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Investigating consumers' cognitive, emotional, and behavioral engagement in social media brand pages: A natural language processing approach

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ABSTRACT

By applying a natural language processing approach, the present study aims to reveal what features of brand posts (i.e., post type, vividness, interactivity, and valence) may impact consumers' behavioral, cognitive, and emotional engagement respectively. After collecting brand posts data from a microblog website, multilevel mixed-effects regression models were utilized to analyze the panel data set. It was found that interactive strategies, such as using interactional posts and integrating interactivity cues, are effective in stimulating all three dimensions of consumer engagement. Post valence, or post sentiment, is positively associated with consumers' behavioral and emotional engagement. Nevertheless, using photos or videos is found to be less effective in motivating consumer engagement. Among these three dimensions of consumer engagement, cognitive engagement is more difficult to be stimulated compared with behavioral and emotional engagement. Implications of the findings are discussed at the end of the paper.

1. Introduction

Since the proliferation of social media such as Facebook, Twitter, and Instagram, brands and companies have started to create their profiles and attempted to form and maintain relationships with the targeted consumers via the brand pages of social media (Kordzadeh and Young, 2020; Tafesse, 2016; Vries et al., 2012). Consumers can not only view the updates posted by the brands they subscribe to, but also actively engage in brand-related activities such as leaving comments, sharing the posts, communicating with brands, and interacting with other consumers, which provides ideal opportunities for social media marketing (Carvalho & Fernandes, 2018; Obilo et al., 2021). Engaging consumers in brand pages can bring several benefits to brands, including consumer satisfaction, trust, brand loyalty and commitment, continuous usage, and consumer value (Barger, Peltier, & Schultz, 2016; Vivek, Beatty, & Morgan, 2012). Therefore, brand pages in social media have been considered as a critical channel to conduct online marketing activities, such as sharing product information, maintaining the customer-brand relationship, fostering consumer community, handling consumers' feedback, encouraging customers' word-of-mouth, and so on (Alvarez-Milán et al., 2018; Ashley & Tuten, 2015; Tsimonis & Dimitriadis, 2014).

To encourage consumers to actively engage in brand-related activities, brands deliberately design and develop post content by utilizing a variety of message strategies (Harmeling et al., 2017). A large number of studies have been conducted by academicians and practitioners to reveal the relationships between brand post strategies and consumer engagement in social media (Tafesse & Wien, 2018). For example, one stream of prior studies has attempted to investigate consumers' engagement through survey questionnaires (Man, Pires, & Rosenberger, 2020; Ranaweera & de Silva, 2021). As survey questionnaires can include psychological instruments, consumers' emotional and cognitive engagements are always examined in such studies (e.g., Millissa & Cheung, 2022; Wang, 2021). However, the analysis of individuals' behaviors based on the self-reported data can always be challenged because of the problems of accuracy and response bias in survey methods (Rosenman, Tennekoon, & Hill, 2011). In other words, the respondents always answer the questions in artificial settings based on their memory and imagination, while their actual behaviors cannot be observed or recorded (Klašnja et al., 2017). Alternatively, many scholars have started to analyze consumers' engagement based on consumers' behavioral records on social media (Deng et al., 2021; Liu, Shin, & Burns, 2019; Yousaf et al., 2020). This stream of research usually crawls tens of thousands of brand posts and consumer behavioral data (e.g., consumers' likes, shares, comments) and examines the relations

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between brand post characteristics and consumers' responses (e.g., Dai & Wang, 2021; Dhaoui & Webster, 2020; Lee, Hosanagar, & Nair, 2018). Nevertheless, such studies mainly focused on consumers' behavioral engagement but neglected other dimensions of consumer engagement such as cognitive and emotional engagement (Claffey & Brady, 2017; Yousaf et al., 2020). This is partly attributed to the lack of methods and techniques to extract consumers' cognition and emotion from text-based information. As consumers' emotional and cognitive engagement are critical criteria for social media marketers to evaluate the effectiveness of brand posts design, it is necessary to understand how brand posts can stimulate consumers' emotional and cognitive engagement in the social media context.

The present study attempts to address the research gap by investigating the influential factors underlying consumers' cognitive and emotional engagement in social media brand pages by applying a natural language processing approach. Particularly, taking the advantages of natural language processing techniques, the present study aims to classify and manifest different types of brand posts, as well as consumers' cognitive and emotional engagement via a machine learning approach. Prior studies have identified several clusters of influential factors that are associated with consumers' behavioral engagement, such as post types and topics, post vividness, interactivity, posting time, fan numbers, industry sectors, and so on (Araujo et al., 2015; Kordzadeh and Young, 2020; Menon et al., 2019). In line with these studies, the present study intends to explore the influential factors in terms of brand post types (i.e., informational, transformational, interactional), post vividness (i.e., media formats such as photos and videos), interactivity (i.e., interactive cues such as hashtags, mentions, and URL links), post valence (i.e., the sentiment of brand posts), after controlling the brand-level factors (e.g., fan numbers, brands' experience of social media marketing, and the origin country of brands). The findings are supposed to contribute to a better understanding of what brand posts characteristics would impact consumers' cognitive, emotional and behavioral engagement in social media.

2. Literature review

2.1. Brand post strategies

As brand posts are regarded as important vehicles for social media marketing, social media marketers and practitioners have attempted to utilize a variety of message strategies to design post content and features, aming to effectively stimulate consumer engagement in brand pages (Dhaoui & Webster, 2020; Kordzadeh and Young, 2020). Brand posts provide themes and topics for consumers to express their feelings and experiences, and communicate with brands as well as other consumers, which contributes to brand exposure and consumer commitment (Harmeling et al., 2017). Because marketers have control over the design and implementation of brand posts on social media, they have enthusiasm for exploring how to create brand posts properly and effectively to engage consumers (Tafesse and Wien, 2017). A variety of message strategies and media formats can be utilized to promote the popularity of brand posts among consumers on social media, such as text, images, videos, external web links, hashtags, mentions, as well as informational, emotional, and experimental message content (Ashley & Tuten, 2015; Tafesse, 2016). As response, consumers may actively interact with brands through different actions afforded by social media platforms such as liking, sharing, and commenting (Tafesse & Wien, 2018).

There are mainly-two approaches of studies focusing on consumer engagement of brand posts on social media. One approach is to investigate consumer engagement based on questionnaire survey and psychological instruments, aiming to reveal consumers' psychologies and motivations when interacting with brand posts on social media (e.g., Ranaweera & de Silva, 2021; Su, Mariadoss, & Reynolds, 2019). Generally, studies of this approach usually treat consumer engagement as a multidimensional construct consisting of three main aspects including cognition, emotion, and activation (Algharabat et al., 2019; Man et al., 2020). A variety of psychological and motivational factors are found to be associated with consumers' engagement, such as post attractiveness (Millissa & Cheung, 2022), consumer attitude (Wang, 2021), and self-image expression (Wang & Lee, 2020), etc.

The other approach explores consumer engagement by crawling brand posts content and consumer behavioral traces (e.g., likes, shares, comments) in social media and further analyzing through natural language processing methods (Dai & Wang, 2021; Dhaoui & Webster, 2020; Lee et al., 2018). A large number of prior studies in this approach have attempted to reveal the relationships between the post characteristics and consumers' engagement in brand pages of social media, and the main findings and analysis methods are summarized in Table 1. However, there are several research gaps concerned with the latter approach. First, prior studies have mainly focused on exploring consumers' behavioral engagement (e.g., number of likes, shares, and comments) but neglected other dimensions of consumer engagement such as cognitive and emotional engagement (Deng et al., 2020). As consumer engagement is a multidimensional concept, other aspects concerned with consumers' cognitive and emotional engagement should also be taken into consideration (Brodie et al., 2011; Menon et al., 2019). With the development of natural language processing methods, it is possible to reveal more insights into consumers' opinions and affections based on their behavioral traces (Stieglitz et al., 2018). In addition, concerned with the analysis methods, most studies ignored the multilevel nature of the data (i.e., brand level and post level). This may partly explain why the findings of the relationships between brand post characteristics and consumer engagement are mixed and inconclusive (Cvijikj & Michahelles, 2013; Luarn, Lin, & Chiu, 2015; Tafesse, 2015; Vries et al., 2012; Yousaf et al., 2020). Last but not least, prior research mainly explored the brand post content using English but neglected social media platforms that use different languages. This may constrain the generalization of the findings of past studies, especially considering the impacts of different social contexts and linguistic characteristics.

2.2. Consumer engagement

Though prior studies have conceptualized consumer engagement from different perspectives (for a review, see Alvarez-Milán et al., 2018), the majority of the literature classified consumer engagement into three dimensions, including cognitive, emotional, and behavioral engagement (Brodie et al., 2011; Dhaoui & Webster, 2020; Tafesse & Wien, 2018). For instance, when studying virtual brand community, Brodie et al. (2013) defined consumer engagement as "a multidimensional concept comprising cognitive, emotional, and/or behavioral dimensions, and plays a central role in the process of relational exchange where other relational concepts are engagement antecedents and/or consequences in iterative engagement processes within the brand community" (p. 107). Hollebeek et al. (2014) conceptualized consumer engagement as "positively valenced brand-related cognitive, emotional and behavioral activity during or related to focal consumer/brand interactions" (p. 154). Similarly, Dessart et al. (2016) stated that consumer engagement is "expressed through varying levels of affective, cognitive, and behavioral manifestations that go beyond exchange situations" (p. 409). Therefore, consumer engagement should be investigated from a multidimensional perspective rather than a unidimensional view (Claffey & Brady, 2017). Accordingly, the present study adopts this classification and examines consumer engagement in brand pages in terms of cognitive, emotional, and behavioral dimensions.

The underlying mechanism between brand post characteristics and consumer engagement can be explained from the perspective of the Stimulus-Organism-Response (SOR) theory (Mehrabian and Russell, 1974). This theory states that the stimuli from environments can impact individuals' inner feelings and organismic experiences, which further influences their behavioral responses (Peters et al., 2013). This theory

Table 1
Summary of related studies.

Author(s)	Platform	Influential factors	Engagement measures	Coding methods	Analysis methods	Key findings
Vries et al. (2012)	Not indicated	Post types, vividness, interactivity, position, comments valence	Number of likes and comments	Automated text analysis	OLS regression	Different factors impacted the number of likes and comments respectively, such as vividness, interactivity, and/or comments sentiment.
Cvijikj and Michahelles (2013)	Facebook	Post types, vividness, interactivity, workday, peak hours	Number of likes, shares, comments	Manual	Negative binomial regression	Entertaining and informative content could motivate consumers' behavioral engagement, while interactivity decreased the level of engagement.
Araujo et al. (2015)	Twitter	Informational, emotional and Traceability cues	Number of retweets	Automated text analysis	Multilevel modelling	Informational cues of brand posts were positively associated with number of retweeting, and interaction effects of emotional cues were also identified.
Luarn et al. (2015)	Facebook	Post types, vividness and interactivity	Number of likes, shares, comments	Manual coding	ANOVA	Post vividness, interactivity, and content type were found to have significant influence on consumers' behavioral engagement.
Tafesse (2015)	Facebook	Post types, vividness, interactivity, novelty, consistency	Number of likes and shares	Manual coding	Poisson regression	Post vividness, interactivity, novelty, consistency and content types exerted significant influence on consumers' liking and/or sharing behavior.
Jeon et al. (2016)	Facebook	Message structure, call for action, reward, revenue, celebrity	number of likes and replies	Manual coding	OLS regression	Post content that contained useful information, calling for action, and rewards was more likely to motivate consumers' reaction such as liking and replying.
Tafesse (2016)	Facebook	Posts affordances for social, perceptual, epistemic, embodied experiences	Number of likes and shares	Manual coding	Poisson regression	The affordances for perceptual, social and epistemic experiences of brand posts could predict consumers' liking and sharing behaviors.
Kim and Yang (2017)	Facebook	Informational and transformational cues of brand posts	Number of likes, shares, and comments	Manual coding	OLS regression	Transformational (e.g., ego, social, sensory) and informational (e.g., ration, acute needs, and routine) cues in brand posts may lead to different types of consumer engagement.
Schultz (2017)	Facebook	Post types, vividness, interactivity, position, post time, post length, fan numbers	Number of likes, shares, and comments	Manual coding	OLS regression	Post interactivity had positive effect on consumers' liking, sharing, and commenting behaviours, while post vividness and content types generated mixed results.
Soboleva et al. (2017)	Twitter	Interactive, textual, and visual features, fan numbers, frequency, industry	Number of retweets	Excel formulas	Negative binomial regression	Hashtags, retweet requests and photos in brand posts resulted in to a higher level of retweets across different industries, while URL links, non-initial mentions and videos had mixed effects.
Lee et al. (2018)	Facebook	Informative and persuasive content, message type, industry	Number of like and comments	Natural language processing	Logistic Regression	While persuasive content positively impacted consumers' liking and commenting behaviors, informative content had negative effect on consumers' behavioural engagement.
Tafesse and Wien (2018)	Facebook	Post types, industry, number of fans, videos, photos, URL	Number of likes and shares	Manual Coding	MANCOVA	The transformational posts could effectively stimulate consumers' behavioral engagement, and also enhanced the effectiveness of brand posts when combined with informational and interactional message.
Liu et al. (2019)	Twitter	Post entertainment, interaction, trendiness, customization	Number of likes, shares, mentions	Natural language processing	Fixed-effects model	Post entertainment, interaction, trendiness were positively related with consumers' engagement in brand pages.
Menon et al. (2019)	Facebook and Twitter	Post types, vividness, interactivity	Number of likes, comments, shares, replies and retweets	Manual coding	Logistic regression	Entertainment posts played important roles in encouraging consumers' engagement in both platforms, while the effects of other factors varied across different social media platforms.
Dhaoui and Webster (2020)	Facebook	Post formats, posting time, brand presence, brand replies, fan numbers, industry	Liking, recommendation, conversation	Natural language processing	Negative binomial regression	Photos and videos would stimulate liking behavior and brand replies encouraged consumers' positive comments, and there was a "positivity spiral" and "negativity spiral" phenomenon
Kordzadeh and Young (2020)	Facebook	Post topics, vividness, posting frequency, organization	Number of likes, shares and comments	Manual coding	Negative binomial regression	Post topics, vividness, and organizations could predict the number of likes, shares, and/or comments in brand pages.
Li and Xie (2020)	Twitter Instagram	Image characteristics, text content, posting time, account features	Number of likes and shares	Automated text analysis and deep learning	Negative binomial regression	High quality images positively affected consumers' engagement, while the effects of image-text fit and the presence of human face might vary in different platforms.
	Facebook				OLS regression	

(*continued on next page*)

Table 1 (*continued*)

Author(s)	Platform	Influential factors	Engagement measures	Coding methods	Analysis methods	Key findings
Yousaf et al. (2020)		Post orientation, vividness, culture	Number of likes, shares and comments	Manual coding		The combination of vividness and interactive content would contribute to consumers' engagement, while instrumental message decreased engagement.
Dai and Wang (2021)	Weibo	Post format, interactivity, content theme, emotionality, posting time	Number of likes, shares and comments	Natural language processing	Machine learning and neural network models	Post features in terms of format, interactive cues, content themes, emotions, posting time and content length can predict customer engagement behavioral choices.
Deng, et al. (2021)	Facebook	post linguistic styles in terms of emotionality, complexity, and informality	Number of likes, shares and comments	Natural language processing	multi-level regression model	The results showed that post linguistic styles such as emotions, post length, interactive cues could exert distinct influences on consumers behavioral engagement.

has been widely utilized as the theoretical foundation for analyzing the relations between brand posts and consumer engagement in social media (e.g., Dai & Wang, 2021; Millissa & Cheung, 2022). The present study also applies this theory to explain the relationships between brand posts characteristics and consumer engagement on social media. In the present study, the stimuli refer to the characteristics of brand posts designed by social media marketers, such as post type, post vividness, interactivity cues, and post valence. These characteristics are supposed to stimulate consumers' internal feelings and motivations and further affect their responses in terms of cognitive, emotional, and behavioral engagement.

2.2.1. *Cognitive engagement*

Cognitive engagement is defined as consumers' attention, absorption, and conscious mental involvement in brand-related information (Dessart et al., 2016; Hollebeek et al., 2014). Consumers may evaluate the functional features of products, benefits and weaknesses of usage, and innovative characteristics based on the information provided by the brand (Tafesse, 2016). Especially for new consumers, they tend to heavily rely on the information-processing patterns to assess the quality of products and services (Bowden, 2009). The cognitive information-processing is likely to satisfy consumers' instrumental motives such as utility and relevant information needs (Mollen & Wilson, 2010). On brand pages of social media, brands often provide informative content for consumers, such as the introduction of new products, promotion campaigns, educational content, professional tips, etc. This may evoke consumers' cognition and elaboration of the brand-related information, and further motivate consumers to engage in brand-related activities.

2.2.2. *Emotional engagement*

Emotional engagement captures consumers' emotional feelings towards a brand and affective commitment in brand-consumer relationships (Dessart et al., 2016; Hollebeek et al., 2014). Such relationships may arouse a variety of feelings, such as love, passion, arousal, curiosity, excitation, sadness, anger, and so on (Heath, 2009; Higgins, 2006; Hollebeek, 2011). Emotional engagement reflects consumers' psychological connectedness to a brand, and it is partly independent of the evaluation of the brand's instructional and functional attributes (Bowden, 2009). It derives from consumers' gratifications such as trust, commitment, sense of belonging, pride, and other affective experiences (Brodie et al., 2013). Such affective experiences with a brand are found to contribute to consumers' loyalty, word-of-mouth, tolerance to service failure, and help to foster a deeper and ongoing relationship with the brand (Bowden, 2009). On brand pages of social media, brands may utilize kinds of strategies (e.g., images, videos, story-telling, celebrities) to arouse consumers' emotions and make consumers feel emotionally connected with the brand (Lim et al., 2020).

2.2.3. *Behavioral engagement*

Behavioral engagement refers to consumers' voluntary investment of effort, time, and energy in brand-related activities (Hollebeek et al., 2014). Examples include word-of-mouth, blogging, providing reviews, helping other consumers, and offering feedback on product innovation (Harmeling et al., 2017). Such spontaneous behaviors are driven by consumers' needs to express their voices and present their self-identity, which as a result enhances brands' marketing performance (van Doorn et al., 2010; Tafesse & Wien, 2018). Particularly, brand pages facilitate consumers' behavioral engagement in an easier and faster way. Several actions left on brand pages, such as liking, sharing, and commenting, are regarded as proxies of consumers' behavioral engagement in prior studies (Kordzadeh and Young, 2020; Schultz, 2017; Tafesse, 2015). However, mere behavioral count without considering the meanings and features of the user-generated content sheds little light on the marketing practices of brand pages (Tafesse & Wien, 2018). The present study attempts to propose a theoretical framework to address the relationships between brand post strategies and the multiple aspects of consumer engagement (i.e., cognitive, emotional, and behavioral engagement).

3. Hypothesis development

Based on a comprehensive review of past studies concerned with the relationships between post strategies and consumer engagement, the present study attempts to reveal the effects of post features in terms of post types (i.e., informational, transformational, interactional) (Liu et al., 2019; Tafesse & Wien, 2018), post vividness (Luarn et al., 2015; Menon et al., 2019), post interactivity (Cvijikj & Michahelles, 2013; Schultz, 2017), post valence (Berger & Milkman, 2012; Leventhal et al., 2014), with controlling the effects of brand-level factors. The conceptual framework of the present study is present in Fig. 1. The details of the hypotheses concerned with the relationships between post characteristics and consumers' cognitive, emotional, and behavioral engagement are articulated in the following sections.

3.1. *Post types*

The types of brand post content have been found to exert influence on consumers' behavioral engagement (Cvijikj & Michahelles, 2013; Tafesse, 2015; Yousaf et al., 2020). Previous studies have classified brand posts into different types, such as functional, emotional, experiential, educational, and social content (for a review, see Tafesse and Wien, 2017). A widely used typology of brand posts classifies post content into three types, including informational, transformational and interactional (Tafesse & Wien, 2018; Tafesse and Wien, 2017). Other typologies may use different terms that can correspond to these three types of brand posts (e.g., Ashley & Tuten, 2015; Liu et al., 2019; Menon et al., 2019). This typology has been widely validated by prior research concerned with brand post strategies and social media marketing (Kim & Yang, 2017; Kusumasondjaja, 2018). The present study also adopts this classification to explore the effects of brand post types on consumers' behavioral, cognitive, and emotional engagement.

The informational post focuses on providing brand-related factual and informative content for consumers to process, such as product

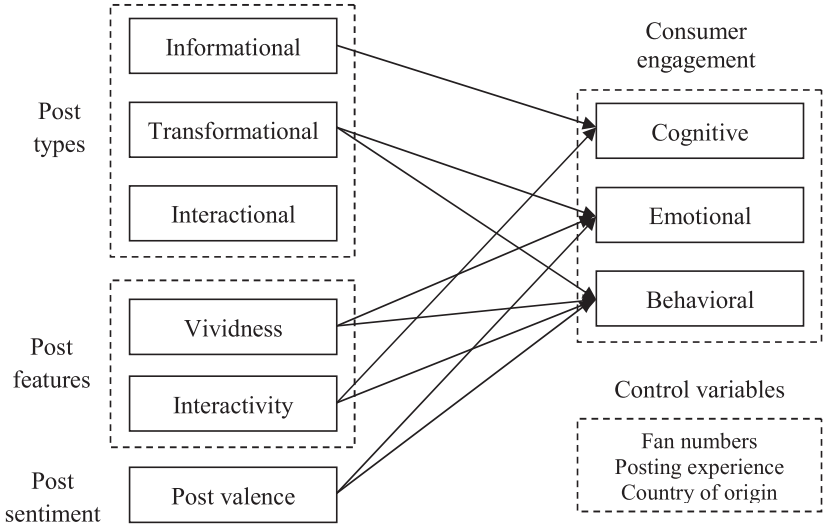

Fig. 1. The conceptual framework.

description, new release, special offers, and educational updates (Kim & Yang, 2017). It tries to draw consumers' attention and cognition and facilitate them to evaluate the benefits of the products and services provided (Cvijikj & Michahelles, 2013). Previous studies have identified that informational posts could impact consumer engagement on brand pages (e.g., Kim & Yang, 2017; Tafesse, 2016). As informational posts afford consumers' functional needs and need consumers to devote time and energy to processing the information (Kim & Yang, 2017; Tafesse & Wien, 2018), the present study expects that information post is more likely to exert influence on consumers' cognitive engagement. Thus, the following hypothesis is stated:

H1: Informational post has a significant impact on consumers' cognitive engagement in brand pages.

Transformational post is affect-based and appeals to consumers' emotions and affective reactions (Cvijikj & Michahelles, 2013). It emphasizes the hedonic and symbolic features of the brand, aiming to transform consumers' impression of the brand with particular psychological experiences and feelings (Tafesse & Wien, 2018; Tafesse and Wien, 2017). Examples include emotional photos and videos, encouraging stories, entertaining advertisements, brand resonance, and experiential posts. Previous studies have identified the relationship between transformational posts and consumers' behavioral engagement (e.g., Kusumasondjaja, 2018; Luarn et al., 2015; Tafesse, 2015). In addition, as part of consumers' motives to use social media are derived from hedonic needs (Cvijikj & Michahelles, 2013), transformational post aligns well with such motives and is more likely to encourage consumers' affective responses (Kim & Yang, 2017; Tafesse & Wien, 2018). Thus, we expect that the transformational message is also effective to stimulate consumers' emotional engagement. Accordingly, the following hypotheses are proposed:

H2a: Transformational post has a significant impact on consumers' behavioral engagement in brand pages.
H2b: Transformational post has a significant impact on consumers' emotional engagement in brand pages.

Interactional post is a unique type of advertising content on social media compared to traditional media channels such as television or radio, reflecting the interactive nature of social media platforms (Tafesse & Wien, 2018). The interactional post tries to initiate interactions between brand and consumers and between consumers themselves (Luarn et al., 2015). In interactional posts, brands often call for actions of consumers, such as sharing personal experiences, participating in brand-related activities, forwarding the brand posts, and so on. This kind of message strategy is supposed to foster a sense of community and social connection with the brand (Tafesse & Wien, 2018). Consumers are willing to participate in such interactions because of the social motives afforded by social media (Claffey & Brady, 2017). Consequently, this may encourage consumers to actively participate in kinds of interactions on brand pages, such as leaving comments, sharing the posts, and communicating with other consumers. Prior studies have found that brand interactional posts could attract consumers' behavioral engagement (e.g., Liu et al., 2019; Luarn et al., 2015). The present study further expects that interactional posts may contribute to consumers' cognitive and emotional engagement as well. When participating in the interactions, consumers are likely to devote more cognitive and emotional resources to interact with each other (Tafesse, 2015). To present an ideal self and gain recognition in the interactions (Tafesse, 2016), consumers tend to process the post content carefully and organize their languages deliberately. Therefore, the present study hypothesizes that:

H3a: Interactional post has a significant impact on consumers' behavioral engagement in brand pages.
H3b: Interactional post has a significant impact on consumers' cognitive engagement in brand pages.
H3c: Interactional post has a significant impact on consumers' emotional engagement in brand pages.

3.2. *Post vividness*

Vividness is defined as the richness of media formats (e.g., text, photos, and videos) that can stimulate individuals' different senses (Luarn et al., 2015; Vries et al., 2012). The vividness of media content may vary according to the different levels of visual, auditory, and sensory cues afforded by distinct media formats (Kim & Yang, 2017). For instance, a brand post containing photos or videos is thought to be more vivid than that using text only. Vivid media content is capable of delivering more information and meanings about the products and services and thus may lead to more behavioral responses from consumers (Soboleva et al., 2017). The relation between brand post vividness and consumers' behavioral engagement has been identified by prior research (e.g., Cvijikj & Michahelles, 2013; Kordzadeh and Young, 2020). In line with previous studies, the present study states that:

H4a: The degree of post vividness has a significant impact on consumers' behavioral engagement in brand pages.

Furthermore, the present study expects that post vividness would enhance consumers' emotional engagement in brand pages. As a high degree of vividness of media content tends to appeal to more emotions through multiple senses, such brand posts are more likely to motivate consumers to actively share their emotional and experiential feelings if they feel an "emotional congruence" (Mollen & Wilson, 2010). For example, if a brand video tells a story about the importance of persistence and courage, consumers may be moved and tend to share their feelings and experiences in the comments. In other words, as vivid media content is more likely to trigger more senses and emotions of consumers (Tafesse, 2016), we expect that the degree of post vividness is significantly associated with consumers' emotional engagement. Thus, it is hypothesized that:

H4b: The degree of post vividness has a significant impact on consumers' emotional engagement in brand pages.

3.3. Post interactivity

Post interactivity refers to the capability of the post content in affording interactions and communications between brand and consumers as well as between consumers themselves (Kim & Yang, 2017; Vries et al., 2012). Interactivity cues of a brand post may include links to external websites, hashtags, and mentions (Liu et al., 2019; Schultz, 2017). Brand posts often utilize one of these cues or a combination of these features to motivate consumers to interact with the brand or other consumers in brand pages. For example, a brand post embedded with hashtags usually indicates a topic for discussion which attempts to invite consumers to join in the conversions and interactions. A brand post with mentions often aims to encourage interpersonal communications with consumers. Past studies have confirmed the relation between post interactivity and consumers' behavioral engagement (Araujo et al., 2015; Soboleva et al., 2017), and a similar effect is expected in the present study as well. So it is hypothesized that:

H5a: The degree of post interactivity has a significant impact on consumers' behavioral engagement in brand pages.

In addition, brand posts with interactivity cues are found to be more informative and interesting (Soboleva et al., 2017). Post interactivity is deemed to be significantly associated with several social and affective outcomes, such as satisfaction, positive attitude, and active involvement (Luarn et al., 2015). When interacting with others on social media, consumers may tend to express more opinions and emotions to attract attention and gain status among peer users (Lee & Ma, 2012). So we expect that post interactivity may also exert significant influence on consumers' cognitive and emotional engagement. Thus, the following hypotheses are proposed:

H5b: The degree of post interactivity has a significant impact on consumers' cognitive engagement in brand pages.
H5c: The degree of post interactivity has a significant impact on consumers' emotional engagement in brand pages.

3.4. Post valence

Post valence refers to the positive, neutral, or negative sentiment expressed in the post content (Hollebeek et al., 2014; Vries et al., 2012). Previous studies found that sentimental messages tend to receive more feedback in online communication (Huffaker, 2010). This is because positively or negatively valenced content tends to stimulate consumers' different physiological arousal, such as relaxation, enjoyment, excitation, sadness, anxiety, and anger, and further leads to consumers' emotional responses and behavioral reactions (Stieglitz & Dang-Xuan, 2013; Tellis et al., 2019). In other words, consumers can detect the emotion and sentiment transmitted by the message content and then conduct a variety of actions accordingly, such as sharing the content, leaving comments, and talking with others (Berger & Milkman, 2012). Then it is expected that post valence is significantly associated with consumers' behavioral engagement, and the following hypothesis is postulated:

H6a: The degree of post valence has a significant impact on consumers' behavioral engagement in brand pages.

As positively or negatively valenced messages may stimulate consumers' kinds of emotions, their responses may also be emotion-oriented. Joyce and Kraut (2006) found that positive sentiment in a message could foster a sense of community while negative sentiment might result in hostile feedback. Individuals are easily aroused by emotional and sentimental expressions and may react emotionally as a result (Bandura, 2001). Similarly, brand posts utilizing different degrees of sentimental language may lead consumers to respond with different levels of emotions accordingly (Vries et al., 2012). In other words, post valence tends to engage consumers emotionally. Therefore, the present study proposes that:

H6b: The degree of post valence has a significant impact on consumers' emotional engagement in brand pages.

3.5. Control variables

Besides post-level characteristics that may exert influence on consumers' cognitive, emotional and behavioral engagement, brand-level attributes (e.g., number of fans, experiences of social media marketing, the origin country of brands) may also impact different dimensions of consumer engagement (Araujo et al., 2015). For instance, Tafesse (2015) and Soboleva et al. (2017) found that fan numbers of brand pages were positively associated with consumers' behavioral engagement such as liking and sharing. Ashley and Tuten (2015) identified that brands' updating frequency would affect consumers' participation in brand pages. Tafesse (2016) found the origin country of the brand could impact consumers' liking and sharing behaviors on brand pages. Therefore, the effects of brand-level attributes should be taken into consideration when examining the influential factors underlying consumers' engagement. As the purpose of this study is to investigate how message strategies at the post level may impact consumers' engagement, the related brand-level attributes would be examined as control variables in the analysis.

4. Methodology

4.1. Sampling and data collection

To examine the relationships between brand post characteristics and consumer engagement, the present study collected data from Weibo, a Chinese social media platform widely used for social media marketing in China. As a counterpart of Twitter, Weibo was founded in 2009 and has more than five hundred and fifty million active users (Smith, 2020). Many local and intentional companies conduct marketing activities on this platform. Considering its business value in marketing for international companies, strategies for promoting brand posts on Weibo should also be investigated. Another reason we chose Weibo is that the prior research dominantly focused on English post strategies but neglected consumers in non-English regions and markets. Then studying social media marketing strategies using other languages is supposed to contribute to a better understanding of the effectiveness of brand posts strategies in different social and cultural contexts (Dai & Wang, 2021; Humphreys and Wang, 2018).

Before collecting data, we found a comprehensive brand list of sportswear brands which contained more than eight hundred global and national brands (https://www.chinasspp.com). This comprehensive brand list would make our sample include not only top-ranked brands like Nike but also small- and medium-sized companies which also attempt to promote their brands and products on social media. In other words, the sample containing different tiers of brands should make our findings more generalizable. We then identified the brands that have created profiles on Weibo and were active during 2019. We did not collect the latest data because the pandemic of COVID-19 started in January 2020. During the pandemic, the marketing activities on social media were extraordinarily increased because of the pandemic-related lockdown and home quarantine in the offline context (Syaifullah et al., 2021). As a result, marketing activities during the pandemic may not represent brands' regular social media marketing strategies in a normal situation. Therefore, we did not collect brands data on social media after 2020 but focused on their activities in 2019. Finally, one hundred and thirty-four brands were identified as active brand accounts that had updated posts from January to December 2019.

An open-source software package Weibo-spider (https://pypi.org/project/weibo-spider/) was employed for automatically crawling posts and comments from the timeline pages of the selected brands. For privacy concerns, the screen names and other personal information of consumers were removed before analysis. The brand-level data (e.g., id, fan numbers, post numbers, location, etc.) and post-level data (e.g., post content, number of likes, shares, comments, comments content, posting time, etc.) were collected. As the posts were uploaded at the different time across one year, we then managed to construct a panel data set in which each brand contained at least one post every week. Considering the different frequencies of post updating of each brand, we randomly chose one post in each week if a brand updated several posts in a week. Then each brand in the sample would have around fifty-two posts (as there were fifty-two weeks in 2019, and some may have less because of missing posts in certain weeks). The brands that did not update the posts regularly were excluded from the sample as there would be too many missing post values for such brands. As a result, the panel data contained sixty-nine brands and three thousand six hundred and fourteen posts based on the data collection criteria.

4.2. Operationalization

4.2.1. The independent variables

Post types. Based on the typology of brand posts discussed above, the brand posts in the sample were classified into one of the three types (i.e., informational, transformational, and interactional). Natural language processing (NLP) was utilized to classify the types of brand posts in the present study. NLP is an analysis technique that combines knowledge of computer science, linguistics, and statistics to explore textual content and human languages (Lee et al., 2018). It has been widely applied in social science and business research to mine textual data (e.g., Dhaoui & Webster, 2020; Liu et al., 2019). The purpose of utilizing the NPL technique is to facilitate automatic analysis of large-scale data. Also, the dataset and the post-type classification model developed in this paper can be reused in future studies.

The procedure of classifying brand posts is described as follows. First, two thousand brand posts were randomly selected from the sample as the training dataset. Twenty-two student volunteers were recruited as coders to manually tag the types of the posts in the training dataset. The coders were randomly divided into four groups, and each group was assigned five hundred brand posts to tag. In this way, each brand post was tagged by at least five coders. Each of the coders received two hundred RMB as payment. Before tagging, the coders were trained to get familiar with the classification of the post types and the coding procedure. Then the coders were asked to independently classify each brand post into one of the three categories (i.e., informational, transformational, interactional). The final type was determined based on a majority-voting rule. If a post was tagged equally between two types, the final type would be determined by the authors of the study. In this way, these two thousand brand posts were categorized into one of the three post types. Then using the two thousand tagged posts as the training set, we employed the BERT (Bidirectional Encoder Representations from Transformers) language model (Devlin et al., 2018) for Chinese to train a post-type classifier. The pooled output of the BERT model for each post was used as the numerical representation of the post, which was further fed into a dense layer of size 3 to compute the probability distribution over the post types. The categorical cross-entropy between the probability distributions and the ground-truth labels was used as the loss to fine-tune the BERT model. The training process was performed on the Google Colab platform. We evaluated the classifier by 10-fold cross-validation and observed an accuracy of 82 % that was regarded as acceptable (Zou et al., 2021). Based on the well-trained classifier, the rest of the brand posts were further classified into one of the three post categories. Then the post types were coded as a categorical variable for the following analysis.

Post vividness. Consistent with previous studies (Cvijikj & Michahelles, 2013; Tafesse, 2015), the level of vividness was measured based on the usage of photos and videos in the brand posts. Generally, videos represent a high level of vividness, followed by photos and plain texts (Dhaoui & Webster, 2020). Specifically, the level of vividness in the present study was coded as follows: if a post used text only, it was coded as low vividness; if a post attached one photo along with the text, it was regarded as medium vividness; if more than one photo were used, the post was labeled as high vividness; and if a video was attached with the post, it was considered as very high vividness. Then the post vividness was coded as an ordinal variable with four levels (low, medium, high, and very high), and the post using only text was treated as the baseline or reference group in the analysis.

Post interactivity. The degree of interactivity of a brand post was operationalized according to the usage of interactive cues, including hashtags, mentions, and URL links (Liu et al., 2019; Tafesse, 2015). Automated text analysis was applied to identify whether there were any hashtags, mentions, and URL links in the posts. In line with prior research (Menon et al., 2019; Schultz, 2017), the degree of post interactivity was coded as an ordinal variable with four levels: low interactivity indicated that none of these interactive cues were used, medium interactivity referred that at least one of the three types of interactive cues were embedded in the post, high interactivity meant that two types of the interactive cues were utilized, and very high interactivity indicated all these three types of interactive cues were included in a post.

Post valence. The degree of post sentiment was utilized as the measurement of post valence in the present study (Peters et al., 2013; Schreiner et al., 2019). Sentiment analysis was used to detect the sentiment level of each post. Sentiment analysis is a computer-based automated text analysis method for extracting the strength of the text sentiments (Stieglitz & Dang-Xuan, 2013). Specifically, an open-source software package Pysenti (https://pypi.org/project/pysenti/) was used to quantify the sentiment strength of the Chinese posts. This software maintains a sentimental words dictionary. Given a post, the software first checks what sentimental words occur in the post, and then sums up the scores of individual sentimental words as the overall sentiment strength score for the post. As a result, post valence was measured as a continuous variable in the analysis.

Control variables. The brand-level features were set as control variables in the present study, including the number of followers a brand has (Soboleva et al., 2017), the experience in social media marketing (Ashley & Tuten, 2015), and the country of origin of the brand (Tafesse, 2016). Specifically, the number of followers a brand has could be directly counted on the brand page. The experience of social media marketing of a brand was measured by the number of posts the brand had updated on its social media page. To account for the skewness and outliers in both the number of fans and the number of posts, the logarithmic transformation of the numbers was entered into the models as in

previous studies (Li & Xie, 2020; Tellis et al., 2019). The origin country of a brand was also set as a control variable and coded as a dummy factor: if the origin of the country of a brand is from China, it was coded as one; otherwise, it was coded as two.

4.2.2. The dependent variables

Cognitive engagement. In the present study, the comments left by consumers were used to detect consumers' cognitive engagement. Specifically, the cognitive engagement of a post was measured according to the degree of text similarity of consumers' comments under this post (Humphreys and Wang, 2018). That is, if the content of a comment left by a consumer is similar to the brand post content, that means this consumer has put cognitive efforts to process the brand content when writing the comment accordingly. In contrast, if the comment content is quite distinct from the post content, that may indicate that the consumer may not pay enough cognitive effort to review the post content. This method has been widely used to detect individuals' cognition involved in online comments (Atapattu et al., 2019). Particularly, the Jaccard similarity coefficient (Niwattanakul et al., 2013) was utilized to calculate the similarity score between one brand post and consumers' comments under this post. Jaccard similarity coefficient ranges from zero to one. The higher the score is, the more similar the content of the two texts are. We first used the Jieba software package (https://pypi.org/project/jieba/) to segment each post and comment into individual words or phrases and then computed the intersections and unions between them based on exact string matching. The Jaccard similarity scores were calculated based on the exact string matching. All the similarity scores between one brand post and the comments under this post were added together as the proxy of consumers' cognitive engagement for this post. The higher the score is, the more cognitive engagement a post stimulates. The measure of cognitive engagement was regarded as a continuous variable in the analysis.

Emotional engagement. The total sentiment scores of consumers' comments under each brand post were used as proxies for consumers' emotional engagement for one post. Extracting sentiments from consumers' comments is widely used to manifest the affection and emotion consumers express in the online context (Kordzadeh and Young, 2020). Particularly, we were interested in the total amount of sentiments aroused by a brand post rather than the polarity of the sentiments. Thus, the absolute value of the sentiment scores of comments under one post was added together to manifest the emotional intensity aroused by this particular post. The way to extract the sentiments of consumers' comments was similar to that used for detecting post valence. The value of emotional engagement was then analyzed as a continuous variable.

Behavioral engagement. The behavioral engagement was measured by the number of likes, shares, and comments that each brand post received. These behavioral metrics have been widely used as measures of consumers' behavioral engagement in previous studies (e.g., Kim & Yang, 2017; Vries et al., 2012; Yousaf et al., 2020). The numbers could be automatically detected in the post information. The variables of behavioral engagement were treated as continuous variables in the analysis. The descriptive data of the dependent and independent variables are shown in Table 2.

4.3. Model specification

According to the characteristics of the data, multilevel mixed-effects regression models were applied to analyze the data and test the hypotheses of the study. We chose this method to specify the models because the nature of the dataset was multilevel as the posts were nested under the different brands (Dhaoui & Webster, 2020). The variables related to posts (i.e., post types, vividness, interactivity, valence) were set as the first level in the model, and the factors concerned with brands (fan numbers, experiences of social media marking, country of origin) were set as the second level. In this way, the impacts derived from brands rather than post features can be controlled (Araujo et al., 2015). Particularly, because the variables of behavioral engagement (i.e., number of likes, shares, and comments) were counts outcomes and non-negative values, and the standard deviations of the three measures were much larger than their means respectively, the analysis needed to be adjusted for overdispersion (Stieglitz & Dang-Xuan, 2013; Tafesse, 2015). Then the multilevel mixed-effects negative binomial regression was employed to analyze the data. For cognitive and emotional engagement, as both of the measures were continuous variables, multilevel mixed-effects linear regression was utilized to analyze the data. The multilevel mixed-effects regression models were run in STATA version 15.

5. Findings

For behavioral engagement, three multilevel mixed-effects negative binomial regression models were run by setting the number of likes, shares, and comments as dependent variables respectively. The results are presented in Table 3. First of all, as all the likelihood-ratio tests of the three models were significant, these indicated that the multilevel mixed-effects negative binomial regression method provided a better fit

Table 2
The description of the variables in the analysis.

Variables	Category	Observations	Mean	Std. Dev.	Minimum	Maximum
Post type	Informational	1886	–	–	–	–
	Transformational	1269	–	–	–	–
	Interactional	459	–	–	–	–
Post vividness	low	371	–	–	–	–
	Medium	1295	–	–	–	–
	High	1658	–	–	–	–
	very high	290	–	–	–	–
Post interactivity	low	1082	–	–	–	–
	Medium	1785	–	–	–	–
	High	650	–	–	–	–
	very high	97	–	–	–	–
Post valence	sentiment	3614	36.64	29.32	−7.62	432.14
Control variables	fan numbers	3614	233,424	283,493	949	1,040,370
	Experience	3614	4279	3140	316	11,889
	country origin	3614	0.62	0.48	0	1
Dependent variables	No. of likes	3614	213	1897	0	57,567
	No. of shares	3614	451	16,950	0	1,000,000
	No. of comments	3614	55	390	0	10,623
	Cognitive engagement	3614	0.41	2.50	0	55.68
	Emotional engagement	3614	99.82	434.75	0	5204.88

Table 3
Results of behavioral engagement modeling.

Variables	Category	Model 1 (no. of likes) exp(β)	Z	Model 2 (no. of shares) exp(β)	Z	Model 3 (no. of comments) exp(β)	Z
Post type	Informational	(reference group)					
	Transformational	1.29	4.17***	1.02	0.17	1.19	2.12*
	Interactional	2.02	8.57***	3.17	7.80***	5.95	16.80***
Post vividness	low	(reference group)					
	Medium	0.90	−1.16	0.94	−0.40	1.15	1.17
	High	0.84	−1.91	0.79	−1.53	1.02	0.17
	very high	1.53	3.51***	1.54	2.06*	1.28	1.56
Post interactivity	low	(reference group)					
	Medium	1.29	3.76***	2.07	5.86***	1.48	4.35***
	High	2.55	10.12***	8.41	12.13***	3.74	11.06***
	very high	4.52	9.20***	9.75	7.89***	5.10	7.56***
Post valence	sentiment	1.005	3.83***	1.01	6.11***	1.01	5.83***
Control variables	fan numbers (log)	4.70	4.40***	5.24	4.01***	3.80	3.78***
	experience (log)	1.47	0.59	2.13	0.99	1.49	0.61
	country origin	2.63	2.19*	2.80	1.98*	2.02	1.59
LR test (Chi^2)		3025.92***		1546.04***		1739.15***	

Note: *p < 0.05, **p < 0.01, *** p < 0.001.

compared to simple negative binomial regression which did not consider the multilevel features of the data.

Regarding the effects of post types, the results indicated that the number of likes for transformational post was 1.29 times higher than that for informational post (exp(β) = 1.29, z = 4.17, p < 0.001), and the number of comments of transformational post was 1.19 times higher than that for informational post (exp(β) = 1.19, z = 2.12, p < 0.05). Thus H2a was partly supported. In addition, the number of likes (exp(β) = 2.02, z = 8.57, p < 0.001), shares (exp(β) = 3.17, z = 7.80, p < 0.001) and comments (exp(β) = 5.95, z = 16.80, p < 0.001) for interactional post were all significantly higher than those of informational post. Then H3a was supported. In terms of post vividness, it was revealed that the "very high" level of vividness, or the usage of videos, was able to trigger more likes (exp(β) = 1.53, z = 3.51, p < 0.001) and shares (exp(β) = 1.54, z = 2.06,

p < 0.05), while the use of photos had no significant impact. Therefore H4a was partly supported. Concerned with post interactivity, it was found that the more interactive cues were used, the more number of likes, shares and comments a post would attract, for all the estimated coefficients were significant at all levels of post interactivity. So H5a was supported. Last, post valence was positively associated with the number of likes (exp(β) = 1.005, z = 3.83, p < 0.001), shares (exp(β) = 1.01, z = 6.11, p < 0.001) and comments (exp(β) = 1.01, z = 5.83, p < 0.001). That is, the degree of post valence had significant influence on all three types of behavioral engagement, and H6a was supported.

For cognitive and emotional engagement, the results of multilevel mixed-effects regression models are presented in Table 4. The results of likelihood-ratio tests also indicated that the multilevel mixed-effects regression performed better than simple linear regression to fit the models. In terms of cognitive engagement, it was identified transformational post (β = 0.03, z = 0.34, p = 0.735) showed no significant difference in increasing cognitive engagement compared with informational post. So H1 was not supported. By contrast, interactional post (β = 0.46, z = 3.54, p < 0.001) was found to be more likely to arouse cognition than informational post. Then H3b was supported. In addition, higher levels of post interactivity were positively associated with consumers' cognitive engagement (high level: β = 1.09, z = 7.83, p < 0.001; very higher level: β = 1.29, z = 4.75, p < 0.001). So H5b was partly supported.

Regarding emotional engagement, transformational post showed no significant difference in stimulating emotional engagement (β = 25.33, z = 1.49, p = 0.136), and H2b was not supported. In contrast, interactional post was found to significantly impact consumers' emotional engagement (β = 164.43, z = 7.39, p < 0.001). Thus H3c was supported.

Table 4
Results of cognitive and emotional engagement modeling.

Variables	Category	Model 4 (cognitive engagement) β	Z	Model 5 (emotional engagement) β	Z
Post type	Informational	(reference group)			
	Transformational	0.03	0.34	25.33	1.49
	Interactional	0.46	3.54***	164.43	7.39***
Post vividness	low	(reference group)			
	Medium	0.16	1.10	6.42	0.26
	High	−0.07	−0.48	−37.27	−1.53
	very high	0.27	1.43	−16.78	−0.51
Post interactivity	low	(reference group)			
	Medium	0.11	1.12	19.63	1.13
	High	1.09	7.83***	177.43	7.48***
	very high	1.29	4.75***	223.77	4.81***
Post valence	sentiment	−0.001	−0.75	1.38	4.48***
Control variables	fan numbers	0.26	1.67	43.99	1.85
	Experience	0.12	0.41	50.50	1.15
	country origin	0.001	0.00	5.28	0.18
LR test (Chi^2)		165.70***		116.05***	

Note: *p < 0.05, **p < 0.01, *** p < 0.001.

Nevertheless, all levels of post vividness were identified to have no impact on consumers' emotional engagement. So H4b was not supported. Concerned with post interactivity, it was revealed that more interactive cues were likely to arouse more emotions of consumers, for the coefficients of post interactivity at the high level ($\beta = 177.43$, $z = 7.48$, $p < 0.001$) and very high level ($\beta = 223.77$, $z = 4.81$, $p < 0.001$) were significant. Then H5c was partly supported. What's more, post valence was also positively associated with consumers' emotional engagement ($\beta = 1.38$, $z = 4.48$, $p < 0.001$). Therefore, H6b was supported.

6. Discussion

Through analyzing the relationships between brand post characteristics and different dimensions of consumer engagement, the present study has identified influential factors underlying consumers' behavioral, cognitive and emotional engagement respectively. Specifically, behavioral engagement can be evoked by interactional and transformational post, videos, interactive cues, and post valence. Cognitive engagement is associated with different types of posts and high levels of post interactivity. Last, emotional engagement is likely to be stimulated by interactional post, interactive cues as well as post valence. The effects of these different post characteristics on consumer engagement are detailed as follows.

First of all, the present study revealed how different types of brand posts may exert influence on consumer engagement. The findings suggested that interactional post performs best in stimulating consumers' cognitive, emotional, and behavioral engagement compared to informational and transformational post. Meanwhile, transformational post can motivate more likes and comments than informational post. Indeed, consumer engagement involves a variety of motivational states and brands try to design post messages and features according to consumers' motivations (Kordzadeh and Young, 2020; Tafesse & Wien, 2018). Prior research has identified that consumers' motivations to participate in social media include social interaction, information seeking, entertainment, need to belong, self-expression, and recognition (Lee & Ma, 2012; Tafesse, 2016). Then interactional post may align well with consumers' social needs and thus can evoke consumers' enthusiasm to pay cognitive and emotional resources to engage in a variety of interactions. For transformational post, the entertainment elements may capture consumers' hedonic needs for using social media and further encourage consumers' behavioral responses to brand activities (Cvijikj & Michahelles, 2013). Surprisingly, informational post was not significantly associated with consumers' cognitive engagement, but interactional post was. One possible explanation is that informational post usually provides product information and advertising campaigns which are deemed to make the content dry and uninteresting (Tellis et al., 2019). As a result, informational posts may not be as effective as interactional and transformational posts in motivating consumer engagement in brand-related activities. In other words, to stimulate consumers' engagement in brand posts, social media marketers should use more interactional and/or transformational posts rather than informational posts.

Concerned with post vividness, the present study found that embedding videos in brand posts would significantly increase consumers' liking and sharing behaviors. This may be because the video is more vivid and attractive, and is able to create powerful sensory feelings to stimulate consumers' reactions (Luarn et al., 2015). In addition, video can deliver information and meanings that cannot be expressed by plain texts or photos. Therefore, using videos in brand posts is more likely to motivate consumers to engage in brand-related activities. This finding is in line with Kim and Yang's study (2017) that also identified that brand vividness was able to increase the number of likes and shares but not comments. Compared to liking and sharing behaviors, commenting is deemed to be a cognitively triggered behavior that needs consumers' time and efforts to process information and organize languages (Kim & Yang, 2017). Then consumers may be inclined to simply click the like or share buttons rather than writing comments to save time and energies. In contrast with prior studies' findings (Cvijikj & Michahelles, 2013; Tafesse, 2015), the present study found that the impact of using photos in brand posts is limited. One possible explanation is that the majority of the brand posts (more than 80 percent in the sample) are using photos and consumers are already used to this way of framing brand posts (Schultz, 2017). As a result, utilizing photos in brand posts is not effective in stimulating consumer engagement. However, this does not mean that social media marketers should not use photos or videos in the posts. As integrating photos or videos has been widely applied as a prerequisite for designing brand posts on social media and consumers have been already used to it, marketers should further utilize other strategies (e.g., integrating with interactional post content) to encourage consumer engagement.

While prior research had mixed findings of the effects of post interactivity on behavioral engagement (Luarn et al., 2015; Soboleva et al., 2017; Vries et al., 2012), the present study found that post interactivity could exert positive influence on consumers' behavioral, cognitive, and emotional engagement respectively. This can be explained through consumers' social integrative motives to develop and maintain social ties with others and to attain a sense of belongingness on social media (Claffey & Brady, 2017). Consumers are likely to share ideas and experiences on brand pages to find like-minded others and gain status and reputation (Luarn et al., 2015). In this sense, interactive cues embedded in brand posts may facilitate their social needs. For instance, posts with hashtags enable users to search for related information in social media platforms and further encourage consumers to use the same hashtags in their responses to increase the probability to be viewed by a large group of audiences. Mentions are likely to increase interpersonal interactions and attract consumers' attention, especially when the mentioned uses are celebrities (Soboleva et al., 2017), which may further evoke consumers' emotional engagement. Posts with hyperlinks usually have more information and are deemed to be more interesting (Soboleva et al., 2017), and thus may trigger consumers' cognitive engagement. These features align with consumers' socializing, entertainment and self-status needs of using social media and thus contribute to consumers' engagement in brand pages. Thus, social media marketers should use interactive cues (i.e., hashtags, mentions, URL links) in brand posts as often as possible to maintain consumers' engagement.

Regarding post valence, it was found that post valence has a positive impact on consumers' behavioral and emotional engagement, but not on cognitive engagement. As discussed above, consumers' interaction with brands on social media is partly motivated by hedonic motives including entertainment, self-expression, and escapism (Tafesse, 2016). Then posts with positive sentiment align well with consumers' entertainment needs and expectations. After liking, sharing, and/or commenting, the brand post would also be publicly displayed on consumers' profile pages to their followers on social media. Then by sharing positively-valenced content, consumers are able to present themselves in a positive manner and enhance their self-presentation (Berger & Milkman, 2012; Kim & Yang, 2017). This is consistent with prior studies that also found emotional posts could contribute to consumers' behavioral engagement (Lee et al., 2018; Tellis et al., 2019). Furthermore, posts with positive sentiment may satisfy consumers' emotional gratifications such as amusement, trust, and commitment (Brodie et al., 2013). Positively-valenced posts are able to arouse consumers' positive moods, and further increase consumers' affective responses to brand posts (Kim & Yang, 2017; Tellis et al., 2019). By expressing their positive or negative feelings, consumers may attain psychological benefits as well (Claffey & Brady, 2017). Therefore, post valence is found to effectively motivate consumers' emotional engagement. Thus, social media marketers should try to enhance brand posts' positive sentiment to satisfy consumers' gratifications and further motivate their behavioral and emotional engagement with brands on social media.

7. Conclusion

The findings of the present study are supposed to contribute to the understanding of brand post strategies and consumer engagement in several aspects. Firstly, while prior studies mainly focused on studying consumer' behavioral engagement, the present study has attempted to reveal influential factors underlying consumers' cognitive and emotional engagement. Through a natural language processing approach, consumers' cognitions and emotions derived from comments are detected and analyzed. Furthermore, it has been identified that interactive strategies, including using interactional posts and integrating interactivity cues, are effective in motivating consumers' engagement in all three dimensions. In addition, post valence (i.e., the sentiment of brand posts) can effectively stimulate consumers' behavioral and emotional engagement, whereas post vividness has the least effect on consumer engagement. So practitioners should consider which aspect of consumer engagement is targeted when designing brand posts and then choose suitable post strategies accordingly. Last but not least, brand posts using non-English languages are investigated, and the findings further broaden the generability of brand post strategies under different social and cultural contexts.

For social media marketers, the findings of the present study may help them to develop brand posts strategies more efficiently. For example, since interactional post is found to be effective in enhancing all dimensions of consumer engagement, brands can utilize more interactional posts (such as calling for consumers' actions, encouraging experience sharing, contests, and votes) to stimulate consumers' cognitive, emotional and behavioral engagement at the same time. Besides, more interactive cues (such as hashtags, mentions, and URL links) can be embedded in brands posts to facilitate the interactivity between brands and consumers as well as between consumers themselves. In addition, social media marketers may use more positively-valenced content in brand posts if targeting at stimulating consumers' emotional and behavioral engagement. It should be noted that while video is found to be effective in evoking consumers' behavioral engagement such as likes and shares, photos seem to fail to motivate any types of consumer engagement. That does not mean that embedding photos is not important as a brand post strategy. Because the majority of brand posts are now using photos and consumers have already formed such expectation (Schultz, 2017), using photos seems to become a prerequisite for brand post design but not as a motivator to enhance consumers' engagement.

There are some limitations concerned with the present study. First, brands may combine different types of posts in practice, such as combining informational message with transformational post, or transformational content with interactional one. Such a combination of different types of brand posts was not taken into consideration by the present study. There may exist interacting effects of different post strategies (Araujo et al., 2015), and such interacting effects were not examined in this study yet. Furthermore, brand posts may be classified into other types (e.g., Kordzadeh and Young, 2020; Schultz, 2017) other than informational, transformational, and interactional posts. Future studies may explore the effects of other types of brand posts on consumers' engagement. Regarding the theoretical foundation of the present study, there might be a lack of rigorous reasoning to explain the underlying mechanism of how distinct post characteristics may trigger different types of consumer engagement. This is a recurring problem concerned with studies using secondary data crawled from social media (Stieglitz et al., 2018). Future studies may investigate the theoretical understanding of the causal relationships between brand post characteristics and consumer engagement. In addition, the present study only chose the sportswear industry to test the hypotheses. Future studies can explore brand post strategies of other industries to validate the generalizability of the present findings. Despite these limitations, the present study sheds light on how different post characteristics may exert influence on consumers' cognitive, emotional and behavioral engagement in social media.

CRediT authorship contribution statement

Long Ma: Conceptualization, Methodology, Investigation, Formal analysis. **Wei Ou:** Data curation, Software, Formal analysis, Validation. **Chei Sian Lee:** Supervision, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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