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How Do We Engage Customers in Official Activity in the Virtual Brand Community? The Effects of Enterprise-Generated Contents on Customer Engagement Behaviors

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Abstract: The rapid development of information and communication technologies has positioned virtual brand communities as key platforms for facilitating direct interactions between companies and customers. As part of this trend, enterprises are increasingly utilizing enterprise-generated content (EGC) to drive customer engagement within these communities. However, numerous enterprises struggle to achieve the desired levels of online interaction. This study seeks to address this challenge by systematically measuring the characteristics of EGC in brand communities and examining their effects on varying forms of customer engagement behaviors (CEBs). We categorize EGC characteristics into five dimensions and classify CEBs into three different levels based on engagement intensity. Using a large dataset of 21,850 EGC posts and corresponding customer behavior data, we employ text analysis and machine learning techniques to conduct a robust empirical analysis, revealing the complex relationships between EGC characteristics and CEBs. The findings reveal that media richness, information specialty, and information incentive of EGC positively influence higher-intensity CEBs, whereas more obvious information persuasiveness and information marketing fall short of driving active community engagement. This research not only uncovers the nuanced relationships between EGC characteristics and engagement behaviors but also contributes to the empirical results of EGC studies by applying large-sample text analysis methods. Furthermore, it provides valuable insights for enterprises aiming to optimize their content strategies to influence customer behaviors and achieve targeted marketing goals within virtual brand communities.

Keywords: virtual brand community; enterprise-generated content; consumer engagement behavior; content characteristics

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1. Introduction

Recent advancements in information and communication technology have progressively transformed interactions between enterprises and consumers, shifting them from traditional offline environments to online brand communities [1]. For instance, as of June 2024, China had over 1.1 billion Internet users, reflecting consumers' growing proficiency with social networking sites. Recognizing this trend, brands have prioritized establishing virtual brand communities as dedicated spaces for consumer engagement. These communities are typically crafted online by brands to post brand-related messages and generate brand-related content [2], thereby enabling interactions with consumers through liking, replying, and other forms of engagement on brand posts. Virtual brand communities have not only become an important front for enterprises and consumers to carry out professional communication but also the main platform for consumers and other consumers to engage in

social and brand discussion. There is no doubt that brand communities, as a form of social media expression, outperform both official websites and third-party social media platforms in terms of customer traffic and cultivating customer loyalty [3]. Within these communities, enterprises can more effectively develop or maintain customer relationships and offer superior customer–brand communication through the utilization of enterprise-generated content (hereafter, EGC). Consequently, managing virtual brand communities has become critical for enterprises to enhance customer–brand communication, strengthen customer relationships, and ultimately promote brand growth.

Customer engagement behavior (CEB) within virtual brand communities is widely acknowledged to yield substantial benefits for brands. This engagement is a give-and-learn process and encompasses activities such as sharing, co-developing, socializing, and learning. Marketers grasp customers' needs by analyzing customers' sharing or responding to products and services on social networks [3]. These efforts significantly impact brand loyalty [4] and yield various positive outcomes, including customer co-creation and commitment [5], new service development [6], faster adoption of new products [7], as well as stronger self-brand connections [3]. Positive participation from community users is instrumental in ensuring the successful operation of these communities, as demonstrated by numerous firm practices.

Enterprises have thus actively sought to generate engaging content within brand communities to foster deeper connections with customers. Compared to broader social media platforms, enterprise-managed virtual brand communities provide a brand-centric environment conducive to gathering customer insights, encouraging co-creation, and influencing customer behaviors. This leads to more meaningful engagement, enhanced brand advocacy, and greater loyalty, while also informing product development and marketing strategies [8].

However, despite these efforts, many enterprises fail to achieve the expected levels of customer engagement, often wasting valuable resources. The inability to elicit the desired customer responses in official activities within virtual brand communities remains a pressing challenge. This raises the following critical question: How can enterprises design and execute official activity posts to effectively drive customer engagement behaviors? Addressing this question is essential for realizing the full potential of virtual brand communities.

This practical challenge underscores the urgent need for actionable insights; it also reveals significant gaps in the existing research. CEBs have become increasingly important for enterprises, and enterprise-generated content (EGC) has emerged as a critical tool for fostering and maintaining strong customer relationships. Despite research on these topics rapidly growing, the specific ways in which EGC influences different customer engagement behaviors to create value within virtual brand communities remain insufficiently explored. To clarify, the research gaps are identified as follows:

Research gap 1: Lack of comprehensive understanding of EGC influences mechanisms in virtual brand community.

While numerous studies have examined thriving brand communities, various types of EGC, and related customer behaviors, a comprehensive understanding of how EGC drives engagement remains lacking. On the one hand, prior research has explored the general functions of content within brand communities and its role in maintaining loyal customer bases. For instance, some studies evaluated how "content" in virtual brand communities contributes to customer loyalty [9,10], while others highlighted the value brand communities provide to customers, such as psychological benefits (e.g., entertainment, brand learning, and hedonic value) [11] or behavioral experiences (e.g., parasocial interaction, co-creation) [12,13]. Additionally, research has considered how the characteristics of virtual brand communities (e.g., non-regionality, information quality, and system functionality) impact customer–brand relationships [2,14]. On the other hand, studies on EGC have shown its potential to shape customer behaviors and deepen brand loyalty when aligned with audience preferences and brand messaging [15,16]. However, the mechanisms through

which EGC effectively drives engagement and fosters loyalty in virtual brand communities remain underexplored. Therefore, further investigation is needed to fully leverage the potential of EGC in stimulating interactive marketing within this unique context.

Research gap 2: Isolated focus on individual attributes of contents in virtual community.

Another gap persists as the existing literature predominantly focuses on isolated attributes or features, without comprehensively analyzing how different EGC characteristics influence engagement behaviors in distinct ways. For instance, a large number of studies have investigated the psychological and behavioral effects of some specific content features in online communities, such as entertainment value [12,17], visual complexity [18], or informativeness [13,19]. There are also some studies that focus on certain characteristics of user-generated content (UGC) and their influences [20,21]. Although some scholars, such as Tyrväinen et al. [22], have noticed the distinct characteristics and roles of UGC and EGC, they have not further categorized content information into specific dimensions or conducted a more comprehensive, dimension-based discussion [23]. Overall, existing research tends to either isolate the effects of individual attributes or broadly analyze UGC's influence on customer behaviors, leaving the unique role of EGC and its characteristics underexplored. A systematic examination of how EGC's information attributes drive customer engagement is necessary to address this gap.

Research gap 3: Limited comparative analysis of EGC characteristics on different CEBs.

Another significant research gap lies in the comparative analysis of how different EGC characteristics influence various forms of CEBs. Prior studies have examined content-driven engagement, emphasizing the general role of content in fostering interaction and loyalty [10]. For example, Rosenthal and Brito [9] discussed fan engagement behaviors in brand communities, while Moran et al. [21] compared engagement behaviors across brands. However, these studies often view content effects holistically without exploring how specific characteristics (e.g., information persuasiveness, incentives) uniquely affect distinct engagement behaviors, such as liking, replying, or sharing. While some research highlights the motivational role of incentives in driving engagement [24], these findings often rely on aggregated measures and fail to differentiate between types of CEBs. Addressing this gap is crucial for understanding how EGC characteristics influence specific customer behaviors, providing actionable insights for both researchers and practitioners [25].

These research gaps highlight several key challenges in practices. Firstly, it creates an incomplete understanding of how EGC can be strategically employed to maximize customer engagement. Secondly, it risks oversimplifying the nuances of content-driven engagement by focusing on singular attributes rather than the broader array of content characteristics that may differentially impact consumer behavior. They also may lead to biased or skewed interpretations of how brands should optimize their content strategies within virtual brand communities, ultimately limiting the effectiveness of EGC in driving meaningful consumer–brand interactions. To address the above research gaps, this study systematically explores how various dimensions of EGC characteristics influence different levels of customer engagement behaviors (CEBs) in virtual brand communities. Specifically, this research focuses on five key EGC dimensions: information persuasiveness, media richness, information specialty, information marketing, and information incentive. By integrating advanced text analysis and machine learning techniques such as LIWC and word2vec, these characteristics were quantified and analyzed to examine their relationships with three types of CEBs—replying, liking, and saving. Through this specific relational study, the subtle differences in the effects of EGC information characteristics, which have not been addressed in the existing literature, can be explained, thereby helping businesses make more precise adjustments to their interactive marketing strategies in virtual brand communities.

Correspondingly, the research objectives of this study encompass the following three aspects:

(1) To classify EGC characteristics into actionable dimensions using advanced text analysis and machine learning tools such as LIWC and word2vec.
(2) To analyze the specific role of each EGC characteristic in shaping various forms of engagement behaviors.
(3) To contribute to the design of more effective EGC strategies to enhance customer engagement.

The empirical results of this study show that media richness, information specialty, and information incentive have positive impacts on replying behavior. In addition, both information specialty and information incentive also positively influence liking behavior, whereas information persuasiveness is found to have a negative effect on liking behavior. Additionally, information persuasiveness positively affects saving behavior, while information marketing negatively impacts it. Overall, information specialty and information incentive emerge as the most influential characteristics according to our findings. These findings contribute to the literature by systematically linking EGC characteristics to CEBs, providing a more comprehensive understanding of how content strategies can be optimized for virtual brand communities. Additionally, this study demonstrates the application of big data analytics and machine learning tools in uncovering insights from unstructured data, offering a methodological contribution to the study of online customer engagement.

2. Theoretical Background

2.1. The Information Adoption Model

The information adoption model (IAM) is a theoretical framework developed to explain how individuals evaluate and adopt information in various contexts, particularly in online environments. The IAM highlights two primary factors influencing information adoption: information quality and source credibility [26]. The IAM has been widely applied in fields such as e-commerce, social media, healthcare, and virtual communities to understand how users interact with content and make decisions. For instance, Zhu et al. [5] demonstrated that argument quality in online retailing influences product usefulness evaluations, subsequently driving purchase behavior. Similarly, Erkan and Evans [27] extended the IAM to social media, showing that electronic word-of-mouth (eWOM) impacts purchase intentions through information quality and source credibility. Other studies, such as those by Cheung et al. [28] and Zhang and Watts [29], confirmed the model's applicability in explaining how online community users adopt and are influenced by information. In virtual brand communities, users often assess the quality of peer-generated content or marketer-generated content to determine its usefulness for decision-making [30]. Even in chatbot-based online marketing, aspects like language style significantly shape customer experiences and acceptance [31]. Collectively, these studies demonstrate the IAM's value in designing effective communication strategies by emphasizing the importance of high-quality information from credible sources.

This research focuses on consumers' adoption behavior towards information published by an enterprise in its virtual brand community. The IAM provides an appropriate theoretical framework for understanding this process and allows for a deeper analysis of how EGC characteristics influence consumer behaviors in virtual brand communities. Specifically, we propose that EGC characteristics reflect the quality of the information and the credibility of its source, while customer behaviors toward EGC represent the outcome of cognitive evaluation processes. From the perspective of information cognition and evaluation, characteristics addressed in this study, such as information persuasiveness, media richness, information specialty, information marketing, and information incentives, represent different dimensions of information quality and credibility. For example, EGC with high media richness offers more detailed information and an enhanced experience, aligning with the high-quality information emphasized in the IAM. Investigating its impact on engagement behaviors, such as liking or sharing, explores whether consumers in virtual brand communities make decisions based on perceived information quality, consistent with the IAM's logic.

From a behavioral perspective, the IAM helps to interpret behavioral changes when consumers are exposed to different characteristics of EGC. This means that consumers' adoption behaviors toward EGC, such as replying, liking, and saving, can be seen as outcomes of evaluating EGC information characteristics. For example, EGC with high information specialty aids in consumer decision-making, thereby encouraging engagement. Similarly, information incentives act as external motivators within the IAM framework, and they were proposed to have positive impacts on different engagement behaviors. This study aims to further confirm that the IAM can explain how incentive factors in EGC drive engagement behaviors. The IAM reinforces the ability of the research model in this study to explain how EGC characteristics influence customer behaviors in virtual brand communities.

2.2. Enterprises-Generated Content and Its Characteristics

(1) Enterprises-generated Content (EGC)

Enterprise-generated content (EGC) refers to digital content officially produced and distributed by a brand or organization to achieve specific marketing, brand management, or consumer engagement objectives [32,33]. Unlike user-generated content (UGC), which originates from users' independent, voluntary creation and often reflects diverse and personal perspectives, EGC is explicitly aligned with the brand's strategic goals, ensuring consistency in terms of tone, messaging, and branding [34]. Examples of EGC include officially released promotional campaigns, fan engagement activities, product-related announcements, and official responses to customer inquiries on platforms such as brand websites, social media accounts (e.g., Facebook, WeChat, or Twitter), and virtual brand communities [34,35]. Based on this information attribute, in management practice, EGC plays distinct roles depending on the platform's level of brand control. In brand-owned communities, such as virtual brand communities with integrated social media functions, EGC serves as the primary driver of interaction, offering curated and authoritative content that aligns closely with the brand's goals [11]. Moreover, users on such platforms are often brand fans or possess a certain level of brand loyalty potential, making them more likely to engage in effective brand-based interactions, thereby contributing to the realization of brand value. Van Doorn et al. [36] verified that this controlled environment enables brands to foster trust and directly influence customer engagement behaviors, such as liking, commenting, and sharing. By contrast, on open social media platforms, where UGC and EGC coexist, brands must compete with user-generated narratives, which may not always align with their objectives [37]. In such contexts, the impact of EGC is often moderated by the volume and sentiment of UGC [36]. In summary, the forms of EGC can be categorized into two groups: (1) information about brand products and promotional activities officially released by the enterprise and (2) the enterprise's response or feedback to customer inquiries and evaluations. The distribution channels for EGC also fall into two categories: (1) brand-controlled virtual communities and (2) third-party online platforms. For this study, we focus specifically on EGC proactively published by enterprises within brand-owned communities, such as product- or activity-related posts with social functionality. Due to the absence of competing content and the higher level of brand control, the role of EGC is more pronounced in this context. Therefore, this setting holds greater research significance and will provide more valuable insights for enterprise decision-making.

(2) EGC Characteristics

In recent years, researchers have identified various characteristics of EGC that play a crucial role in shaping customer behaviors on online platforms. For instance, Yang et al. [38] explored the attractiveness of audience visits to brand micro-blogs from the perspective of entertainment attributes, such as interactivity, vividness, and entertainment value. Jamil et al. [39] demonstrated that EGC marketing activities significantly influence customer satisfaction and purchasing behaviors on social media platforms. Meanwhile, Tyrväinen et al. [22] explored how content attributes such as information quality, information useful-

ness, and emotion affect loyalty behaviors. Other researchers also mentioned features like entertainment and information [40], informative and persuasive/emotional content [41], media richness [42], and quality of content [43]. However, these studies are often limited in scope, focusing on one or two specific characteristics.

In addition, there exist diverse research findings concerning the impact of EGC on customer behavior. For example, Weiger et al. [40] demonstrated that engaging and informative content improves customer satisfaction and drives repeated interactions. On the other hand, overly promotional content may lead to customer disengagement or skepticism [44]. However, existing research often emphasizes the effects on a single type of engagement behavior, such as liking or sharing, without considering the varying degrees of influence that different EGC characteristics may have across a spectrum of engagement behaviors. Similarly, Souki et al. [45] investigated the impacts of entertainment and social and functional values on the likelihood of sharing behavior but did not offer a detailed analysis of how these values influence distinct engagement behaviors. While EGC is recognized as a powerful tool for influencing customer behavior, its nuanced effects across different intensities of engagement remain underexplored, calling for more comprehensive research in this area. Furthermore, much of the research has been limited to generalized online environments or third-party social media platforms. Studies specifically addressing the impact of EGC within brand-owned virtual brand communities are relatively scarce.

This study requires a more explicit and detailed expression of EGC characteristics within virtual brand communities to better examine their specific influences on customer behaviors. Here, by integrating insights from the latest empirical studies [22,33,35,46], we classified EGC characteristics into five types regarding the scenario of this study: information persuasiveness, media richness, information specialty, information marketing, and information incentive. These five characteristics are chosen for the following reasons:

Firstly, the impact of the persuasiveness of information can be discerned from the literature on persuasive advertising [47]. The role of persuasiveness in marketing has been well documented, with researchers highlighting its impact on consumer decision-making in various digital contexts [39].

Secondly, media richness is proposed because "photographs, pictures, and other forms of visual imagery are powerful tools of communication" [48], and rich media has been shown to enhance user engagement by providing more vivid and appealing communication. Recent studies also confirm that rich media content fosters greater interaction and emotional response from customers, particularly in social media environments [18].

Thirdly, as a virtual community whose core is the product, the importance of EGC's specialty to the customer is self-evident. This characteristic, information specialty, is particularly relevant in brand communities where consumers seek in-depth product knowledge or specialized insights [38]. Specialized content tends to attract more knowledgeable or invested consumers, thereby strengthening customer–brand relationships.

Fourth, besides introducing actual product information to customers, marketers inevitably use some marketing methods to promote products. Information marketing encompasses strategies embedded in EGC designed to promote products or services directly. Content that incorporates marketing techniques, such as product promotions or discounts, has been found to drive immediate consumer actions, including purchasing or sharing behavior [40,44].

Lastly, customers' participation in activities also requires incentives, and enterprises need to convey incentive information to customers. Information incentive refers to content that provides explicit benefits or rewards to the consumer for engaging with the brand. Research shows that incentive-driven content can effectively increase customer participation, especially in online environments [46].

In the following sections, this research not only conducts a detailed measurement of these characteristics but also provides a comparative analysis of their influence on distinct engagement behaviors. This approach aims to address the existing research gaps and

contribute to a deeper understanding of how brands can strategically leverage EGC to drive engagement behaviors within virtual brand communities.

2.3. Customer Engagement Behaviors in the Virtual Brand Community

(1) Customer Engagement Behaviors in the Context of Online Communities

Existing research on brands and services has advanced the notion of CEB, while there is little agreement over the appropriate scope of customer engagement. Facing particular contexts, many terms have been adopted in the literature, such as virtual engagement, customer engagement, brand engagement, etc. At present, researchers generally consider it as a mechanism that includes users and associates them with brands for relationship building [49]. This article adopts the term customer engagement for examining the phenomenon among e-brand communities on social media.

The findings from online brand community research provide some insight into the existence of CEB practices in individuals. Within the emerging online environment, customers are participating actively in interactive processes and highly immediate communication [50]. Javadpour and Samiei [51] have proposed the idea that the key to the success of a virtual community is members' active participation. Liu et al. [52] revealed that different brand social media information strategies have a differential impact on digital customer engagement levels. Then, the virtual community members' activeness is key to the community's successful operation. The more actively members participate, the more successful the community operation is. This active participation could include direct reactions initiated by the customers on the brand page such as "likes" and comments, and more complicated behavior like sharing and publishing content [53]. As such, many scholars focused on the different levels, types, and measurements of CEBs. In addition, researchers have measured CEBs from a scale of high to low based on the cognitive and emotional components of engagement on social media, such as reading, hitting "like", posting comments, and sharing [54,55]. The number of comments on a Facebook page, likes on Instagram, retweets on Twitter, or reviews on Yelp can also be viewed as CEB measures [46,56].

As such, we consider the customer's direct behaviors in virtual brand communities to be specific expressions of CEBs, reflecting their feedback to EGC practices within the virtual brand community. Furthermore, we categorize CEBs into three levels (high, medium, and low) based on levels of cognitive involvement and interactive attributes, as well as the degree of influence on other consumers, which are discussed below.

(2) Customer Engagement Behaviors in Virtual Brand Communities: A Focus of This Study

For regular brand virtual communities, posts in the forum typically feature three basic engagement functions: "reply", "like", and "save". Figure 1 illustrate these typical online engagement functions on a virtual brand community. The specific explanations of corresponding consumers' behaviors are provided as follows:

"Replying" behavior in a virtual brand community refers to consumers leaving comments or engaging in conversations under posts. It involves direct participation through comments and conversation, which facilitate direct interaction between community members and influences both the content creator and other community members. Replying requires the most cognitive effort and social interaction, making it a form of active engagement. Existing studies emphasize that actions like commenting or replying are more active forms of engagement, reflecting higher levels of involvement and a higher degree of commitment [57,58]. Therefore, it is viewed as high-level engagement behavior in this study.

Figure 1. Three online behaviors related to EGC posts on virtual brand community of Xiaomi.

"Liking" refers to users expressing approval or support for a post by clicking a "like" button, offering immediate and visible feedback. While it requires less cognitive effort than replying, it still provides visible feedback to the content creator. Vilkaite-Vaitone's study [59] confirmed that liking signals approval without the need for deep interaction but still contributes to the content's visibility and popularity. Therefore, it represents a form of moderate engagement. In this study, we define liking as a medium-level engagement behavior.

"Saving" behavior in virtual communities, just like bookmarking, often indicates interest without immediate interaction. These actions require less cognitive and emotional investment than more interactive behaviors like replying, creating content, or giving "likes", which involve active participation and contribution [58]. The COBRA model (Consumer Online Brand-Related Activities) classifies saving behaviors as part of consumption behaviors, which are at the lower end of the engagement spectrum. Saving primarily benefits the individual user and has limited influence on other consumers or the community at large [54]. Thus, saving posts is the lowest level of CEB in our study.

3. Hypotheses Development

Drawing upon the IAM paradigm, our conceptual framework is illustrated in Figure 2. The EGC characteristics are related to the information's persuasiveness, richness, information specialty, information marketing, and information incentive in the IAM paradigm. The CEBs reflect the direct reaction to the information, represented by online behaviors of relying (high level), liking (medium level), and saving (low level). These CEBs contribute to improving the virtual brand community's activity and ensuring its good operation.

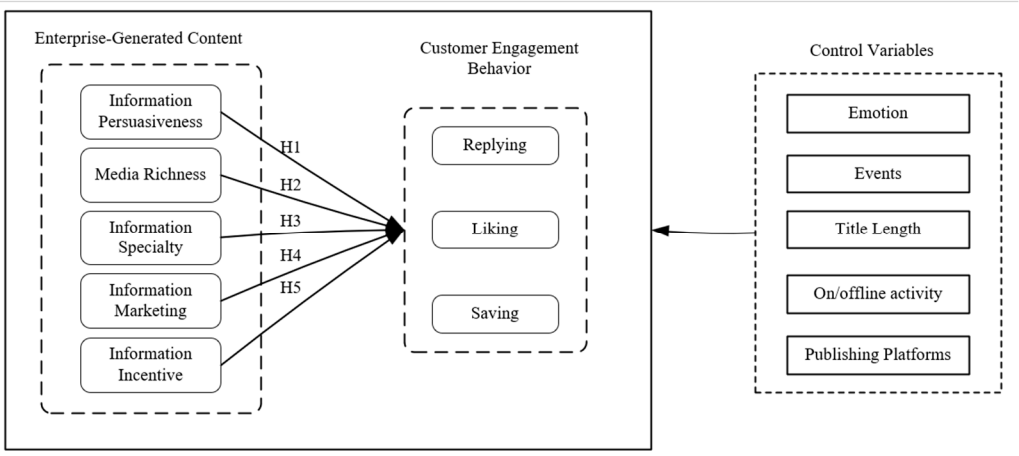

Figure 2. Proposed theoretical model.

3.1. Information Persuasiveness and Customer Engagement Behaviors

Research about content in social and mass media indicates that content is evaluative and can help persuade consumers [60]. Persuasion in social communication can influence and change individuals' attitudes in a free-choice environment [61]. We draw the idea of the information persuasiveness of EGC from the notion of persuasive advertising in the marketing literature. It is a key element of the content characteristics in social media and is used when a consumer is measuring the quality of the information contained in online messages [47]. In this study, information persuasiveness shows the desire for the feedback behaviors directly expressed on the enterprises' official activity messages published in the virtual brand community.

Studies show that persuasive messages in an advertisement enhance evaluations and implant a sense of good experience in customers. They motivate customers to purchase a product by highlighting the positive image of products or brands. Yang and Zhao [62] have proposed that individuals' information processing styles drive consumers' behavioral engagement. For instance, persuasive appeals result in greater consumer engagement intention towards social media ads. Similarly, official marketers in the virtual brand community can attract customers' attention by embedding persuasive characteristics in EGCs. Information persuasiveness directly influences replying behavior because persuasive content encourages consumers to engage in discussions or provide feedback. In addition, persuasive content, especially when it highlights the benefits of a product or brand, tends to evoke positive emotions in consumers, leading them to express their approval through liking. And persuasive content often provides valuable or actionable information that consumers wish to revisit later, either for making a purchase decision or for future reference. Hence, we argue that the information persuasiveness of EGCs in the virtual brand community will enhance increased customer interaction and propose our first hypothesis:

H1. *Information persuasiveness of EGCs in the virtual brand community positively affects replying, liking, and saving behaviors.*

This hypothesis encompasses three specific hypotheses presented in Table 1:

Table 1. Specific hypotheses in hypothesis 1.

Hypothesis	Relationship Between Variables
H1a	Information persuasiveness → replying behavior
H1b	Information persuasiveness → liking behavior
H1c	Information persuasiveness → saving behavior

3.2. Media Richness and Customer Engagement Behaviors

Studies have also focused on the positive effect of media richness on customer usage experience and interaction behavior on online platforms. For example, in the context of online education, research shows that students perform differently depending on whether courses are delivered via video, audio, or text. Notably, student concentration level was more strongly associated with richer multimedia than leaner text-based delivery modalities [63]. Richer communication media may also be more appropriate on social media. For instance, text and language are largely inadequate mediums for articulating esthetic experiences; conversely, photographs, pictures, and other forms of visual imagery are powerful communication tools [18,64]. Similarly, when promoting a product or engaging with customers in virtual brand communities, images or videos can trigger stronger emotional responses and more active participation than text-based posts [65]. Media richness represents the ability of information to transmit multiple cues [66]. We use media richness to evaluate the variety of information included in activity posts published by enterprises.

Because rich media conveys more information, it is beneficial for online consumers. They tend to assimilate the information they receive through richer media online more easily and need to spend less effort searching for information, which helps in decision-making [67]. Replying behavior is particularly influenced by media richness because detailed and visually engaging content allows consumers to better understand the product or service. Liking behavior is driven by rich media as it enhances the emotional appeal of the content. When consumers find the content engaging and visually stimulating, they are more inclined to express their interest by liking the post, which signals their approval and engagement. When content is both informative and visually appealing, consumers are more likely to save it for future reference, especially if it is tied to important product information or future purchasing decisions. Based on this, we argue that when richer media is used in the communication between the brand and customers in virtual brand communities, customers may show higher intentions of providing feedback to the brand. Thus, we have our second hypothesis:

H2. *Media richness of EGCs in the virtual brand community positively affects replying, liking, and saving behaviors.*

This hypothesis includes three detailed hypotheses outlined in Table 2:

Table 2. Specific hypotheses in hypothesis 2.

Hypothesis	Relationship Between Variables
H2a	Media richness → replying behavior
H2b	Media richness → liking behavior
H2c	Media richness → saving behavior

3.3. Information Specialty and Customer Engagement Behaviors

A brand community is specialized because the brand is the center of a product [68], the same as a virtual brand community. The EGC generated within the community involves product-related information. Conveying product-related information to consumers on communal-brand platforms is the main feature of electronic commerce [69]. For instance, EGC may embed product and other related information (e.g., product hardware, product performance). Information specialty measures how close the content in official posts is to the brand community's core product. It is vital for consumers to catch the point of this brand community.

When customers are in a complex information environment, like an online platform, they are typically averse to losses [46]. They are also looking to make an informed and optimal decision [70]. Then, product-related information may spark their favor and subsequent interaction. Hence, when customers possess more product-related information,

they will be more likely to interact with the community. Replying behavior is influenced by the need to express opinions or ask questions about the product. In detail, specialized information helps guide these responses. When EGC is closely tied to the product's features, consumers are more likely to engage with content that they perceive as valuable or relevant to their own interests. In this sense, liking serves as an acknowledgment of the content's relevance and utility in shaping their opinions about the product. Consumers may save product-related content for future reference, especially when they are considering a purchase or want to revisit important details later. Consequently, we expect that the information specialty of EGC positively affects CEBs and propose our third hypothesis:

H3. *Information specialty of EGCs in the virtual brand community positively affects replying, liking, and saving behaviors.*

This hypothesis includes three detailed hypotheses outlined in Table 3:

Table 3. Specific hypotheses in hypothesis 3.

Hypothesis	Relationship Between Variables
H3a	Information specialty → replying behavior
H3b	Information specialty → liking behavior
H3c	Information specialty → saving behavior

3.4. Information Marketing and Customer Engagement Behaviors

Drawing from the advertising literature, we consider information marketing to be relevant for advertisement, such as brand-related information like general news about the brand or brand-related events [35,71]. EGCs in the virtual brand community are similar to advertising on traditional media [72]; crucially, the former is cheaper. Hence, enterprises are more willing to convey brand-related information to the public. Moreover, brand-related information is important for those high-loyalty customers who engage in the brand community for favoritism because they have strong product re-purchase intention [73]. Then, marketing information (e.g., news about brand-related events or business cooperation) that can reduce informational uncertainties often attracts customers' attention [74].

When the marketing content directly addresses topics or events of interest, customers are more likely to reply with their own opinions, experiences, or questions, especially if the information is timely and relevant to their needs. Liking behavior is also affected by information marketing as it plays a crucial role in shaping customers' attitudes toward the brand. And, when customers are presented with useful, relevant, or intriguing brand-related information, they are more likely to save it for future reference. Therefore, greater information marketing can provide more opportunities to attract customers' attention to the EGC. Thus, we propose our fourth hypothesis:

H4. *Information marketing of EGCs in the virtual brand community positively affects replying, liking, and saving behaviors.*

This hypothesis includes three detailed hypotheses outlined in Table 4:

Table 4. Specific hypotheses in hypothesis 4.

Hypothesis	Relationship Between Variables
H4a	Information marketing → replying behavior
H4b	Information marketing → liking behavior
H4c	Information marketing → saving behavior

3.5. Information Incentive and Customer Engagement Behaviors

Information incentive represents the material or non-material motivation inserted in the official activity posts and is important for consumers' decision to be involved in online activities. Extrinsic motivation is an important reason for customers to participate in different social media activities. Extrinsic motivation mentioned here means the activity's motivating factors beyond the task itself, including the quest for an external reward such as financial incentives and real gifts [75]. Studies on incentive in the online environment show that it plays an important role in influencing positive customer attitudes and behaviors. Shen et al. [76] suggest that incentives increase online shoppers' willingness to purchase and re-engage in bidding by motivating their interest and excitement regarding auction products. Yesiloglu et al. [77] found that hedonic reward influences the frequency of consuming and contributing to brand-related posts on social networking sites, and economic incentive is a motive for creating brand-related posts. Therefore, releasing incentive information with rewards may inspire consumers to make more efforts in the brand community. In this study, we define information incentive as the information about both material and non-material incentives.

When brands need customers' recommendations, incentives (e.g., rewards) are effective for encouraging recommendations [78]. When customers participate in firms' activities, they need to spend their time, knowledge, and other resources. Then, customers may compare these costs versus the benefits of engaging in activities. Replying behavior is influenced by information incentives because when incentives are offered, whether in the form of discounts, prizes, or recognition, consumers are motivated to provide more thoughtful responses or share their opinions in order to reap the benefits. This external motivation, beyond their interest in the content, encourages them to interact with the brand or other community members, leading to increased replying behaviors. Liking behavior is similarly impacted by information incentives. When customers are offered rewards or recognition for interacting with posts, they are more inclined to show their approval through liking, which serves as a simple, low-effort form of engagement. Saving behavior is also influenced by information incentives, because incentives can increase the perceived value of the content, making consumers more likely to save it for future use, especially if it helps them access future rewards or further brand interactions. Therefore, enterprises often provide customers with incentives to ensure their participation in the activity by offsetting their costs; hence, customers may be more motivated to engage in activities [72]. We propose our fifth hypothesis:

H5. *Information incentive of EGCs in the virtual brand community positively affects replying, liking, and saving behaviors.*

This hypothesis includes three detailed hypotheses outlined in Table 5:

Table 5. Specific hypotheses in hypothesis 5.

Hypothesis	Relationship Between Variables
H5a	Information incentive → replying behavior
H5b	Information incentive → liking behavior
H5c	Information incentive → saving behavior

Figure 2 depicts the proposed research model. The independent variables are the five EGC characteristics: information persuasiveness, media richness, information specialty, information marketing, and information incentive. The dependent variables are three CEB levels: replying, liking, and saving.

To enhance the robustness of the results and minimize potential confounding effects, we include the following control variables: emotion, events, title length, online/offline activity, and publishing platforms. These control variables are classified into three main

aspects that may significantly influence customer behaviors. The fist aspect is content characteristics, which includes emotion (whether the post reflects subjective emotions), events (whether the post mentions trending social events), and title length (the length of the post's title). These factors influence customer engagement by shaping the emotional appeal, relevance, and clarity of the content. The second one is activity characteristics. This refers to online/offline activity, as hybrid activities combining both online and offline components may drive engagement differently than purely online activities. And the last one is publishing channels, reflected as publishing platforms. This refers to the number and type of platforms where the same content is distributed. Greater distribution across platforms may increase content visibility and user interactions. By accounting for these variables, the analysis ensures that the observed effects are primarily attributable to the proposed EGC characteristics, thereby strengthening the validity and reliability of the research findings.

4. Methodology

4.1. Measurement

We define five key characteristics of enterprise-generated content (EGC): information persuasiveness, media richness, information specialty, information marketing, and information incentive.

Information persuasiveness reflects the strength and intensity of the persuasive tone in the content. It measures how effectively the message is designed to convince or influence consumers. LIWC (Linguistic Inquiry and Word Count), as a software that can quantitatively analyze the categories of words in text content, was used to measure this independent variable. More specifically, LIWC is a widely used linguistic tool that analyzes various psychological and language features within a given text by calculating the frequency of specific word categories. To quantify information persuasiveness, we utilized the LIWC2022 text analysis tool, specifically focusing on the "certain" category of words. The "certain" category includes words that express confidence and certainty, such as "definitely", "always", and "must". These words are considered indicative of persuasiveness, as communication strategies that rely on certainty are often associated with more persuasive messages. In this research, we conducted a word frequency count of "certain" words in each post to reflect the degree of information persuasiveness.

Similarly, we also used the LIWC2022 dictionary to measure another independent variable, "information incentive". Information incentive measures the degree to which the content offers rewards or incentives to motivate consumer engagement. It assesses how much the post encourages participation through rewards like discounts or contests. Therefore, the "money" category in LIWC dictionary is suitable for measuring information incentive due to the presence of financial-related language. Words in "money" category usually related to financial concepts, such as "profit", "payment", and "cost". These terms are commonly used to reflect incentives tied to rewards or motivations. For this study, we calculated the frequency of words in the "money" category appearing in the text of each post and used this number as a proxy measure for the information incentive.

Information specialty indicates the alignment of the official posts with the core product or service of the brand. It measures how closely the content focuses on the central themes and offerings of the brand community. To measure information specialty, we use the word2vec algorithm—an ML approach originally developed to analyze textual data—to assess the similarity between each EGC post and the official product information provided by the brand. Specifically, by converting textual content into vector representations, word2vec captures the semantic relationships between words. In the first phase, we gathered official descriptions and related content (e.g., product/service descriptions and promotional materials) from the brand's website and official Weibo account over the past year to serve as the brand's semantic benchmark. Simultaneously, EGC was extracted from virtual communities. Then, after preprocessing steps such as stop word removal and tokenization, the word2vec model was applied to train word embeddings for the

tokenized results, and all textual data were vectorized into high-dimensional semantic representations. To enhance the quality of semantic representations, we adopted a TF-IDF-weighted text aggregation method, which better aligns the semantic representations of longer texts with the brand's contextual semantics. Finally, each EGC post is then embedded into the same vector space, allowing for a comparison between the post and the official product descriptions. The second phase is to calculate the similarity between the vectors to determine how closely aligned the EGC is with the official product information. For similarity measurement, cosine similarity was chosen as the primary metric. This decision was based on its sensitivity to directional relationships in high-dimensional vector spaces and its standardized results (ranging from -1 to 1), which effectively capture semantic relevance between texts. Additionally, preliminary experiments compared cosine similarity with alternative similarity metrics, such as Euclidean distance and dot product, revealing that cosine similarity outperformed in terms of capturing semantic directionality and demonstrated higher computational efficiency. As a result, higher similarity scores indicate greater levels of information specialty, and low similarity implies that the content is not as product-focused.

Information marketing is also measured utilizing word2vec word embedding techniques. As information marketing refers to the extent to which the content is related to brand-related advertisements or promotional messages, we crawled official advertising and promotion text over the past year to build the corpus for word2vec model training. After converting both EGC posts and official marketing content into numerical vectors, we calculated the cosine similarity between EGC posts and official marketing content. High similarity scores indicate strong alignment, while low scores suggest that the content is less focused on marketing issues.

Media richness assesses the diversity of media formats utilized in the content, such as images, videos, and links. This characteristic captures the variety and depth of the media employed to engage the audience. To measure media richness, the number of images, videos, and links in each EGC post can be directly counted. The combined total of these elements serves as an indicator of media richness, providing a quantitative assessment of how richly the content is presented.

Then, we use the reply, like, and save numbers to measure high, medium, and low engagement behaviors towards each EGC, respectively. To obtain robust estimates of the effect of EGC constructs, we control for five other potentially confounding factors: (1) emotion (whether EGC shows subjective emotions); (2) hot-spot event (whether EGC involves hot-spot event); (3) title length (the title length of the post); (4) online/offline (online or offline activity); and (5) platforms (the number of platforms publishing the same post).

4.2. Data

To examine the differential effects of the characteristics of EGC information on different levels of CEB, we scraped data of the top 60 most active virtual brand communities, spanning a variety of industries and product categories. Unlike traditional social media platforms, these virtual communities are established and managed directly by companies, with the primary objective of fostering customer engagement to enhance brand loyalty. For example, highly active communities such as the Xiaomi Community, Lenovo Community Forum, and Huafen Club of Huawei boast large fan bases and significant daily active user counts. These communities serve as strategic tools for expanding the brand's social influence by leveraging fan networks and the associated fan economy. In these company-initiated communities, official brand accounts frequently post content or organize community activities designed to stimulate customer participation and elevate community activity levels. The active involvement of brands in these communities creates a positive feedback loop, where increased customer interaction leads to stronger brand–customer relationships and greater overall community engagement. This dynamic environment

fosters a healthy and ongoing dialog between the company and its customers, helping to sustain long-term customer loyalty and satisfaction.

The virtual brand communities discussed in this research are created and managed by companies with the goal of fostering customer engagement and enhancing brand loyalty through proactive customer interaction. These communities are characterized by the presence of a large number of certified official brand accounts that are responsible for managing and operating the communities, playing an active role in guiding customer interactions. The posts published by these official accounts are diverse in nature, including community activity announcements, interaction-driven posts, and experience-sharing posts. This varied content aims to maximize customer participation and foster effective brand–customer interactions. To collect the data, we tracked and scraped the top 200 official accounts within these communities based on the number of posts published and the number of followers each account had. The focus of the data collection was on the posts themselves, excluding those with no engagement behaviors (i.e., posts with 0 likes, 0 comments, and 0 shares). In total, we gathered 21,850 posts, capturing the complete content of each post, such as text, links, images, and other embedded media. We also collected corresponding customer engagement feedback, including the number of likes, replies, and saves associated with each post. This rich dataset enables the rigor of this empirical research.

Table 6 shows the descriptive statistics of independent and dependent variables, highlighting significant variability across both groups. Notably, the dependent variables all exhibit substantial overdispersion, as evidenced by standard deviations far exceeding their means. Such highly skewed distributions reflect that some posts attract extremely high engagement and more posts receive minimal interactions. The high variability among dependent variables aligns with the heterogeneous patterns of customer engagement, where certain posts go viral while others remain unnoticed. In addition, among the independent variables, media richness shows the highest variability, with a maximum value of 44, suggesting that some posts include significantly more diverse media content compared to others. Such variability is in line with the diverse nature of online content and user engagement behaviors in virtual brand communities.

Table 6. Descriptive statistics.

Type	Variables	Mean	Std. Dev.	Min	Max
Independent Variables	Information persuasiveness (LIWC)	1.5664	1.1072	0	5
	Media richness	2.7901	4.0315	0	44
	Information specialty (word2vec)	0.4077	0.3023	0	1
	Information marketing (word2vec)	0.2545	0.4359	0	1
	Information incentive (LIWC)	1.2321	1.3774	0	6
Dependent variables	Reward	1047.333	1112.363	0	81,137
	Reply	2513.296	15,556.064	0	193,074
	Save	116.528	342.87	0	2006

4.3. Estimation Procedure

We use a negative binomial regression model to examine the impact of several EGC characteristics on CEBs because of two reasons. First, the three dependent variables (reward, reply, and save) are count data, with each variable being non-negative and right skewed. Second, as shown in Table 6, the data suffer from overdispersion, and the variance of each variable exceeds its mean [79]. These features make the negative binomial regression model a "better fit" for portraying the relationship between EGC characteristics and CEBs. While the negative binomial regression model is appropriate for our dataset, we acknowledge its limitations and potential biases. First of all, the model assumes that customers' engagement decisions (e.g., saving, liking, replying) are independent of one another, which might oversimplify the complexity of consumer interactions in online communities. Secondly,

unobserved factors influencing engagement behaviors could introduce omitted variable bias, potentially affecting the robustness of the results.

Despite these limitations, this model is well suited for this study because of the structure of our data. The model's flexibility allows us to capture the variability in engagement behaviors more accurately. So, in this study, we make two assumptions. First, CEBs are independent. That is, whether a consumer clicks the "save" button, "like" button, and/or give "replies" through their profile solely depends upon their attitude and judgment. Second, a customer's current engagement decision is unaffected by their prior engagement decisions.

We denote i as an EGC post in the virtual brand community. j represents different CEB levels, where j is equal to 1, 2, or 3, representing reward, reply, or save, respectively. Then, the number of CEBs in the j level evoked by an EGC post i is denoted as Y_{ij}. The actual number of rewards, replies, or saves in response to EGC posts, which is the actual value of Y_{ij}, is represented by q. Therefore, the negative binomial regression model can be elaborated on in Equation (1) as follows:

$$P(Y_{ij} = q) = \frac{\Gamma(\lambda_{ij}/\theta + q)}{\Gamma(\lambda_{ij}/\theta)\Gamma(q+1)} \left(\frac{1}{\theta+1}\right)^{\frac{\lambda_{ij}}{\theta}} \left(\frac{1}{\theta+1}\right)^{q}, \lambda_{ij} > 0, \theta > 0 \quad (1)$$

In Equation (1), $\Gamma(\cdot)$ is the gamma distribution and θ refers to the overdispersion parameter [80]. λ_{ij} represents the expected number of CEBs at three different levels: reward, reply, and save. Then, $\log(\lambda_{ij})$ can be elaborated on as a function of a save of independent and control variables. This model is specified in Equation (2) as follows:

$$\begin{aligned} \log(\lambda_{ij}) = \alpha_{0j} + \quad & \alpha_{1j}\text{Persuasive}_i + \alpha_{2j}\text{Mediarichness}_i + \alpha_{3j}\text{Specialty}_i \\ & + \alpha_{4j}\text{Marketing}_i + \alpha_{5j}\text{Incentive}_i + \alpha_{6j}\text{Emotion}_i \\ & + \alpha_{7j}\text{Events}_i + \alpha_{8j}\text{Titlelength}_i + \alpha_{9j}\text{On/offlineactivity}_i \\ & + \alpha_{10j}\text{Publishingplatforms}_i + \varepsilon_{ij} \end{aligned} \quad (2)$$

5. Data Analysis Results

We classify and encode each EGC by manual labeling. The value of each characteristic of EGCs is the sum of the number of corresponding codes. To ensure the objectivity of the coding, three experts were asked to complete the coding process independently, and the consistency of the coding results was tested by Kappa coefficients.

5.1. Regression Results

The effects of each EGC characteristic of the EGC on CEBs are presented in Table 7. And Figure 3 shows the significant hypotheses results.

Table 7. The impact of EGCs in the virtual brand community on CEBs.

EGC Characteristics	CEBS		
	Replying	**Liking**	**Saving**
Information persuasiveness	−0.082	−0.408 ***	0.165 ***
	(0.063)	(0.057)	(0.061)
Media richness	0.043 **	0.001	−0.01
	(0.023)	(0.020)	(0.013)
Information specialty	0.406 ***	0.316 ***	0.085
	(0.102)	(0.107)	(0.097)
Information marketing	−0.099	0.103	−0.167 *
	(0.096)	(0.118)	(0.094)
Information incentive	0.291 ***	1.319 ***	0.131
	(0.089)	(0.094)	(0.086)

Table 7. *Cont.*

EGC Characteristics	CEBS		
	Replying	**Liking**	**Saving**
Control variables			
Online/offline activities	−0.534 ***	−1.363 ***	−0.189
	(0.166)	(0.176)	(0.16)
Publishing platforms	−0.152	−0.283 **	0.042
	(0.132)	(0.13)	(0.125)
Title length	0.061 ***	0.066 ***	0.041 ***
	(0.01)	(0.011)	(0.009)
Emotion	−0.852 ***	−0.7 ***	−0.533 ***
	(0.186)	(0.193)	(0.175)
Hot-spot events	0.016	−0.793	0.3
	(0.854)	(0.876)	(0.796)
Cons	1.945 ***	4.796 ***	3.029 ***
	(0.349)	(0.335)	(0.331)
Log-likelihood	−2864.138	−4785.4524	−3401.6532
Pseudo r2	0.0253	0.0492	0.0077
Lr test	148.63	495.60	52.84
Prob > chi2	0.000	0.000	0.000
STANDARD ERRORS ARE IN PARENTHESES			

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

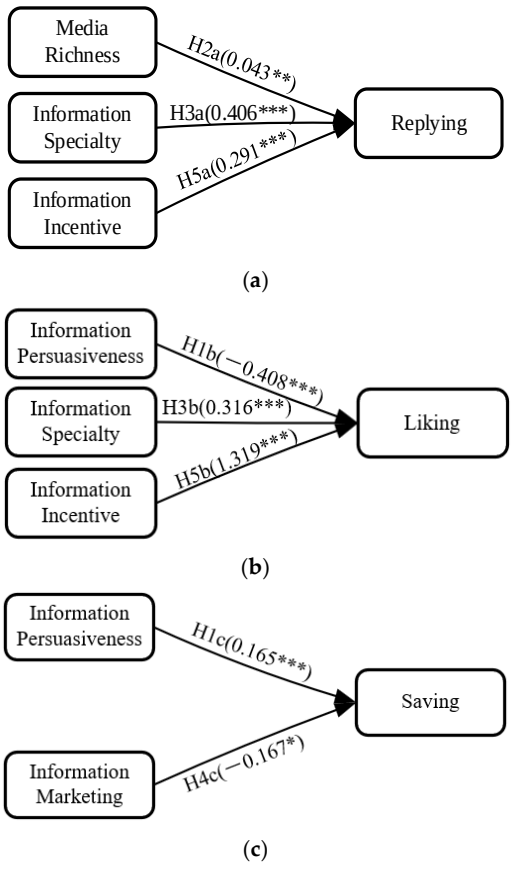

Figure 3. The significant effects of EGC characteristics on CEBs. (**a**) The significant effects of EGC on replying behavior; (**b**) the significant effects of EGC on liking behavior; (**c**) the significant effects of EGC on saving behavior (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).

First, the persuasiveness of an EGC's information is positively, negatively, and insignificantly associated with saving ($\alpha = 0.165$, SE = 0.061, $p < 0.01$), liking ($\alpha = -0.408$, SE = 0.057, $p < 0.01$) and replying behaviors ($\alpha = -0.082$, SE = 0.063, $p > 0.1$), respectively. Thus, H1a is not supported, H1b is rejected, and H1c is supported. Second, media richness positively affects replying behavior ($\alpha = 0.043$, SE = 0.023, $p < 0.05$) but has insignificant impacts on liking ($\alpha = 0.001$, SE = 0.013, $p > 0.1$) and saving behaviors ($\alpha = -0.01$, SE = 0.020, $p > 0.1$). Therefore, H2a is supported, while H2b and H2c are not supported. Third, information specialty is positively associated with replying ($\alpha = 0.406$, SE = 0.102, $p < 0.01$) and liking behaviors ($\alpha = 0.316$, SE = 0.107, $p < 0.01$). Thus, H3a and H3b are supported, while H3c is not supported. Fourth, information marketing only has a significant, but negative, impact on liking behavior ($\alpha = -0.167$, SE = 0.094, $p < 0.05$). Thus, H4b is rejected, while H4a and H4c are not supported. Finally, both replying ($\alpha = 0.291$, SE = 0.089, $p < 0.01$) and liking behaviors ($\alpha = 1.319$, SE = 0.094, $p < 0.01$) are positively affected by information incentive. Thus, H5a and H5b are supported, while H5c is not supported.

Based on the above results, information incentive emerges as the most influential characteristic, strongly driving both replying and liking, and demonstrating its importance in fostering interactive and engagement behaviors. Similarly, information specialty also shows a strong positive effect on both replying and liking behaviors, suggesting that incentivizing content is a key driver of consumer engagement. Conversely, media richness and information persuasiveness had mixed or limited impacts. Moreover, information marketing, apart from its significant negative effect on liking, does not exhibit any other notable positive impacts on engagement behaviors. These findings underline the pivotal role of content quality (e.g., information specialty) and motivational elements (e.g., information incentive) in shaping consumer engagement.

5.2. Robustness Check

We conduct a series of tests to investigate the influence of data and modeling choices and generally check the robustness of our findings. First, we test the correlations among the fine-grained EGC characteristics [81]. Most estimated correlation coefficients are smaller than 0.1, suggesting that there are no strong correlations among the majority of message appeal dummy variables. Second, we develop a log-general linear regression which models a part of the subsamples. The detailed results are summarized in Table 8, which are consistent with our original findings.

Table 8. Robustness check on potential endogeneity.

EGC Characteristics	CEBS		
	Replying	**Liking**	**Saving**
Information persuasiveness	−0.023	−0.005	0.208 ***
	(0.064)	(0.065)	(0.063)
Media richness	0.014 **	0.011	−0.016
	(0.015)	(0.015)	(0.015)
Information specialty	0.277 ***	0.116 ***	0.064
	(0.102)	(0.103)	(0.099)
Information marketing	−0.098	−0.08	−0.22 **
	(0.097)	(0.098)	(0.094)
Information incentive	0.293 ***	0.76 ***	0.203 **
	(0.089)	(0.09)	(0.086)
Control variables			
Online/offline activities	−0.629 ***	−0.914 ***	−0.652 ***
	(0.167)	(0.169)	(0.163)

Table 8. *Cont.*

EGC Characteristics	CEBS		
	Replying	**Liking**	**Saving**
Publishing platforms	0.074	−0.013	0.147
	(0.139)	(0.14)	(0.135)
Title length	0.047 ***	0.086 ***	0.051 ***
	(0.009)	(0.009)	(0.009)
Emotion	−0.678 ***	−0.58 ***	−0.487 ***
	(0.193)	(0.195)	(0.188)
Hot-spot events	−0.088	0.048	−0.077
	(0.174)	(0.176)	(0.17)
Cons	1.108 ***	2.441 ***	1.705 ***
	(0.328)	(0.331)	(0.32)
Root MSE	1.5177	1.5314	1.4778
ADJ R^2	0.1264	0.3160	0.1512
P	0	0	0
STANDARD ERRORS ARE IN PARENTHESES			

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

6. Discussion and Implications

6.1. General Discussion

We empirically examine the impact of EGC in virtual brand communities on CEB and reveal the following key findings.

On the one hand, different EGC characteristics have distinct effects on consumer behaviors. Specifically, media richness, information specialty, and information incentive are more effective than information persuasiveness and information marketing in facilitating marketers-to-customers communication, especially for high and medium levels of CEBs, such as replying and liking behaviors. Additionally, information persuasiveness and information marketing show limited influence on brand–customer interactions, especially regarding replying and liking behaviors, and may even exert a negative impact. In stimulating low-level interaction behaviors such as saving, even though information persuasiveness demonstrates a certain positive effect, information marketing still exhibits a significant negative impact.

In general, richer communication media significantly enhance customers' ability to adapt to social media contexts. This is because richer media provide more comprehensive information, meeting customers' informational needs while offering engaging esthetic experiences. Additionally, specialized information plays a critical role in guiding customers through complex environments, enabling them to make informed and optimal decisions [82]. Incentives, on the other hand, offset the perceived costs associated with CEBs, further encouraging participation.

As expected, persuasive information can stimulate feedback behaviors, but its influence is limited to saving behavior, the simplest level of CEB. Interestingly, contrary to expectations, persuasive information negatively impacts liking behavior, which may hinder the marketing objectives of enterprises. This paradox can be explained through the Self-Determination Theory (SDT). According to the SDT, customers have an intrinsic need for autonomy, competence, and relatedness, which drive their motivation to act. Persuasive or overly directive language from brands often conveys a sense of control, which can undermine customers' autonomy [83]. While contextual cues might initially motivate engagement, they can suppress intrinsic motivation when perceived as coercive [40]. This lack of autonomy disrupts behaviors like liking and replying, where voluntary action is critical.

Another notable finding is that excessive marketing information not only fails to stimulate higher-level engagement behaviors (such as replying and liking) but may even

have a negative impact on lower-level engagement behaviors. The overwhelming presence of commercial information online often feels intrusive and aggressive, leading to irritation or disgust [69]. These negative emotions suppress digital engagement, as customers resist content perceived as excessively promotional or misaligned with their interests [44]. Unlike richer media or specialized information, which enhance cognitive and emotional engagement, overly marketing-focused content erodes trust and deters interaction.

On the other hand, we obtain valuable insights from the perspective of different levels of CEBs. The three customer behaviors—replying, liking, and saving—are influenced by EGC characteristics in distinct ways. In general, media richness, information specialty, and information incentive positively affect replying behavior; information specialty and information incentive positively affect liking behavior; and only information persuasiveness and information marketing significantly affect saving behavior.

When enterprises expect more replying engagement behaviors from their customers, they cannot ignore the importance of rich media and specialty information in the posts. For instance, marketers can insert pictures into EGC text to create an abundant visual stimulation and convey rich effective information. Furthermore, during new product promotions, enterprises can pay more attention to the detailed description of product-related information, such as product name and product performance, to ensure that customers are not overwhelmed by irrelevant textual details. In addition, offering informational incentives significantly boosts replying behaviors. For such content, companies should emphasize reward-based activities that facilitate customer participation.

Regarding liking behavior, enterprises should focus on information specialty and information incentive, rather than information persuasiveness. To encourage liking behavior through information presentation, enterprises should offer rewards with varying perceived values and adjust the complexity of the participation process to suit different customer preferences. This approach can make the interaction more appealing and accessible to a broader range of customers. Additionally, enterprises should refrain from using overly persuasive language in posts when seeking customer feedback, as such language may reduce customers' willingness to engage. For instance, prior to the launch of a new product, the brand may need co-creation activities aimed at eliciting customer opinions to improve the product or corresponding service. By avoiding overly persuasive information, enterprises can foster a more genuine and effective interaction with their customers.

In addition, to induce saving behavior, information persuasiveness emerges as the most influential positive factor. While it may exert a negative influence on liking behaviors to some extent, the explicit and invitational tone conveyed through persuasive information in EGC can effectively stimulate the basic individual saving behavior. This may be particularly instructive for actively guiding customers' engagement behaviors. For example, within virtual brand communities, when an enterprise aims to attract more customers and enhance customer loyalty by promoting some important posts, it can achieve this by issuing more activity invitations and posting more practical information, such as product performance and usage tips.

6.2. Theoretical Implications

This study contributes to the existing EGC and CEB literature by addressing key research gaps. It provides substantial theoretical contributions across three key aspects.

First, it enhances our understanding of the relationships between EGC characteristics and customer engagement behaviors (CEBs) within virtual brand communities. Existing research rarely compares the impact of EGC characteristics across different levels of CEBs in such brand-controlled environments. By uncovering the nuanced and complex relationships between EGC and CEBs, this study fills that gap. Using the information adoption model (IAM) as the theoretical foundation, we expand its application to virtual brand communities. On the one hand, some findings presented in this study support the framework of the IAM and expand its application boundaries. The IAM emphasizes that individuals evaluate information quality and source credibility to decide whether

to adopt or reject it. Our findings support this framework, demonstrating that EGC characteristics, such as information specialty, media richness, and information incentives, significantly influence engagement behaviors. For instance, content with high information specialty aids decision-making in complex environments, positively affecting replying and liking behaviors. Similarly, information incentives—through material or non-material rewards—stimulate engagement, aligning with the IAM's emphasis on external motivators in the adoption process. These findings highlight how IAM principles operate in virtual brand communities.

On the other hand, this study identifies areas where the IAM requires refinement. While the IAM posits that persuasive information generally drives positive behaviors, our results show that its effects are more context-dependent. For example, while information persuasiveness positively impacts saving behaviors, it negatively affects liking behaviors. In virtual brand communities, overly persuasive language may be perceived as coercive, reducing consumers' willingness to autonomously engage. This finding suggests that the IAM's assumptions about persuasive information need adjustment to account for specific contexts, particularly where excessive persuasion undermines customer autonomy. As a conclusion, this study provides new avenues for future research, encouraging scholars to further explore how to optimize information strategies within virtual brand communities. It also expands and refines the application of the IAM theory in the field of digital marketing.

Second, our empirical approach not only tests the proposed hypotheses but also offers a comprehensive and multidimensional framework for measuring EGC characteristics. By integrating advanced methodologies such as big data analytics, text mining, and machine learning, this study ensures a robust and precise assessment of EGC characteristics. The use of these sophisticated analytical techniques enhances the scientific rigor of the research, strengthening the overall credibility of the findings. This approach also provides new avenues for a deeper and more granular understanding of the relationship between EGC and customer engagement behaviors.

Third, this study provides valuable insights into how EGC characteristics influence varying levels of CEBs through multi-group analyses. Prior research has largely overlooked how different informational characteristics of EGC elicit distinct engagement responses. Our findings reveal that EGC characteristics trigger varying degrees of customer engagement, offering a nuanced understanding of these mechanisms. For example, high media richness enhances the information experience and drives higher-level behaviors, such as replying. In contrast, information persuasiveness primarily induces low-level behaviors like saving, as its perceived controlling nature can dampen intrinsic engagement. Aggressive information marketing may fail to generate positive engagement and may even alienate customers rather than encourage them to interact. In fact, customers will resist engaging with content that feels too commercial or pushy, especially if it does not align with their interests or needs.

Building on our findings, we can conclude that the impact of EGC on CEBs is not uniformly positive; instead, it varies based on the specific characteristics of the content, sometimes even exerting negative effects. By focusing on behavioral outcomes, we summarize the mechanisms through which different EGC characteristics influence CEBs, providing a clearer understanding of these varied impacts. To elicit high-level CEB, such as replying behaviors, there is a greater need for specialized brand information, rich visual content, and appropriate incentives to further enhance customers' engagement within the community. In contrast, to stimulate medium-level CEB, represented by liking behaviors, highly persuasive language is not necessary, as customers' engagement enthusiasm remains intact even without additional prompting. In addition, positive expressions of information specialty and information incentives can also have a positive impact on liking behavior. Moreover, for low-level behaviors like saving, direct and persuasive language (information persuasiveness) is more effective in guiding participation. These findings suggest that firms must develop differentiated post-design strategies tailored to the specific engagement behaviors of their customers, ensuring more targeted and effective communication.

6.3. Practical Implications

This study also offers managerial implications for tailoring virtual brand community marketing approaches to proactively develop CEBs to promote community activity.

First, all EGC characteristics play an important role in the context of virtual brand communities. Managers should strategically design, optimize, and manage these characteristics—such as media richness, information persuasiveness, and information specialty—to create high-quality content that stimulates active CEBs. By enhancing the quality of information provided, businesses can encourage more meaningful customer interactions, thus driving community activity and increasing the effectiveness of engagement efforts. It is essential that managers use these EGC characteristics as tools to foster desired behaviors and shape customer experiences, thereby ensuring that the content resonates with consumers and encourages them to participate actively.

Second, substantial multi-group differences indicate that the different CEB levels are influenced by specific EGC characteristics. Thus, when expecting specified individuals' feedback, enterprises should carefully consider the characteristics. For instance, when seeking customer opinions and recommendations to improve their products or services, companies should avoid using overly persuasive or forcefully suggestive language in co-creation activity posts, as this may lead to customer resistance. Additionally, another significant finding is that overly prominent information marketing has a detrimental effect on engagement behavior. The growth of the Internet has facilitated the widespread dissemination of marketing messages by businesses. However, customers are often inundated with an overwhelming amount of commercial content online. As a result, they may perceive this as overly intrusive or aggressive, which can trigger feelings of frustration. These negative emotions absolutely amplify the adverse impact. By adjusting content to suit the type of engagement, businesses can more effectively prompt the desired behavior and enhance customer involvement in the community. Tailoring communication based on the type of feedback expected will result in more targeted and effective marketing strategies.

Third, enterprises can leverage different customer behaviors in the virtual brand community to achieve different marketing goals. Businesses should align their engagement strategies with specific marketing objectives. For instance, before the new product comes out, the brand may need a co-creation activity which anticipates customers' opinions as much as possible. Then, enterprises should focus on customer replying behaviors for the product or corresponding service's improvement. Meanwhile, when it needs the community's excitement on the Internet, such as when launching new products, enterprises should consider customers' liking or saving behaviors. Understanding which engagement behavior aligns with particular goals allows businesses to develop more effective strategies that cater to both short-term and long-term objectives.

Fourth, although virtual brand communities are often dominated by large brands, this study offers valuable insights for small businesses and resource-constrained niche brands. These enterprises can leverage the findings to strategically design content that fosters customer engagement while minimizing costs. By prioritizing information specialties and incentives, small companies can create targeted, high-value content that meets customer needs and encourages a meaningful interaction. For instance, niche content highlighting unique brand strengths can differentiate small businesses and build loyalty. Incentives, even modest ones, can further motivate participation without requiring substantial investment. Additionally, small businesses should avoid overly aggressive marketing tactics, which may alienate potential customers. Instead, fostering authentic relationships through co-creation activities and dialog can be more impactful. Actively incorporating customer feedback to refine products or services not only strengthens their competitive edge but also ensures cost efficiency. In this way, virtual brand communities can serve as a strategic tool for small enterprises to compete with larger brands by creating meaningful and resource-efficient customer engagement.

7. Conclusions and Limitations

7.1. Conclusions

In this study, we examined the influence of various enterprise-generated content characteristics on customer engagement behaviors, focusing on five specific traits: information persuasiveness, media richness, information specialty, information marketing, and information incentive. We further categorized CEBs into three different levels—liking, replying, and saving—and employed empirical methods to analyze how each EGC characteristic influences these behaviors. To support the empirical results, we rigorously measured the study variables by crawling extensive text data and utilizing advanced text analysis and machine learning techniques, such as LIWC and word2vec. This methodological approach robustly supported the empirical findings of our research. The findings indicate that each CEB is influenced by several EGC characteristics. Specifically, media richness, information specialty, and information incentive positively affect replying behavior. Information specialty and information incentive also positively influence liking behavior, whereas information persuasiveness has a negative impact on liking behavior. Additionally, while information persuasiveness positively affects saving behavior, information marketing exerts a negative impact.

This study makes several key contributions. It deepens the understanding of how EGC characteristics influence customer engagement behaviors in virtual brand communities, offering insights for optimizing content strategies. It uses advanced analytics and machine learning tools to precisely measure EGC characteristics, enhancing research rigor. Additionally, it also improves the existing theoretical models, such as the IAM, by emphasizing the complex effects of different content characteristics of virtual brand communities on various participation behaviors. Finally, this study provides practical implications for businesses, offering guidance on tailoring marketing strategies to stimulate desired engagement behaviors and avoid negative customer reactions.

7.2. Limitations and Future Research Directions

This study has several limitations. First, we only considered the characteristics of five major aspects of EGC information within virtual brand communities. Future research could expand this framework by including a broader range of content attributes, such as emotional appeal and entertainment value, to further explore the combined impact of informational and functional attributes. Additionally, this study ignored user-generated content (UGC) in the same virtual brand community. For future research, incorporating the analysis of UGC alongside EGC could provide a more comprehensive understanding of how both content types interact and influence customer behaviors. Second, this study is constrained by its focus on specific data sources, as we primarily examined EGC characteristics of typical brands within specific industries in China, such as electronics and automotive, which have a broad fan base. This limits the generalizability of the findings across different industries or cultural contexts. Future research could explore more diverse scenarios, such as different industries, companies of varying sizes, and diverse market cultures, to understand how different factors may affect the relationship between EGC and customer engagement behaviors. Finally, the current study primarily focuses on CEBs triggered by posts actively published by official corporate teams of enterprises in virtual brand communities. However, with the increasing use of Artificial Intelligence-Generated Content (AIGC) for content creation and automated responses within these communities, this study does not explore how AIGC created by enterprises influences customer interactions. Future research could address this gap by investigating the role of AIGC in shaping customer engagement, comparing its effectiveness with human-generated content, and investigating how automated responses impact customer behaviors. This would provide valuable insights into the evolving dynamics of virtual brand communities and extend the current understanding of content-driven customer interactions.

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