level. \tag{27}$$

From Equation (22), the ranking of each secondary evaluation index from highest to lowest importance is shown in Table 4.

Table 4. Ranking of importance of secondary evaluation indicators.

Primary Evaluation Indicators	Ranking the Importance of Secondary Evaluation Indicators
KOL individual level	Number of fans > Word of Mouth effect > Promotion mode > Fan quality > Fit with product
Advertising product level	Brand identity > Brand background > Product universality
Advertising level	Past promotion results > Ad creativity > Duration of advertising video > Ad placement time
Platform level	Perceived critical mass > Network bottlenecks > Web properties
User level	Users' trust in the platform > Users' recognition of the Ad > Users' brand engagement

Based on the results shown by Formulas (24) and (26), we can make a clear ranking of the indicator factors that affect this KOL. On this basis, the KOL can be targeted to improve the scheme. According to the principle of maximum affiliation, it is obtained from Equation (24) that Zhu Xiaohan ranked second in terms of improvement intensity at the KOL level, advertising level and user level, that is, stronger. In addition, the improvement intensity at the level of promote product and platform ranked third, that is, strong. Finally, as shown in Equation (26), for the KOL “Zhu Xiaohan” to promote their advertisements on TikTok, it can be judged that the enhancement of their promotion levels are all at the stronger level.

5.2. Case 2

Fang Qi's previous main business was hosting, and later transformed into self-media, mainly engaged in tourism-related promotion. Compared with Zhu Xiaohan, the variety of products promoted by Fang Qi is not so rich.

5.2.1. Determine the Set of Evaluation Indicators and Weight Set

In order to ensure the objectivity and effectiveness of the comparative analysis, the evaluation method and uncertain variable settings we chose were consistent with Case 1. On this basis, the experts voted on the impact of various evaluation indicators on improving the KOL's ability with "Fang Qi kiki" as the research object. And the results are shown in Figure 3 and Table 5. As shown in Figure 3, the experts' scoring of the indicators remains concentrated in the first half.

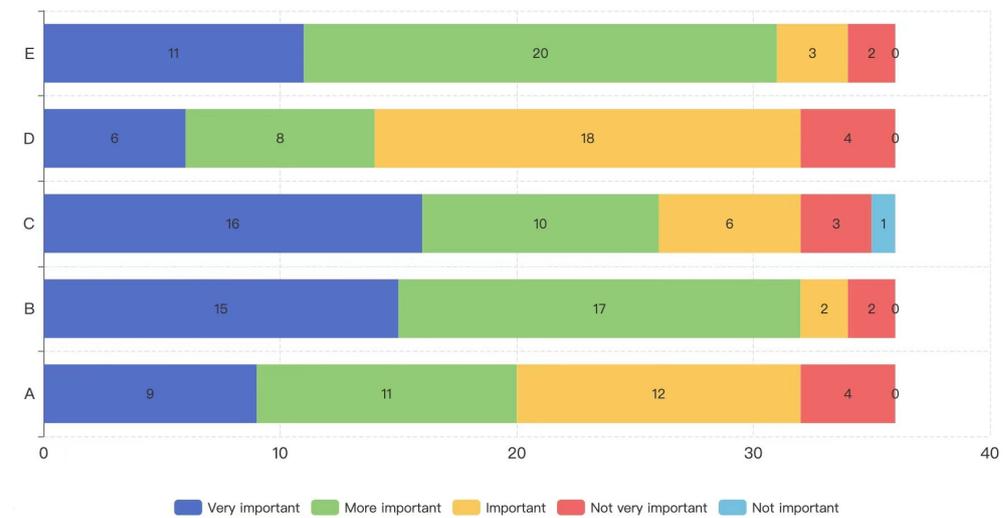


Figure 3. Distribution of evaluative data of primary level indicators for Fang Qi.

Through the same evaluation method as Case 1, we obtain the weights of the primary level evaluation indicators as shown as

$$P = (0.1939, 0.2110, 0.1999, 0.1869, 0.2083). \quad (28)$$

Figure 4 shows the distribution of primary indicator evaluation data. Among them, the first column of the first row represents the color corresponding to the quantity when the indicator "word-of-mouth effect" is "important". And, depending on the color, we can look for the corresponding number on the far right of the way. Other rows and other columns of data are in the same way. From Figure 4, we can see that the colors of the three grids of "word-of-mouth effect" and "the number of fans" and "the fit with product" are very red. That is to say, for Fang Qi, experts believe that in addition to "the word-of-mouth effect" and the number of fans, there is another important indicator, that is, the fit with the product. Moreover, experts still believe that all indicators have a certain impact on Fang Qi.

Then, based on the data shown in Table 5, we can obtain the weights of the secondary evaluation indicators as shown as

$$\begin{aligned} P_1 &= (0.2203, 0.1915, 0.1944, 0.2097, 0.2041) \\ P_2 &= (0.3415, 0.3336, 0.3249) \\ P_3 &= (0.2668, 0.2599, 0.2462, 0.2271) \\ P_4 &= (0.3235, 0.3471, 0.3294) \\ P_5 &= (0.3527, 0.3424, 0.3049). \end{aligned} \quad (29)$$

Table 5. Statistical table of secondary evaluation index weights.

Secondary Indicators	Very Important	More Important	Important	Not Very Important	Not Important
Number of fans (A_{11})	10	21	3	2	0
Fan quality (A_{12})	13	12	6	5	0
Promotional mode (A_{13})	12	15	5	4	0
Word-of-mouth effect (A_{14})	19	15	2	0	0
Fit with product (A_{15})	20	9	6	1	0
Product universality (B_{21})	11	15	8	2	0
Brand background (B_{22})	8	16	9	3	0
Brand identity (B_{23})	9	14	7	6	0
Ad creativity (C_{31})	16	13	5	2	0
Past promotion results (C_{32})	13	15	4	4	0
Ad placement time (C_{33})	9	14	8	4	1
Duration of advertising video (C_{34})	7	12	9	5	3
Web properties (D_{41})	10	14	8	3	1
Perceived critical mass (D_{42})	17	12	5	2	1
Network bottlenecks (D_{43})	14	9	9	4	0
Users' trust in the platform (E_{51})	17	11	6	2	0
Users' recognition of the ad (E_{52})	15	15	3	1	2
Users' brand engagement (E_{53})	10	13	4	6	1

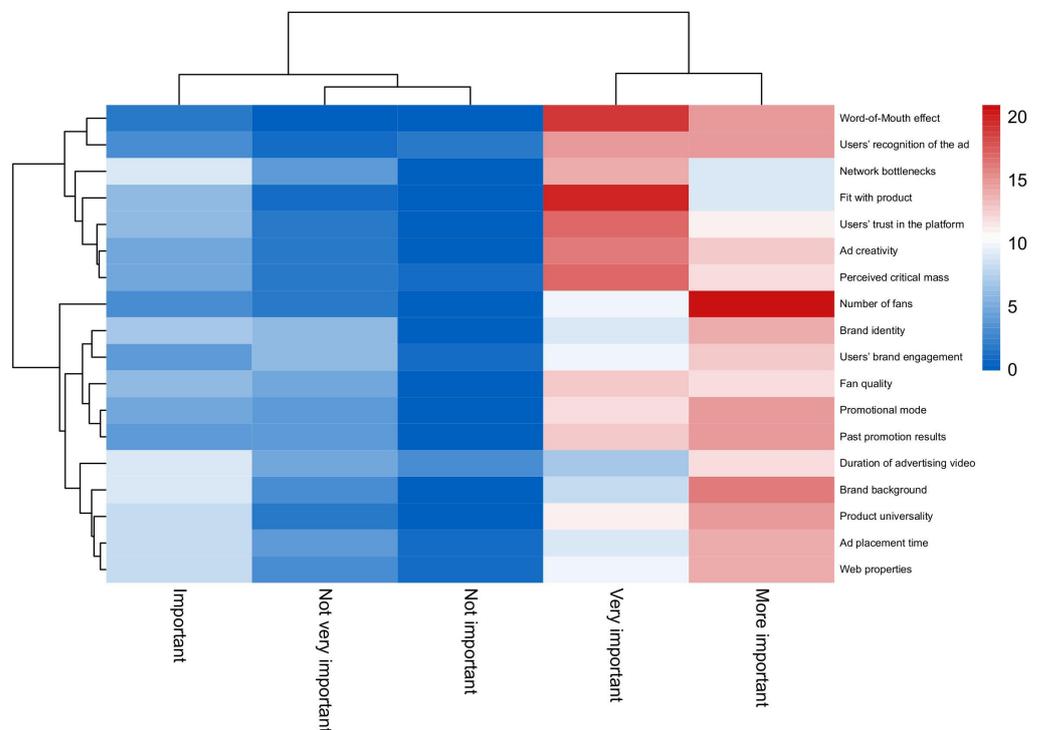


Figure 4. Distribution of evaluative data for primary level indicators.

5.2.2. Determination of Rubric Set, Evaluation Matrix, and Evaluation Results

So, when the indicators are strengthened, how strong is the improvement of “Fang Qi kiki”? As shown in Table 6, 36 experts scored the intensity of each indicator affecting the KOL’s improvement.

Table 6. Statistical table of enhancement degree evaluation.

Primary Evaluation Indicators	Secondary Evaluation Indicators	Very Strong	Stronger	Strong	Not Very Strong	Not Strong
A	$A_{11}, A_{12}, A_{13}, A_{14}, A_{15}$	10, 9, 11, 15, 9	13, 17, 13, 13, 16	9, 7, 8, 6, 7	4, 3, 4, 2, 4	0, 0, 0, 0, 0
B	B_{21}, B_{22}, B_{23}	14, 13, 11	12, 13, 18	4, 5, 4	5, 4, 3	1, 1, 0
C	$C_{31}, C_{32}, C_{33}, C_{34}$	11, 13, 10, 12	15, 16, 12, 17	6, 4, 11, 5	4, 3, 3, 2	0, 0, 0, 0
D	D_{41}, D_{42}, D_{43}	11, 13, 9	12, 18, 20	9, 4, 5	3, 1, 2	1, 0, 0
E	E_{51}, E_{52}, E_{53}	11, 9, 11	17, 15, 10	6, 9, 9	2, 3, 5	0, 0, 1

In order to ensure the objectivity and rigor of the case, we still set the comments to the same uncertain variables. By applying the same assessment methodology, we obtained the final evaluation results, as shown in Equations (30) and (31).

$$\begin{aligned}
 E[Q_1] &= (0.2762, 0.3253, 0.1313, 0.0396, 0) \\
 E[Q_2] &= (0.3173, 0.3174, 0.0753, 0.0446, 0.0033) \\
 E[Q_3] &= (0.2876, 0.3328, 0.1126, 0.0338, 0) \\
 E[Q_4] &= (0.2759, 0.3715, 0.1033, 0.0220, 0.0016) \\
 E[Q_5] &= (0.2579, 0.3151, 0.1379, 0.0362, 0.0015).
 \end{aligned}
 \tag{30}$$

Equation (30) is the evaluation result of the secondary evaluation index. And, the overall expectation value of the comprehensive evaluation is

$$\begin{aligned}
 E[Q] &= E[(q_1\eta_1, q_2\eta_2, q_3\eta_3, q_4\eta_4, q_5\eta_5)] \\
 &= (q_1E[\eta_1], q_2E[\eta_2], q_3E[\eta_3], q_4E[\eta_4], q_5E[\eta_5]) \\
 &= (0.2833, 0.3316, 0.1119, 0.0355, 0.0013).
 \end{aligned}
 \tag{31}$$

5.2.3. Analysis of Results

According to the constructed KOL promotion ability level evaluation model, the order of importance of the primary evaluation indexes can be known by the ranking of their weights as

$$Ad\ product\ level > User\ level > Advertising\ level > KOL\ individual\ level > Platform\ level.
 \tag{32}$$

From Equation (30), the ranking of each secondary evaluation index from highest to lowest importance is shown in Table 7.

According to the principle of maximum membership, the analysis of Equation (30) shows that Fang Qi ranks second in the improvement intensity of the five levels, that is, stronger. Moreover, through the results of Equation (31), it can be seen that its overall improvement intensity also ranks second.

Table 7. Ranking of importance of secondary evaluation indicators.

Primary Evaluation Indicators	Ranking the Importance of Secondary Evaluation Indicators
KOL individual level	Number of fans > Word of mouth effect > Fit with product > Promotion mode > Fan quality
Advertising product level	Product universality > Brand background > Brand identity
Advertising level	Ad creativity > Past promotion results > Ad placement time > Duration of advertising video
Platform level	Perceived critical mass > Network bottlenecks > Web properties
User level	Users' trust in the platform > Users' recognition of the Ad > Users' brand engagement

5.3. Comparative Analysis

Although Zhu Xiaohan and Fang Qi are both head KOLs with tens of millions of fans, their positioning is still different. Judging from the results of Equations (27) and (32), the difference in the weight of primary level indicators for Zhu Xiaohan and Fang Qi is very large. In particular, the weight of advertising product level is the lowest for Zhu Xiaohan, but the first for Fang Qi. Considering this phenomenon from a practical perspective, Zhu Xiaohan's role positioning is multifaceted. Meanwhile, Fang Qi, as a travel blogger, her role positioning is relatively monotonous. On the other hand, Zhu Xiaohan has been in Tik Tok for longer, so her traffic is relatively stable. Therefore, the importance of the advertising product level for the two KOLs shows serious differences. Another primary level indicator that shows a large difference is KOL individual level. For Zhu Xiaohan, she has more room to play and can show the efficacy of the product as plot content. The effect of her performance determines the advertising effect of the product. Therefore, KOL individual level is very important for Zhu Xiaohan. However, the product efficacy of Fang Qi when introducing regional customs is often overwhelmed by the poetry in her words. Additionally, for the other three primary indicators, there is no clear difference. Finally, from the specific value' comparison analysis, the weight value of Fang Qi in the five levels is higher than 0.3. Fang Qi's lowest value is also higher than Zhu Xiaohan's highest value. Therefore, it can be seen that Zhu Xiaohan's improvement ability is slightly weaker than Fang Qi's at present.

Then, the evaluation results of the secondary indicators of the two KOLs were analyzed.

For the primary indicator KOL individual level, we found that for the two KOLs, Number of fans and Word of mouth effect were equally important, but the importance of Fit with product, Promotion mode and Fan quality changed. For Fang Qi, product matching is more important than the other two secondary indicators. For Zhu Xiaohan, KOL's promotion model is relatively important. These are closely related to KOL's role positioning.

For the primary indicator Advertising product level, the influence of Brand background on both KOLs is at an intermediate level. However, Brand identity and Product universality influenced the two KOLs to a diametrically similar degree.

For the primary indicator Advertising level, we can find that the two secondary indicators of Past promotion results and Ad creativity have a higher degree of influence on both KOLs. However, the impact of Past promotion results on Zhu Xiaohan will be heavier. It is not difficult to understand that Zhu Xiaohan's advertising level is relatively stable, so the influence of Ad creativity is not as strong as Fang Qi. In addition, the impact of Duration of advertising video on Zhu Xiaohan is greater than that of Ad placement time. However, Fang Qi is the opposite.

For the primary indicator Platform level, the results for both KOLs were consistent.

For the primary indicator User level, there was also no difference in the results of the two KOLs.

Judging from the results of Section 5.1, if you want to improve Zhu Xiaohan's influence ability, you can focus on improving the three levels of KOLs, advertising and users. Zhu Xiaohan has reached a certain bottleneck, and the platform and products have little impact on it. In contrast, if you want to improve Fang Qi, these five levels of improvement space are quite large.

6. Conclusions

Mobile social media is an effective tool for enterprises to create, acquire and co-create value with customers. KOL advertising based on short video platforms provides a huge marketing boost. In particular, KOL advertising promotion is not simply about selecting one KOL for promotion, but selecting several for synchronous or installment promotion. Therefore, we need to establish an evaluation framework to determine the promotion level of different KOLs and rank them. Based on this, we can fully understand the selected KOLs and conduct reasonable planning to obtain the best advertising decisions.

Based on the above considerations, this paper forms a systematic KOL evaluation method, which eliminates the subjective uncertainty in the KOL evaluation process. Firstly, an evaluation index system based on KOL's promotion ability was constructed, including 5 first-level indicators and 18 s-level indicators. Secondly, the uncertainty theory satisfying symmetry is innovatively applied to deal with the non-quantifiable problem in the evaluation process of KOLs. Finally, different KOLs are compared and analyzed to clarify the impact of each index on different objects. The research results of this paper can provide targeted suggestions for the improvement of different KOLs.

In this study, we applied the uncertainty theory to the rating evaluation of short video advertising promoters, forming a very new KOL evaluation method. The assessment methods used in this paper can also be applied in many areas to solve other assessment problems. For example, in a company, when evaluating candidate managers, the same method used in this article can be employed.

Author Contributions: Conceptualization, Y.N.; methodology, D.L.; validation, F.L.; data curation, F.Z. and Y.G.; writing—original draft preparation, M.J.; writing—review and editing, M.J. All authors have read and agreed to the published version of the manuscript.

Funding: The APC was funded by all authors.

Data Availability Statement: Not applicable.

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

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