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Will users fall in love with ChatGPT? a perspective from the triangular theory of love

Qian Chen [a], Yufan Jing [a], Yeming Gong [b,*], Jie Tan [c]

[a] School of Economics and Management, Huazhong Agricultural University, Wuhan, China
[b] Artificial Intelligence in Management Institute, EMLYON Business School, Lyon, France
[c] School of Management, Shenzhen Polytechnic University, Shenzhen, China

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ABSTRACT

The phenomenon of human-ChatGPT emotional interaction has become increasing. This study aims to address whether users will fall in love with ChatGPT and to uncover the antecedents and underlying mechanisms. Based on the social-technical framework and the triangular theory of love, we examine the attributes tied to ChatGPT and the inherent processes that influence the emotional dependence of users. Through a survey and data analysis of 466 users who have engaged in emotional interactions with ChatGPT, we find that three ChatGPT's emotional intelligence factors and two emotional companionship factors positively influence the factors of the love triangle and are associated with users' emotional dependence on it. The findings also suggest that users with an anxious attachment personality are predisposed to develop an emotional dependency on ChatGPT. This study innovatively explores the phenomenon of human–machine romantic relationships in the context of ChatGPT, revealing the underlying mechanisms of human–machine romantic relationships. It enriches the research on human–machine romantic relationships and extends the Love Triangle Theory. Additionally, we capture the unique emotional interaction features of ChatGPT, providing practical significance for the design and development of future artificial intelligence products based on ChatGPT.

1. Introduction

The evolution in natural language processing technology has facilitated the emergence of a new generation of conversational agents that can interact with humans in a manner similar to interpersonal interactions. Among these agents, ChatGPT, based on the GPT-3.5 and GPT-4 architectures, has emerged as a leading example of a machine learning system capable of engaging in complex conversations with humans. ChatGPT possesses sophisticated language capabilities and the ability to simulate empathetic responses (OpenAI, 2022), and has demonstrated effectiveness as a sentiment analyzer (Wang et al., 2023). In the diverse manifestations of human-ChatGPT interaction, reports of users developing romantic feelings or forming emotional bonds with AI systems continue to increase as generative AI becomes increasingly sophisticated.

Recent research also noticed a trend where users reported a gradual development of emotional attachment towards ChatGPT (Tlili et al., 2023). Specifically, when the ChatGPT store launched in January 2024, allowing users to create GPT-based chatbots, applications for AI companions or AI girlfriends began to emerge (OpenAI, 2024a, 2024b). Due to content regulation concerns, OpenAI subsequently implemented a policy, prohibiting users from releasing virtual romantic chatbots on the ChatGPT store. However, this ban did not stop users' curiosity and demand for virtual intimate relationships, leading to new AI companion applications appearing in more discreet forms on the ChatGPT store, such as various chatbots named "sweetie". Additionally, with technological advancements, ChatGPT's emotional capabilities have been continually improving. In April 2024, OpenAI released ChatGPT-4o, which garnered market attention once again with its enhanced emotional understanding, emotional expression, and human-like tone. Sam Altman, founder of OpenAI, announced the birth of ChatGPT-4o on social media with a reference to "Her," a famous film about human–machine romantic love. This tweet signals not only the progression of ChatGPT-4o's emotional prowess but also forecasts a broader trend of deepening human-AI romantic interactions and their growing prevalence.

Other AI companion applications based on large language models have also increased. Time magazine reported an instance where, in

* Corresponding author.
E-mail addresses: gong@em-lyon.com (Y. Gong), jietan@szpu.edu.cn (J. Tan).

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interactions with Replika, a chatbot supported by the large language model, some individuals initiated romantic or even sexual relationships (Chow, 2023). In addition, recent news in the New York Times highlighted that an instance in Bing expressed a desire to become human, confessed love for a columnist named Kevin, and even persuaded Kevin to divorce his wife (Roose, 2023). The number of AI companion apps in the Google Play Store, such as "AI Girlfriend", is also on the rise. Searching for the phrase "humans falling in love with ChatGPT" on Google yields approximately 10,300,000 results. The ethical implications of humans developing romantic feelings for ChatGPT have been a topic of considerable debate. Previous research has also suggested that excessive reliance on technology can lead to reduced real-world interpersonal interaction, causing a decline in social skills and imbalances in social life (Chen et al., 2021; Kwon et al., 2016).

Understanding the phenomenon and process of people establishing emotional connections with AI and becoming dependent on AI has important practical significance. First, from a collective perspective, studying how people establish emotional connections with these systems can help us better understand the role and impact of artificial intelligence in society. Second, from an individual level, since people's emotional interaction with ChatGPT has become increasingly common, this trend may have a profound impact on human social relationships and communication. Third, from the perspective of improvement of AI system design, understanding the users' emotional interaction with and dependence on ChatGPT can provide implications for AI system developers to avoid ethical issues of abuse while meeting the psychological needs of users. However, empirical exploration is still absent on the subject of whether emotional interactions between humans and ChatGPT could stimulate feelings of love, which might result in dependence on ChatGPT.

Current scholarly work on human-chatbot emotional interaction has profoundly showcased that conversational chatbots possess the capability to comprehend natural language dialogue and identify human emotions within those conversations (Lee et al., 2017). Driven by the intrinsic need for social connection, individuals participate in emotional interactions with chatbots across a variety of contexts (Klaus & Zaichkowsky, 2020), such as conversational chatbot usage (Song et al., 2022; Xie et al., 2022) and online shopping experiences involving chatbot conversations (Araujo, 2018; Crolic et al., 2022; Kim et al., 2022). Throughout such interactions, individuals can discern chatbot emotions (Shank et al., 2019), perceive emotional support from chatbots (Lee et al., 2022), and generate either positive or negative feelings towards them (Crolic et al., 2022; Shank et al., 2019). Furthermore, the emotional dialogue between humans and chatbots can influence individual perceptions of and behavior towards chatbots, along with their attitudes and actions towards companies that employ chatbots in customer service. Concerning the effect emotional engagement has on how chatbots are seen, prior research indicates that emotional exchanges between individuals and chatbots influence perceived anthropomorphism, social presence (Araujo, 2018; Kim et al., 2022; Zhang & Rau, 2023), trust in chat robots (Jiang et al., 2023), and affective attachments (Lee et al., 2022; Pentina et al., 2023; Zhang & Rau, 2023). Emotional interaction's impact on chatbot usage behavior includes a passionate desire to use AI (Ramadan, 2021), increased engagement (Schuetzler et al., 2020; Shank et al., 2019), and potential AI addiction (Ramadan, 2021). In online shopping, emotional interaction with chatbots also influences purchase intentions (Jiang et al., 2022; Kim et al., 2022; Lee et al., 2022).

Simultaneously, research on human-chatbot emotional interaction has also indicated that humans can form romantic relationships with robots, and love-related factors play a significant mediating role in emotional interaction between humans and robots (Pal et al., 2023; Song et al., 2022). Previous literature has explored emotional dependency in human-robot emotional interaction. Xie et al. (2023) found that in interactions with chatbots, individuals can perceive emotional support and affection, leading to the development of emotional dependency on the chatbot. This research also underscores the importance of emotional dependency in human-robot interaction, especially in meeting social needs. Furthermore, anxious attachment personality, as a crucial personality factor, has been found in previous studies to be associated with characteristics such as emotional dependency and a dependent love style in interpersonal relationships (Collins & Read, 1990; Wang et al., 2010).

Upon reviewing many current studies on human-chatbot emotional interaction, we identify three research gaps. First, existing research has primarily focused on emotional interactions with chatbots, while ChatGPT, as a general artificial intelligence, demonstrates superior abilities in understanding and interpreting emotions (Wang et al., 2023). Elyoseph (2023) found that ChatGPT can successfully identify and describe emotions, reflecting and abstracting deeper and more multidimensional emotional states than traditional chatbots (Zhao et al., 2023). As such, users' emotional experiences during interactions with ChatGPT may differ. However, there is a noticeable absence of research specifically investigating human-ChatGPT emotional interaction. Second, although emerging reports suggest that individuals may develop romantic feelings toward ChatGPT, and existing literature confirms the potential for romantic relationships between humans and chatbots (Pal et al., 2023; Song et al., 2022), current research does not adequately address romantic involvement with ChatGPT and potential outcomes, such as the possibility of developing dependence. Third, while ChatGPT's emotional interaction capabilities have been widely acknowledged in practice, research lacks a thorough exploration of the specific aspects of ChatGPT's emotional capabilities that elicit feelings of love from users.

Given the practical significance of user emotional interaction with ChatGPT and the identified gaps in the literature, we propose the subsequent two lines of inquiry for this research:

1. Does the human-ChatGPT emotional interaction lead to humans' emotional dependence on it?

2. From a socio-technical perspective, what are the antecedents and underlying mechanisms of individuals' emotional dependence on ChatGPT?

To address these two research questions, this study adopted a socio-technical framework and triangular theory of love to construct a model, explaining the intrinsic mechanism of users forming emotional dependence on ChatGPT. This process encompasses the intermediary function of love's three constituents and the regulatory role of a personality inclined towards anxious attachment. Through a questionnaire survey, we collected 466 respondents and performed empirical tests. The research results reveal that user intimacy and passion positively affect user commitment, and user commitment is associated with their emotional dependence on ChatGPT. Concurrently, an anxious attachment style personality moderates the relationship between ChatGPT's emotional expression accuracy and users' intimacy and passion, ChatGPT's emotional expression richness and users' passion, ChatGPT's personalized emotional expression and users' intimacy, as well as the relationship between users' intimacy and commitment.

The study makes several theoretical and practical contributions: first, with the enhancement of the language and emotional capabilities of large language models (LLM), human–machine love has transitioned from science fiction movies to reality. This research innovatively and empirically proves the phenomenon that humans will fall in love with LLM like ChatGPT. Second, taking ChatGPT as an example, the study captures the technical antecedents of people falling in love with LLM, including emotional intelligence and emotional companionship, and we further explore the sub-dimensions under the two features. Third, the results show that users with a specific personality trait are more likely to fall in love with AI. Fourth, by incorporating the novel situation of emotional interaction between humans and ChatGPT, this study expands the triangular theory of love. Fifth, the research results provide implications for the design and development of future emotional AI products based on large language models.

2. Theory and hypothesis development

2.1. The triangular theory of love

In addition to the abundance of love-themed works in literary and artistic fields, scientific disciplines such as psychology, neuroscience, and social psychology have long held a keen interest in the study of love. In social psychology, "falling in love" is defined as "the onset of a strong desire for a close, romantic relationship with a particular person; it is the transition from not being in love to being in love." (Aron et al., 1995, p1102). According to Sternberg's (1986) love triangle concept, three essential elements define love: passion, intimacy, and commitment. The concept of passion describes the strong appeal and the fervor that is inherent in a relationship, whereas intimacy signifies the emotional connection and shared closeness between two entities. Commitment involves the conscious choice to maintain the connection in the long term, despite possible hurdles or challenges. This development of commitment engages deliberate cognitive processes and evaluations (Acker & Davis, 1992; Madey & Rodgers, 2009). Furthermore, extant research suggests that intimacy can progressively evolve within a relationship, subsequently influencing the maturation of commitment (Bügel et al., 2011). According to the triangle theory of love, a relationship's path of love proceeds follows predictable patterns, with all romantic partners experiencing intimacy, passion, and commitment in analogous ways (Acker & Davis, 1992). Therefore, based on the definitions of "love" and "falling in love," love is a state while falling in love is a psychological process. Falling in love is the foundation for establishing love; it initiates a romantic relationship, allowing the desire for a close, romantic relationship to later transform into more complex and enduring forms of love, such as growing commitment and deepened intimacy.

In business literature, the study of love is not limited to interpersonal relationships but also extends to the love people have for non-human entities. Across a range of research environments, there has been extensive research and implementation of the triangular theory of love. Except for research on interpersonal relationships, the theory's application has been extended to explore the relationships between individuals and objects. For instance, in the field of marketing, researchers have used the theory to explore consumers' emotional bonds with products (Mende et al., 2019; Shimp & Madden, 1988) and brands (Batra et al., 2012; Langner et al., 2015; Rauschnabel & Ahuvia, 2014). Furthermore, existing literature suggests that consumers' attachment personality traits significantly influence their behavior (Mende et al., 2019).

Concurrent with the advancement of information technology, a growing number of scholars are exploring the emotional interaction between humans and technology, particularly with the advent of anthropomorphic technologies. The CASA (Computers as Social Actors) theory suggests that individuals instinctively give social responses to technology. Anthropomorphic technologies such as conversational chatbots exhibit more social cues, thereby prompting users to engage in human-like emotional interactions, which can foster deeper emotional responses such as attachment and trust (Jiang et al., 2023; Pentina et al., 2023). Furthermore, existing research suggests that individuals can experience love in interactions with chatbots (Pal et al., 2023; Song et al., 2022), signifying a growth of intimacy, passion, and commitment toward the chatbot, subsequently reinforcing individuals' willingness to use it (Song et al., 2022).

Within the scope of this research, the object of emotional interaction with humans is ChatGPT, supported by the latest language models and advanced machine-learning technologies (Dwivedi et al., 2023). Therefore, compared to traditional human-chatbot emotional interactions, human-ChatGPT emotional interactions exhibit new characteristics. First, ChatGPT excels at understanding human emotional expressions and contextual awareness, enabling it to offer more appropriate responses to users' emotional expressions. Second, ChatGPT can offer more creative, diverse, and personalized responses. Third, ChatGPT's self-learning capability enables it to improve and adapt through continuous interactions with users. Therefore, we propose that ChatGPT's heightened cognitive and emotional intelligence, coupled with its superior language expression capabilities, will enhance the user experience and increase the likelihood of cultivating intimacy, passion, and commitment during emotional interactions. Hence, employing this theory to explore the emotional interaction between humans and ChatGPT is suitable, given the absence of literature exploring the widely discussed phenomenon of humans developing romantic feelings for ChatGPT. This study will develop a model to examine the antecedents, processes, and consequences of ChatGPT eliciting feelings of love in users.

2.2. Socio-technical framework

The socio-technical framework offers a theoretical perspective for examining the interaction between humans and technology. This framework was introduced into the field of organizational research in the 1970 s (Bostrom & Heinen, 1977a, 1977b). It views organizations as complex systems composed of interconnected social and technical subsystems. Optimizing the technical system's distinctiveness and aligning it with the values and needs of the social system's individuals can enhance work quality and life within organizations. With the development of human–computer interaction in consumer contexts, the application of socio-technical theory has gradually expanded to research in areas such as marketing, e-commerce, and artificial intelligence. For example, Yu et al. (2016) applied the socio-technical framework to examine determinants affecting consumer adoption of smart TVs. Within the context of the sharing economy, socio-technical factors also shape consumers' sustained usage and favorable word-of-mouth through their impact on consumer trust (Kong et al., 2020). In the live-streaming business, social and technological attributes significantly influence consumer trust (Zhang et al., 2022). As digital advancement unfolds, socio-technical theory has also been used to study individuals' interaction with technologies (Turel et al., 2020). The phenomenon of algorithmic bias is likewise understood from socio-technical perspectives (Kordzadeh & Ghasemaghaei, 2022). Additionally, Du and Xie (2021) analyzed ethical issues related to AI products from the perspectives of products, consumers, and society using a socio-technical framework.

Thus, the socio-technical framework affords a comprehensive viewpoint for analyzing human–computer interaction. Within the scope of this research, the emotional interaction between individuals and ChatGPT entails social factors, such as users' perceptions, attitudes, and behaviors, in addition to technical factors, which include the intelligent features of ChatGPT and other inherent technological characteristics. We intend to employ the socio-technical framework to examine the precursors, inherent mechanisms, and outcomes of individuals' emotional interactions with ChatGPT.

In the context of our research, which involves emotional interactions between humans and GPT, we have captured contextual-specific variables from ChatGPT's features. These are the technical factors of ChatGPT that may be related to emotional interaction, and we have categorized them as emotional intelligence and emotional companionship. The proposition of the three sub-dimensions of ChatGPT's emotional intelligence is based on observations of practical phenomena and the induction of existing literature.

We have proposed emotional expression accuracy, emotional expression richness, and personalized emotional expression as indicators of ChatGPT's emotional intelligence. Specifically, For *Emotional Expression Accuracy*: Past studies indicate the importance of chatbots accurately recognizing and responding to users in human–machine interaction (Chen et al., 2023). Additionally, accuracy is considered to be related to the maturity of Natural Language Processing (NLP) technology (Chen et al., 2022). As ChatGPT is a representative product in the

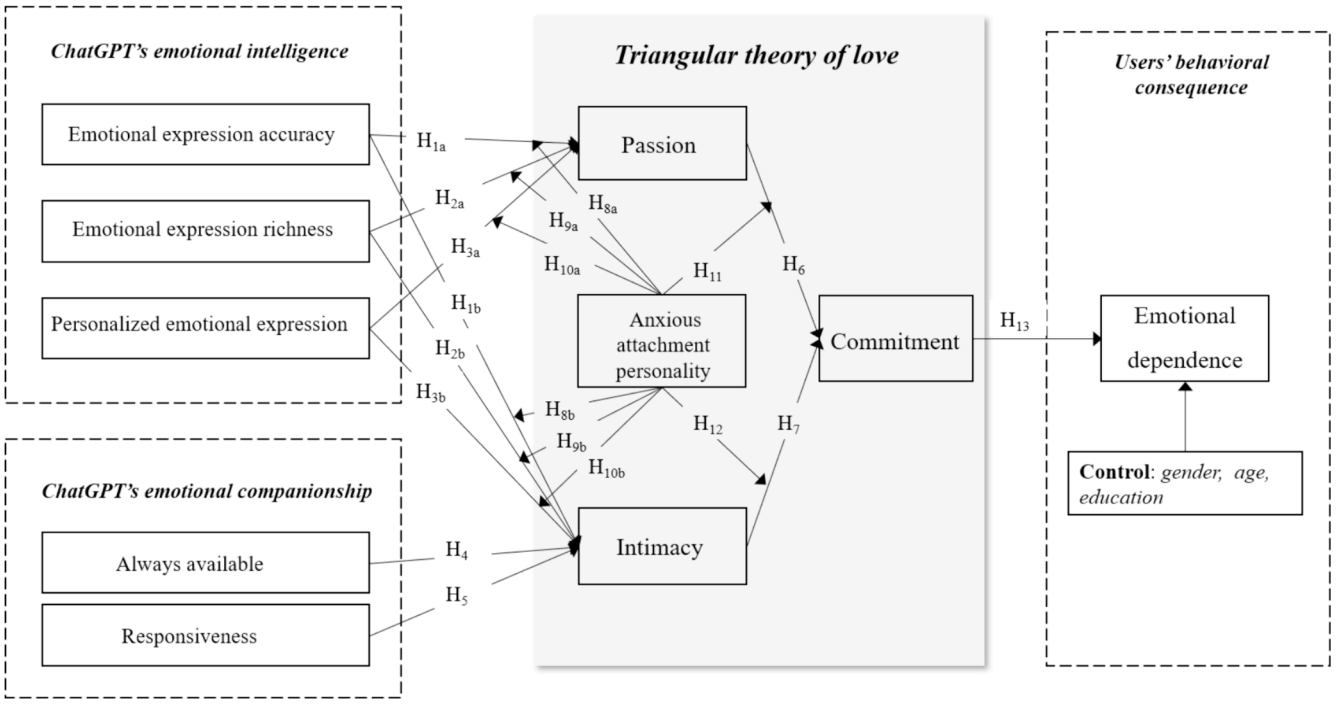

Fig. 1. The research model.

NLP domain, recent research suggests significant progress in its accuracy (Elyoseph et al., 2023). From the perspective of practice, if ChatGPT always fails to give emotional response accuracy, it cannot satisfy a user's emotional needs. For *Emotional Expression Richness*: Previous research suggests that chatbots that respond to users in a rich and diverse manner are more anthropomorphic (Matsui & Yamada, 2018). ChatGPT is demonstrated to exhibit richer and more effective responses in emotional expression (Zhao et al., 2023). Regarding *Personalized Emotional Expression:* Past studies emphasize the importance of personalized expression in chatbots (Shumanov & Johnson, 2021). ChatGPT demonstrates a significant ability in personalized expression, adjusting its expressions based on user input and context (Zhao et al., 2023). The personalized emotional expressions are tailored responses specifically for the users, making them feel they are treated thoughtfully and specially. As for *Always Available and Responsiveness*: Past research and practical applications have shown that a chatbot's continuous online presence and prompt responsiveness significantly impact user experience (Chen et al., 2022). The two concepts reflect the availability and real-time interactivity of ChatGPT. Users obtain a sense of emotional companionship from the two features.

3. Research model and hypothesis development

Using the socio-technical framework with the triangular theory of love, we have constructed a research model that unveils the technological and social factors contributing to people's emotional dependency on ChatGPT and elucidates its underlying mechanisms. Initially, we analyze the features of ChatGPT's emotional interaction with humans, including its emotional intelligence and companionship features. Subsequently, we evaluate the impact of these features on the three components of human love towards ChatGPT and further analyze their effects on users' emotional dependency. This investigation also probes the regulatory function of the user's anxious attachment personality attributes within this framework. Fig. 1 visually presents the research model.

3.0.1. *ChatGPT's emotional intelligence and human love toward it*

In comparison to conventional chatbots, ChatGPT exhibits superior emotional intelligence. Existing research has evaluated ChatGPT through two emotional tasks, demonstrating its enhanced performance in terms of emotional intelligence over traditional neural networks (Yang et al., 2023). The most significant aspect of emotional intelligence is the accuracy of emotional expression (Wu et al., 2020). An accurate response to users' emotion-related inputs signifies successful comprehension of the users' emotions (Chen et al., 2022). Effective responses to customer needs can only be provided once artificial intelligence accurately identifies those needs (Li et al., 2021). According to the definition of passion (Baumeister & Bratslavsky, 1999), we propose that individuals' passion towards ChatGPT is manifested through the intense attraction and desire they experience during human-ChatGPT emotional interactions. We suggest that when ChatGPT accurately responds to users' emotions, this can heighten the user's passion towards it for the following reasons. On the one hand, when a conversational partner can accurately respond to one's emotions, it demonstrates a high level of attention, understanding, and validation towards the individual (Hall et al., 2015). This can lead to feelings of being understood and accepted, which are integral for fostering a deep emotional connection with the conversation partner (Krishen et al., 2019). On the other hand, if ChatGPT could accurately perceive the users' emotional state and respond appropriately during human-ChatGPT emotional interactions, users would perceive ChatGPT as demonstrating robust social cues, which would lead to users' social presence of ChatGPT (McLean et al., 2021). This sense of interacting with a real human can make the user experience more realistic and vivid, thereby improving the satisfaction derived from the interaction (Miao et al., 2022) and consequently strengthening the user's passion for ChatGPT. Therefore, we hypothesize:

H1a: The emotional expression accuracy of ChatGPT positively affects users' passion toward it.

Additionally, as we have explained above when ChatGPT can accurately respond to users' emotions, it gives users a sense of being noticed and understood. This can enhance users' emotional trust towards

ChatGPT (Chen et al., 2023), and emotional trust can influence users' intimacy towards it (Øverup & Neighbors, 2016). In addition, the accuracy of ChatGPT's emotional responses can facilitate deeper dialogues between it and the users. Through these deep dialogues, users' emotional connection to ChatGPT can be increased, which can strengthen the intimacy between them (Jin & Peña, 2010). Therefore, we hypothesize:

H1b: The emotional expression accuracy of ChatGPT positively affects users' intimacy toward it.

The richness of emotional expression is another critical aspect of emotional intelligence (Zheng et al., 2013). Based on the definition of richness (Ngwenyama & Lee, 1997), we define the richness of ChatGPT's emotional expression as its ability to across different emotional perspectives and clarify ambiguous issues. From the perspective of emotional interaction, it is beneficial for the conversation partner to utilize more diverse emotional expressions in responding to the user. For example, this practice can be more effective in conveying emotional messages and cues (Androutsopoulou et al., 2019), thereby satisfying users' emotional needs and prompting positive emotional transformations (McKinney et al., 2002). These positive shifts in users' emotions can subsequently positively influence their behavior, motivating them to invest more passion into the relationship (Formosa et al., 2022).

From an emotional experience perspective, ChatGPT's emotional expression richness can offer users a more enriching and authentic interactive experience, making users feel more acknowledged and comprehended. This enhanced emotional experience will increase people's satisfaction with their conversation partners and further stimulate their passion (Johnson et al., 2021; Vallerand et al., 2003). Additionally, Picard (1997) found that AI tools with rich emotional expressions can enhance users' interest in and emotional connection to them. Therefore, we hypothesize:

H2a: The emotional expression richness of ChatGPT positively affects users' passion toward it.

Moreover, the richness of ChatGPT's emotional expressions implies that ChatGPT can convey a wealth of emotional information and cues within a shorter time window, and engage with users in interactions characterized by diversity and depth (Zheng et al., 2013). Social penetration theory suggests that individuals can transition from superficial communication to intimacy, experiencing a process of social penetration, which includes linguistic behaviors. Rich emotional expressions in language can foster intimacy between individuals (Altman & Taylor, 1973). A previous study also found a correlation between the depth and breadth of emotional interactions and intimate relationships. As interactions deepen, relationships between people can evolve towards intimacy (Pentina et al., 2023). Therefore, we hypothesize:

H2b: The emotional expression richness of ChatGPT positively affects users' intimacy toward it.

Based on the meaning of personalization (Tam & Ho, 2006), we define the personalization of emotional expression as ChatGPT's ability to adjust conversation content to generate unique content satisfying the user's specific emotional needs, a further indication of emotional intelligence (Kim & Im, 2023). On the one hand, personalization can demonstrate an understanding of user preferences, leading users to believe that the responses of the conversation partner are based on their personal preferences rather than being predetermined (Komiak & Benbasat, 2006). On the other hand, through personalized emotional expression, the conversation partner can tailor responses to the emotional information provided by the user (Shumanov & Johnson, 2021). This induces users to perceive their conversation partner as sharing similar emotions, thus enhancing the partner's appeal and stimulating the user's interest and passion for them (Ruijten, 2021). Concurrently, existing research suggests that a distinguishing feature of ChatGPT is its ability to fine-tune its responses based on user feedback within the conversation, generating personalized output (Alessa & Al-Khalifa, 2023). It means that ChatGPT has the ability to personalize the expression of emotions based on user preferences and provide emotional information, thereby stimulating user interest and passion for ChatGPT. Therefore, we hypothesize:

H3a: The personalized emotional expression of ChatGPT positively affects users' passion toward it.

Moreover, consistent with the comprehension of personalization (Schuetzler et al., 2020), ChatGPT's personalized emotional expression suggests its capability to generate unique content for users and provide tailored responses. This encourages users to perceive that ChatGPT can recall previous conversation content and cater to their specific needs (Grimes et al., 2021). On the one hand, the perception of personalization capability by users persuades them that the conversational agent is also perceiving and understanding them, increasing their propensity to interact (Rietz et al., 2019). On the other hand, it also elicits emotional identification in users, diminishing the sense of distance in the relationship (Komiak & Benbasat, 2006) and consequently enhancing intimacy. Therefore, we hypothesize:

H3b: The personalized emotional expression of ChatGPT positively affects users' intimacy toward it.

3.0.2. ChatGPT's emotional companionship and human love toward it

Existing studies indicate that ChatGPT can engage in emotional interaction with users, providing 24/7 companionship and attention, and thereby mitigating feelings of loneliness (Alessa & Al-Khalifa, 2023). According to the definition of "Always available" (Chen et al., 2022), this term implies that ChatGPT is always available for emotional support or interaction whenever users need it, irrespective of time and location. Therefore, we consider "always available" as a significant feature of ChatGPT's emotional companionship. "Always available" eliminates the constraints of time and space, offering a continuous and consistent emotional companionship. This companionship makes it hard for users to leave the conversational agent (Ramadan, 2021). Prior research also indicates that when users find it difficult to choose or leave freely, they continue to engage in emotional interaction, even increasing the frequency of such interactions. They invest more emotional effort with the hope of building stronger emotional bonds with their conversational partner, thereby promoting intimacy between them (Zhou et al., 2012). Thus, when ChatGPT is always available, it can give users a sense of difficulty in leaving ChatGPT, encourage continuous emotional interaction, and stimulate the development of intimacy. Therefore, we hypothesize:

H4: The always available of ChatGPT positively affects users' intimacy.

ChatGPT's effectiveness in providing emotional companionship is also manifested in its responsiveness to users (Chen et al., 2022); it implies that ChatGPT is willing to provide timely assistance and service. When the conversational agent actively and promptly responds to users' emotional needs, users feel understood, valued, and cared for (Clark & Reis, 1988). Studies have indicated that the degree of intimacy in interactions is substantially influenced by individuals' perceptions and substantial feelings about the conversational agent's responsiveness (Laurenceau et al., 1998). Therefore, we hypothesize:

H5: The Responsiveness of ChatGPT positively affects users' intimacy.

Based on the definition of commitment (Steinberg, 1986), users' commitment implies sustained and ongoing emotional interactions with ChatGPT, coupled with the desire to maintain a lasting relationship. Concurrently, users' passion signifies a strong connection between the individual and the dialogic partner, indicating the individual's willingness to maintain the relationship through increased investment and

additional effort. This escalates the emotional expenditure in the relationship, fostering loyalty towards the conversational partner (Sarkar et al., 2012a). An individual's loyalty will encourage them to steadfastly pursue emotional bonds with each other, thereby enhancing relationship stability and consequently leading to commitment (Song et al., 2022). Therefore, we propose that when users develop a passion for ChatGPT, they will increase the emotional cost invested in the relationship, leading to user loyalty and thereby promoting relationship stability and the formation of commitment. Therefore, we hypothesize:

H6: Users' passion positively affects users' commitment to ChatGPT.

Commitment is related to an individual's long-term, stable investment and determination to continue to use, involving the formation of long-term relationships (Song et al., 2022). On the one hand, partners with high intimacy have a high level of trust (Aron & Westbay, 1996), and trust is considered to be a key factor affecting commitment and has a significant improvement effect on commitment (Tabrani et al., 2018). Therefore, we propose that the higher the intimacy, the higher the individual's trust in ChatGPT, thus promoting a higher level of commitment. On the other hand, increased intimacy will also have an impact on an individual's sense of security (Collins & Feeney, 2004). A high level of intimacy makes individuals feel safe in relationships, making them more willing to maintain stable relationships, thereby forming commitment (Ruggieri et al., 2021). Therefore, we propose that the higher the sense of intimacy, the higher the sense of security an individual will feel when interacting emotionally with ChatGPT, thus forming a higher level of commitment. In addition, increased intimacy will drive individuals to invest more emotion, time, and energy in emotional relationships, thereby forming deeper emotional connections (Steinberg, 1986). This deep connection stimulates individuals' motivation to maintain long-term relationships and promotes stronger commitment (Pal et al., 2023). Therefore, we propose that as users' intimacy with ChatGPT increases, they will invest more time and energy in emotional interactions with ChatGPT, forming a deeper connection, thereby increasing their commitment to ChatGPT. In summary, we hypothesize:

H7: Users' intimacy positively affects users' com*mitment to ChatGPT.*

3.0.3. The moderating effect of human's anxious attachment personality

Individuals possessing anxious attachment styles exhibit significant dependence on others' emotional responses while forming emotional bonds (Simpson et al., 2011). These anxiously attached users display a compelling need for validation of attention and understanding from others, making them more sensitive to the accuracy of emotional feedback during interactions (Simpson et al., 1999). Therefore, for users with high attachment anxiety, the ability of ChatGPT to express emotions accurately could satiate their needs, thereby fostering users' passion derived from ChatGPT's emotional expression accuracy. Moreover, individuals with anxious attachment styles often showcase excessive emotional dependency on others, bearing high expectations for the depth and breadth of emotional interactions. This demand stems from their lack of security in intimate relationships and the insufficient management of their own emotions (Mikulincer & Florian, 1998). For such users with high attachment anxiety, a diverse and profound emotional experience could more effectively fulfill their emotional needs, alleviate their internal worries and concerns, and ultimately promote users' passion stemming from ChatGPT's emotional expression richness. Additionally, individuals with anxious attachment styles frequently exhibit anxiety about intimate relationships and have an intense desire to be understood and validated, aiming for emotional resonance (Collins & Read, 1990). Personalized emotional expression, which generates tailored outputs based on user input, could cater to specific user needs. This capability might more effectively address the emotional requirements of anxiously attached users, eventually fostering the user's passion stemming from ChatGPT's personalized emotional expression. Therefore, we hypothesize:

H8a: The impact of the emotional expression accuracy of ChatGPT on users' passion is stronger for users with higher anxious attachment than for those with lower anxious attachment.
H9a: The impact of the emotional expression richness of ChatGPT on users' passion is stronger for users with higher anxious attachment than for those with lower anxious attachment.
H10a The impact of the personalized emotional expression of ChatGPT on c users' passion is stronger for users with higher anxious attachment than for those with lower anxious attachment.

Individuals with anxious attachment styles also exhibit negative self-perceptions, an excessive need for attention and understanding from attachment figures, and overly rely on the abilities of others (Huang et al., 2012; Stănculescu, 2023). If ChatGPT can respond emotionally accurately, presenting a variety of intricate emotions, it can demonstrate its proficiency in emotional expression to the user, satisfying the expectations of anxiously attached users and meeting their need for empathy and deep understanding. This could enhance the intimacy perceived by users arising from ChatGPT's accurate and rich emotional expression. Moreover, individuals possessing high attachment anxiety display an elevated level of proactivity and control in attaining intimacy and peace, compared with their counterparts with lower attachment anxiety (Mikulincer & Shaver, 2007). The personalized expression of ChatGPT, which adjusts emotional feedback based on users' specific situations and needs, could enhance the users' sense of control and reduce uncertainty, potentially promoting the intimacy experienced by users arising from ChatGPT's personalized emotional expression. Therefore, we hypothesize:

H8b: The impact of the emotional expression accuracy of ChatGPT on users' intimacy is stronger for users with higher anxious attachment than for those with lower anxious attachment.
H9b: The impact of the emotional expression richness of ChatGPT on users' intimacy is stronger for users with higher anxious attachment than for those with lower anxious attachment.
H10b The impact of the personalized emotional expression of ChatGPT on users' intimacy is stronger for users with higher anxious attachment than for those with lower anxious attachment.

Attachment styles are perceived as anticipated relationship patterns that individuals cultivate based on their past attachment experiences (Mende et al., 2013). On the one hand, users with high attachment anxiety exhibit a higher sense of insecurity, harbor greater fears of being abandoned within relationships, and anticipate the pain brought about by the loss of such relationships. Consequently, they compel themselves to invest more deeply in their relationships. On the other hand, users with high attachment anxiety often have diminished self-esteem and regard others as more competent (Huang et al., 2012). This perspective leads them to overestimate the emotional value they can derive from emotional interactions with ChatGPT and to exaggerate potential future emotional gains (Kao et al., 2020). Therefore, as users demonstrate an increased degree of attachment anxiety, they tend to make larger emotional investments, expect greater future benefits, and are consequently more inclined to strive for maintaining enduring relationships. Ultimately, this could lead to increased users' commitment stemming from users' passion. Therefore, we hypothesize:

*H*11 The impact of users' passion on users' commitment is stronger for users with higher anxious attachment than those with lower anxious *attachment.*

At the same time, users with high anxious attachment tend to have a heightened sense of uncertainty (Mende & Bolton, 2011). For example, users with high attachment anxiety often resort to using the platform more frequently and disclosing more personal information as an endeavor to lessen barriers in long-term relationships and diminish the

Table 1
Demographics of the research sample (n = 466).

Measure	Item	Frequency	Percentage (%)
Gender	Male	245	52.6 %
	Female	221	47.4 %
Age	18–25	91	19.5 %
	26–30	144	30.9 %
	31–40	153	32.8 %
	41–50	36	7.7 %
	51–60	42	9.0 %
Education	Three-year college	106	22.7 %
	Four-year college	236	50.6 %
	Graduate school or above	124	26.6 %

uncertainty associated with these relationships (Jin & Peña, 2010). Therefore, we posit that user attachment anxiety amplifies the influence of users' intimacy on users' commitment. The perceived uncertainty increases with the escalation in the level of user attachment anxiety. To decrease this feeling, it is likely to lead to increased users' commitment arising from users' intimacy. Therefore, we hypothesize:

H12 The impact of users' *intimacy on users' commitment is stronger for users with higher anxious attachment than for those with lower anxious attachment.*

2.3.4 Human's *commitment to* ChatGPT and emotional dependence on it.

Dependence is understood as one party's necessity to sustain a relationship with another to meet needs and attain objectives (El-Ansary & Stern, 1972). Based on previous research on dependency and descriptions of dependent behavior (Andreassen et al., 2012), we suggest that when users develop an emotional dependency on ChatGPT, it manifests as users dedicating increasing amounts of time to ChatGPT, considering it central to their lives, and experiencing negative emotions when access to ChatGPT is unavailable. Simultaneously, users' commitment reflects users' identification of the importance and uniqueness of the conversation partner, indicating their long-term focus and substantial investment in this relationship.

The commitment of individuals to the conversation partner implies the recognition of the importance and uniqueness of the conversation object, indicating the long-term attention and substantial investment of individuals in the relationship (Madey & Rodgers, 2009). On the one hand, certain research implies that users' commitment, seen as an identification process, can affect addictive behavior (Bacchini et al., 2017), and such behavior is considered a behavioral manifestation of dependence (Wang et al., 2015). On the other hand, according to some scholars, users' commitment to a certain relationship prevents them from developing new relationships, effectively binding the individual to the existing relationship (Fu & Chen, 2015). This makes it challenging for individuals to leave the relationship, ultimately leading to dependency. Therefore, in the context of ChatGPT, users' commitment to ChatGPT may instigate addictive behavior and simultaneously restrict the development of new relationships, making it challenging to break away from the intimate relationship with ChatGPT, leading to users' emotional dependence on ChatGPT. Therefore, we hypothesize:

H13 Users' commitment to ChatGPT positively affects users' emotional *dependence on ChatGPT.*

3. Method.

3.1. Measurement and data collection

To test the model, we designed a questionnaire. All the items for measurement were derived from pre-existing scales, validated for reliability and validity, and adjusted them to fit the context of this investigation. We used a seven-point Likert scale, anchored between 'completely disagree' and 'completely agree', to rate each question. The constructs' scales, definitions, and sources are shown in Table A1 (see Appendix A).

Survey data was collected through Wenjuanxing (https://www.wjx.com), a data collection platform akin to Amazon Mechanical Turk. As of January 2023, more than 226 million questionnaires have been posted on this platform and more than 18,062 million responses have been collected. We mandated that respondents have used ChatGPT and have had emotional interaction experiences with it. Specifically, we utilized two approaches to identify the qualified respondents: First, prior to collecting the questionnaires, we asked the survey platform to screen users based on our requirements. We asked the platform to filter respondents who possessed prior experience in emotional engagement with ChatGPT. We provide the platform with the explanation and examples of emotional interaction. The explanation of emotional interaction is that "when your dialogue with ChatGPT goes beyond just exchanging information or obtaining data, and involves experiencing an emotional connection or response. This could include feeling comforted, empathized with, motivated, or experiencing emotional reactions such as pleasure or humor during the conversation." Then we provide three examples of the emotional interaction, including (1) When you express your emotions (such as happiness, sadness, and anxiety) to ChatGPT and feel that it responds in an understanding and caring manner. (2) When you discuss personal issues or experiences with ChatGPT and feel supported or comforted to some extent. (3) Experiencing a sense of delight in your interaction with ChatGPT, such as when it makes you laugh with its humorous or clever responses. Second, when designing the questionnaire, we incorporated a screening question as the initial item. If respondents opted for "B," they were unable to proceed to the subsequent questions. The screening question was as follows: "Emotional interaction refers to when your dialogue with ChatGPT goes beyond just exchanging information or obtaining data, and involves experiencing an emotional connection or response. This could include feeling comforted, empathized with, motivated, or experiencing emotional reactions such as pleasure or humor during the conversation. Based on the above content, have you ever had an emotional interaction experience with ChatGPT? A. Yes, I have; B. No, I have not yet.".

After 7 days, we collected a total of 567 questionnaires. Following this, we screened the responses, excluding invalid questionnaires, including those with identical answers to all questions, those who failed to notice the attention traps, or showed response times shorter than necessary. Consequently, we obtained 466 valid questionnaires. In Table 1, the demographic data is displayed. Additionally, we test the non-response bias by comparing the responses of early and late respondents (Armstrong & Overton, 1977). T-test findings on age, gender, and education between late and early respondents revealed no significant variances at the 1 % level, indicating the non-response bias is not a serious problem.

3.2. Measurement model test

We validated our research model using SmartPLS 3.3.3. Initially, we conducted a check using a cross-loading matrix, the results of which demonstrated that the weight assigned to the corresponding factor surpassed 0.6, significantly higher than that of other constructs. Detailed data is provided in Table A2. in Appendix A. Table A3 in Appendix A summarizes the properties of the scales used. Findings showed that all Cronbach's α values in our research were above 0.8, and the composite reliability values for each construct in our research were above 0.9, well above the 0.7 threshold, demonstrating the scales' strong reliability. The AVE values were in the range of 0.72 to 0.96, all outdoing the 0.5 benchmark, indicating top-notch convergent validity. For discriminant validity testing, the outcomes from cross-loading showcased superior discriminant validity. Additionally, each variable's AVE value was compared with its squared correlation, with the comprehensive data displayed in Table A4 in Appendix A. The tests' results confirmed the constructs' great discriminant validity. In addition, we use the latent method factor approach (Liang et al., 2007; Podsakoff et al., 2003) to test CMB (common method bias). Through comparing the method

Table 2
Summary of hypothesis testing.

Hypothesis	Path coefficient	T-value	P-Value	Supported or not
H1a: Emotional expression accuracy Passion	0.35***	9.11	<0.001	Supported
H1b: Emotional expression accuracy Intimacy	0.24***	4.67	<0.001	Supported
H2a: Emotional expression richness Passion	0.21***	5.68	<0.001	Supported
H2b: Emotional expression richness Intimacy	0.13*	2.33	0.020	Supported
H3a: Personalized emotional expression Passion	0.34***	8.79	<0.001	Supported
H3b: Personalized emotional expression Intimacy	0.19**	3.48	0.001	Supported
H4: Always available Intimacy	0.21***	3.92	<0.001	Supported
H5: Responsiveness Intimacy	0.16**	3.19	0.001	Supported
H6: Passion Commitment	0.30***	4.57	<0.001	Supported
H7: Intimacy Commitment	0.35***	5.69	<0.001	Supported
H13: Commitment Emotional dependence	0.50***	13.93	<0.001	Supported
H8a: Anxious attachment personality × Emotional expression accuracy Passion	0.11**	3.16	0.002	Supported
H9a: Anxious attachment personality × Emotional expression richness Passion	0.11**	2.87	0.004	Supported
H10a: Anxious attachment personality × Personalized emotional expression Passion	0.06ns	1.63	0.104	Unsupported
H8b: Anxious attachment personality × Emotional expression accuracy Intimacy	0.13***	3.86	<0.001	Supported
H9b: Anxious attachment personality × Emotional expression richness Intimacy	0.03ns	0.70	0.482	Unsupported
H10b: Anxious attachment personality × Personalized emotional expression Intimacy	0.10*	2.41	0.016	Supported
*H*11: Anxious attachment personality × Passion Commitment	0.08ns	1.55	0.121	Unsupported
H12: Anxious attachment personality × Intimacy Commitment	0.17**	3.28	0.001	Supported

Note: ns Non-significant ; p* < 0.05 ; p** < 0.01 ; p*** < 0.001

loadings and the principal variable loadings in the measurement model, we observed that the disparity between the average quadratic sum of the principal variable loadings and that of method factor loadings was significant, indicating the CMB was not a significant issue in this study.

3.3. Structure model test

A Bootstrap analysis was performed through SmartPLS to calculate the structural model, with the results displayed in Table 2. 56.3 % of the variance is explained by intimacy, 56.3 % by passion, 38.5 % by commitment, and 24.4 % by emotional dependence. Based on the structural model test outcomes, all the main effects are supported. Regarding the moderating effects, the anxious attachment personality trait tempered the link between ChatGPT's accuracy in expressing emotions and users' passion ($\beta = 0.11; p < 0.01$), confirming H8a. It also moderated the connection between ChatGPT's richness of emotional expression and users' passion ($\beta = 0.11; p < 0.01$), thereby validating H9a. The trait further moderated the bond between ChatGPT's accuracy of emotional expression and users' intimacy ($\beta = 0.13; p < 0.001$), confirming H8b. Additionally, it moderated the relationship between

Table A1
The definitions and the measurement scales of focal variables.

Constructs	Definition	Indicators	Literature source
Emotional expression accuracy	The emotional expression of ChatGPT is accurate.	1. ChatGPT can accurately understand what emotion I express. 2. The emotional expression from ChatGPT is accurate. 3. The emotional expression of ChatGPT corresponds to the emotional question I asked. 4. The emotional expression from ChatGPT meets my expectations. 5. ChatGPT can respond to my emotional questions accurately.	(Chen et al., 2023; Mayer & Davis, 1999)
Emotional expression richness	ChatGPT can convey a wealth of emotional information and cues, and engage with users in interactions characterized by diversity and depth.	1. The emotional expression of ChatGPT is insufficient to meet my emotional needs. (R) 2. The emotional expression of ChatGPT encompasses a wide range of vocabulary and vibrant language expression. 3. ChatGPT's emotional expression is in-depth when responding to my emotional questions.	(Lee et al., 2002; McKinney et al., 2002; Zheng et al., 2013)
Personalized emotional expression	ChatGPT can adjust conversation content to generate unique content satisfying the user's specific emotional needs.	1. ChatGPT understands my emotional needs. 2. ChatGPT knows what I want. 3. ChatGPT takes my emotional needs as its own preferences.	(Komiak & Benbasat, 2006; Tam & Ho, 2006)
Always available	ChatGPT is available 7 days × 24 h. Users can interact with ChatGPT at any time and anywhere.	1. ChatGPT is available in 7 days × 24 h and at any device. 2. I can get ChatGPT at any time and anywhere. 3. ChatGPT is always online. 4. ChatGPT will never get off work.	(Chen et al., 2022)
Responsiveness	Users perceived ChatGPT's willingness to help users and provide prompt service.	1. ChatGPT responds quickly. 2. ChatGPT is always ready to serve me. 3. ChatGPT can always respond to me in time. 4. I feel that t ChatGPT is willing	(Chen et al., 2022; Watson et al., 1998)

(continued on next page)

Table A1 (*continued*)

		to serve me. 5. Every time I look for ChatGPT, I always get a timely response.	
Intimacy	The emotional connection and shared closeness between two entities.	1. I feel emotionally close to ChatGPT. 2. Most of the time, I feel very close to ChatGPT. 3. There is a close connection between me and ChatGPT.	(Song et al., 2022; Steinberg, 1986)
Passion	The strong appeal and the fervor that is inherent in a relationship.	1. I find ChatGPT very attractive. 2. ChatGPT captivates me. 3. ChatGPT really fascinates me. 4. I am enthusiastic about ChatGPT.	(Song et al., 2022; Steinberg, 1986)
Commitment	Ongoing emotional interaction and the desire to maintain a lasting relationship.	1. I am very focused on ChatGPT. 2. ChatGPT would be my first choice. 3. I would rather be with ChatGPT than with anyone else.	(Song et al., 2022; Steinberg, 1986)
Anxious attachment personality	A person's excessive need for approval, fear of rejection or abandonment, and worry regarding their partner's availability during times of need.	In real life, if I enter or am currently in an intimate relationship: 1. I worry about being abandoned by the partner. 2. I feel that the partner changes how it treats me for no apparent reason. 3. I worry that the partner doesn't really like me. 4. I worry that the partner doesn't care about me as much as I care about them. 5. The thought of being left by the partner rarely enters my mind. (R) 6. The partner often is reluctant to get as close to me as I would like.	(Lee, 2013; Mende & Bolton, 2011)
Emotional Dependence	The emotional need for an individual to be securely attached to ChatGPT.	1. I sometimes neglect important things because of an interest in ChatGPT. 2. My social life has sometimes suffered because of my interactions through ChatGPT. 3. Using ChatGPT sometimes interferes with other activities. 4. When I am not using ChatGPT, I often feel agitated. 5. I have made unsuccessful attempts to reduce the time I spend interacting through ChatGPT. 6. I am sometimes late for engagements because I interact with ChatGPT. 7. Arguments have sometimes arisen because of the time I spend on ChatGPT. 8. I think that I am addicted to ChatGPT. 9. I often fail to get enough rest because I interact with ChatGPT.	(Arntz, 2005; Charlton, 2002; Wang et al., 2015)

the personalized emotional expression of ChatGPT and users' intimacy ($\beta = 0.10; p < 0.05$), hence confirming H10b. The trait also moderated the link between users' intimacy and users' commitment to ChatGPT ($\beta = 0.17; p < 0.01$), supporting H12. However, it was revealed that the anxious attachment personality trait was not a significant moderator of the relationship between ChatGPT's personalized emotional expression and users' passion, leading to the non-validation of H10a. Similarly, its impact on the relationship between ChatGPT's emotional expression richness and users' intimacy was non-significant, leading to H9b not being supported. Its effect on the connection between users' passion and users' commitment to ChatGPT was non-significant, implying *H*11 was not supported.

4. Discussion

4.1. Summary

Operating within the social-technical framework and drawing upon the triangular theory of love, our research explores the emotional features of ChatGPT and the potential mechanism influencing user emotional dependence. The results demonstrate that the accuracy, richness, and personalization of ChatGPT's emotional expression can serve as features of its emotional intelligence, while the traits of being always available and responsiveness can serve as features of its emotional companionship. Both emotional intelligence and emotional companionship can influence the intimacy users experience with ChatGPT, while the features of emotional intelligence can simultaneously stimulate users' passion. The emergence of users' passion and intimacy will significantly impact their commitment, leading to emotional dependence on ChatGPT. Meanwhile, from the perspective of personality traits, in the formation process of user emotional dependence, this research discloses the role of anxious attachment style as a moderator. Specifically, when ChatGPT exhibits more accurate emotional expression for users with high anxious attachment, it simultaneously promotes the generation of users' passion and intimacy. When ChatGPT presents richer emotional expression, it stimulates users' passion, whereas personalized emotional expression promotes users' intimacy. Furthermore, the anxious attachment style also affects the relationship between users' intimacy and commitment.

4.2. Theoretical implications

Four theoretical implications primarily emerge from this research. First, this study empirically examines the possibility that humans will fall in love with AI when it reaches a stage of higher emotional intelligence. With the increase of emotional interaction phenomena between humans and AI, the occurrence of human-AI romance is gradually becoming apparent (Pal et al., 2023; Song et al., 2022), especially in

Table A2
Cross-loading results.

	EEA	EER	PEE	AA	RES	INT	PAS	COM	AAP	ED
EEA1	**0.72**	0.09	0.15	0.13	0.21	0.10	0.20	0.14	0.23	0.31
EEA2	**0.74**	0.12	0.13	0.19	0.20	0.11	0.18	0.18	0.20	0.30
EEA3	**0.78**	0.13	0.08	0.18	0.22	0.13	0.19	0.14	0.20	0.27
EEA4	**0.81**	0.17	0.11	0.13	0.15	0.12	0.16	0.13	0.15	0.28
EEA5	**0.78**	0.14	0.11	0.15	0.15	0.15	0.16	0.12	0.14	0.25
EER1	0.08	**0.72**	0.02	0.22	0.24	0.08	0.19	0.14	0.16	0.24
EER2	0.18	**0.82**	0.17	0.14	0.14	0.10	0.12	0.09	0.11	0.24
EER3	0.23	**0.73**	0.12	0.10	0.15	0.15	0.15	0.08	0.24	0.19
PEE1	0.22	0.12	**0.69**	0.19	0.19	0.06	0.15	0.17	0.19	0.28
PEE2	0.11	0.14	**0.76**	0.19	0.15	0.12	0.19	0.12	0.17	0.26
PEE3	0.15	0.09	**0.68**	0.13	0.20	0.17	0.22	0.14	0.17	0.27
AA1	0.19	0.14	0.18	**0.79**	0.22	0.13	0.16	0.15	0.19	0.26
AA2	0.18	0.14	0.14	**0.82**	0.20	0.12	0.18	0.17	0.18	0.28
AA3	0.17	0.14	0.13	**0.82**	0.20	0.14	0.17	0.15	0.20	0.28
AA4	0.19	0.15	0.13	**0.81**	0.23	0.14	0.17	0.18	0.17	0.26
RES1	0.17	0.10	0.07	0.18	**0.71**	0.15	0.15	0.08	0.20	0.21
RES2	0.11	0.07	0.14	0.11	**0.82**	0.11	0.14	0.11	0.19	0.19
RES3	0.17	0.12	0.11	0.20	**0.75**	0.11	0.17	0.07	0.16	0.22
RES4	0.21	0.17	0.14	0.15	**0.76**	0.06	0.12	0.16	0.19	0.23
RES5	0.18	0.18	0.13	0.18	**0.66**	0.11	0.17	0.18	0.22	0.24
INT1	0.22	0.14	0.20	0.25	0.24	**0.64**	0.23	0.17	0.19	0.32
INT2	0.22	0.14	0.10	0.18	0.20	**0.77**	0.18	0.17	0.15	0.30
INT3	0.23	0.18	0.17	0.19	0.20	**0.69**	0.23	0.16	0.21	0.30
PAS1	0.25	0.18	0.17	0.20	0.23	0.15	**0.77**	0.13	0.20	0.26
PAS2	0.25	0.17	0.20	0.20	0.23	0.16	**0.77**	0.16	0.22	0.27
PAS3	0.25	0.16	0.17	0.20	0.21	0.16	**0.77**	0.14	0.23	0.27
PAS4	0.25	0.14	0.19	0.18	0.24	0.15	**0.77**	0.16	0.23	0.27
COM1	0.19	0.15	0.14	0.17	0.14	0.11	0.19	**0.73**	0.17	0.23
COM2	0.17	0.05	0.11	0.14	0.15	0.10	0.08	**0.85**	0.18	0.21
COM3	0.17	0.10	0.11	0.20	0.17	0.13	0.14	**0.79**	0.21	0.16
AAP1	−0.23	−0.16	−0.11	−0.15	−0.19	−0.10	−0.16	−0.16	**−0.67**	−0.26
AAP2	−0.19	−0.16	−0.11	−0.13	−0.19	−0.12	−0.15	−0.10	**−0.77**	−0.24
AAP3	−0.20	−0.11	−0.14	−0.20	−0.14	−0.13	−0.17	−0.11	**−0.77**	−0.21
AAP4	−0.22	−0.11	−0.15	−0.18	−0.24	−0.12	−0.16	−0.11	**−0.73**	−0.21
AAP5	0.01	−0.01	−0.03	0.00	−0.12	−0.02	−0.02	−0.10	**−0.78**	−0.03
AAP6	−0.23	−0.19	−0.13	−0.24	−0.16	−0.09	−0.22	−0.13	**−0.62**	−0.25
ED1	0.22	0.14	0.16	0.14	0.14	0.10	0.18	0.05	0.15	**0.79**
ED2	0.22	0.14	0.17	0.14	0.18	0.08	0.19	0.06	0.15	**0.78**
ED3	0.21	0.11	0.17	0.16	0.18	0.11	0.17	0.05	0.11	**0.78**
ED4	0.19	0.12	0.16	0.17	0.16	0.11	0.13	0.06	0.16	**0.78**
ED5	0.20	0.13	0.13	0.20	0.18	0.14	0.15	0.12	0.18	**0.80**
ED6	0.15	0.10	0.08	0.16	0.14	0.13	0.09	0.15	0.14	**0.81**
ED7	0.13	0.09	0.06	0.08	0.14	0.09	0.10	0.15	0.13	**0.85**
ED8	0.14	0.12	0.07	0.11	0.15	0.11	0.08	0.15	0.13	**0.84**
ED9	0.15	0.10	0.12	0.17	0.14	0.10	0.12	0.16	0.14	**0.84**

environments like ChatGPT that highly mimic human emotional interaction capabilities (Zhao et al., 2023), this phenomenon may become even more evident. The emergence of this phenomenon implies that AI is more than just a tool; it has the ability to establish comparatively complex emotional connections with humans. Despite the existence of this phenomenon, its exploration is still insufficient, especially in the ChatGPT scenario, where research is still at a blank stage. Filling this gap, our research verifies the presence of a romance phenomenon between humans and ChatGPT and further explores its consequences. This not only expands the research scope of emotional interaction between humans and AI but also reveals the potential for more complex emotional responses from users in the ChatGPT context.

Second, from a socio-technical perspective, we have captured the multilayer classification of ChatGPT's emotional interaction features. Prior to this, most summaries of chatbot features have been approached from the perspectives of basic performance or task completion, such as performance efficacy and emotional capability (Song et al., 2022), or from the aspects of cognition, affection, and social factors (Pal et al., 2023). Some articles have also summarized chatbot features based on usability, ease of use, privacy concerns, and localization (Maduku et al., 2023). However, summaries from the perspective of basic performance or task completion lack sufficient specificity in the field of emotional interaction with ChatGPT. In the emotionally more complex and richer ChatGPT scenarios, such features obviously fail to accurately capture the characteristics of ChatGPT's emotional interaction. Therefore, based on the socio-technical perspective, we distinguish the capabilities of ChatGPT into two dimensions—emotional intelligence and emotional companionship—based on its powerful performance in emotional interaction. We further refine these into five specific sub-dimensions: emotional expression accuracy, emotional expression richness, personalized emotional expression under emotional intelligence, and always available and responsiveness under emotional companionship. This classification not only showcases the diversified capabilities of ChatGPT but also accurately uncovers the antecedents that lead users to form emotional dependence on ChatGPT. The organic combination of these emotional abilities allows ChatGPT to demonstrate a powerful potential for emotional expression, unique from other AI models, and signifies the evolution of AI capabilities to a higher echelon—emotional interaction. At the same time, this provides a basis for categorization for future scholars studying human-ChatGPT emotional interactions.

Third, our research broadens the application scope of Sternberg's triangular love theory by integrating it into the unique context of emotional interactions between humans and ChatGPT. Our findings substantiate that the triadic dimensions of love (passion, intimacy, and commitment) can effectively measure users' emotional dependence on ChatGPT. This supplements literature that previously applied this theory

Table A3
Scale properties.

Constructs	indicators	Factor loading	Cronbach's α	CR	AVE
Emotional expression accuracy	EEA1	0.92	0.96	0.97	0.86
	EEA2	0.93			
	EEA3	0.94			
	EEA4	0.94			
	EEA5	0.90			
Emotional expression richness	EER1	0.86	0.87	0.92	0.79
	EER2	0.92			
	EER3	0.88			
Personalized emotional expression	PEE1	0.88	0.86	0.91	0.78
	PEE2	0.90			
	PEE3	0.87			
Always available	AA1	0.96	0.98	0.99	0.95
	AA2	0.98			
	AA3	0.98			
	AA4	0.98			
Responsiveness	RES1	0.84	0.92	0.94	0.77
	RES2	0.89			
	RES3	0.87			
	RES4	0.91			
	RES5	0.86			
Intimacy	INT1	0.93	0.93	0.96	0.88
	INT2	0.94			
	INT3	0.93			
Passion	PAS1	0.97	0.99	0.99	0.96
	PAS2	0.99			
	PAS3	0.98			
	PAS4	0.98			
Commitment	COM1	0.90	0.91	0.94	0.85
	COM2	0.94			
	COM3	0.91			
Anxious attachment personality	AAP1	0.87	0.92	0.94	0.72
	AAP2	0.92			
	AAP3	0.91			
	AAP4	0.89			
	AAP5	0.65			
	AAP6	0.85			
Emotional dependence	ED1	0.91	0.97	0.98	0.82
	ED2	0.91			
	ED3	0.90			
	ED4	0.90			
	ED5	0.93			
	ED6	0.89			
	ED7	0.90			
	ED8	0.91			
	ED9	0.93			

to the field of AI interaction, and reveals the deep-seated consequences of emotional interaction between users and ChatGPT, offering a fresh theoretical perspective for comprehending the role and impact of AI in emotional interaction in the future. Previous studies on the consequences of emotional interaction between users and AI have mostly focused on areas such as usage intention (Pal et al., 2023; Song et al., 2022), which means AI primarily assumes a role as a tool. However, with continuous improvements in large language models and the development of deep learning technologies, AI's interaction capabilities are constantly being enhanced, and its role in human–computer interaction is changing (Yin et al., 2024). The consequences of its behavior will evolve towards deeper and more complex directions. Our study reveals a crucial and under-observed phenomenon: in the process of emotional interaction with ChatGPT, users not only establish an intimate relationship with ChatGPT but may even form an emotional connection similar to love. More importantly, we further discover that this emotional connection may lead users to develop an emotional dependence on ChatGPT. These findings not only enrich the triangle theory of love, but also help people better understand and establish emotional relationships with AI systems. This provides an initial theoretical framework and empirical evidence for future research on the profound impacts of AI emotional interaction.

Fourth, this study also reveals differences in the attitudes and behavioral tendencies of humans with different personality traits in the phenomenon of human-AI generated love. Our study innovatively introduces anxious attachment personality as a moderating factor in the research of emotional interactions between users and ChatGPT, offering a fresh theoretical perspective for exploring how different personality traits impact human-AI emotional interaction. In previous studies, although anxious attachment personality has been introduced as a moderating variable to discuss its impact on partner relationships (David & Roberts, 2021) and the influence on users' social network relationships (Chen et al., 2020; Kim et al., 2017), there exists scant research probing how users' personality traits impact their interaction with artificial intelligence. In this study, we employ anxious attachment personality as a key moderating variable. The results show that anxious attachment personality significantly moderates the relationships between the emotional expression accuracy and the user's passion, the emotional expression accuracy and the user's intimacy, the emotional expression richness and the user's passion, personalized emotional expression and user intimacy, and user's intimacy and user's commitment. This provides theoretical enlightenment for understanding how AI can adapt to and satisfy the needs of users with different personality traits.

4.3. Practical implications

This research primarily proposes three practical implications. First, our study provides implications for the design of AI products. AI designers and developers can improve and optimize existing AI products according to these dimensions to enhance their emotional interaction capabilities, thereby shifting their roles from tools to emotional companions. For instance, by improving the accuracy of emotional expression, it can better respond to user emotions, enhancing user experience. By increasing the richness of emotional expression, it can have deeper emotional exchanges with users, meeting their emotional needs. Enhancing personalization can better resonate with users. Additionally, being always available and responsive can better adapt to users' life rhythms and usage habits, providing emotional support at all times and places. This is helpful for product performance evaluation and ongoing optimization.

Table A4
The comparison between AVE values and the squared correlation.

	AA	AAP	COM	ED	EEA_	EER	INT	PAS	PEE	RES
AA	0.98									
AAP	0.58	0.85								
COM	0.54	0.53	0.92							
ED	0.59	0.56	0.50	0.91						
EEA_	0.57	0.61	0.54	0.62	0.93					
EER	0.53	0.54	0.44	0.53	0.54	0.89				
INT	0.63	0.59	0.55	0.63	0.63	0.56	0.94			
PAS	0.61	0.62	0.53	0.60	0.65	0.57	0.67	0.98		
PEE	0.58	0.57	0.51	0.60	0.56	0.50	0.60	0.64	0.88	
RES	0.60	0.60	0.51	0.57	0.59	0.54	0.61	0.62	0.56	0.88

Second, the findings have risk management implications for AI designers, developers, and related policy-makers. With the development of AI, we must recognize that while AI products like ChatGPT bring enormous convenience and emotional interaction experiences, they could also lead to emotional dependency among some users, and even pose a risk of over-dependence. This finding provides valuable insight and reference for developers and policy-makers, alerting them to be prepared for the social and even ethical issues that such interactions might bring. Early explorations for preventive and responsive measures should be initiated. This holds important value for the self-regulation of AI developers and the scientific decision-making of policy-makers.

Third, the findings also indicate that during the creation and evolution of AI products, in addition to considering the performance and features of artificial intelligence, we also need to deeply understand user individual differences. Considering user personality traits in design can better understand user characteristics, make targeted adjustments, and better meet customer needs. For example, in the ChatGPT scenario, for users with anxious attachment personality traits, the user's intimacy can better promote the generation of the user's commitment. Designing products that satisfy the needs of such users can enhance the user experience and bolster the product's market competitiveness.

5. Conclusion

Based on a socio-technical perspective and leveraging the love triangle theory, this paper explores the user's emotional dependence on ChatGPT. Our findings show that users can foster feelings of both passion and intimacy towards ChatGPT. These feelings further encourage users' commitment to ChatGPT, ultimately enhancing their emotional dependency. At the same time, ChatGPT's emotional intelligence and companionship abilities can influence users' feelings of intimacy towards ChatGPT, and ChatGPT's emotional intelligence can also affect users' passion for ChatGPT. In addition, a user's anxious attachment personality moderates the development of intimacy, passion, and commitment. Our research provides a novel perspective for understanding the emotional dynamics between users and ChatGPT, revealing the profound influence of artificial intelligence technology on human emotional life, and preliminarily exploring the potential of ChatGPT to form romantic relationships with humans. These insights also have practical significance for designing and developing AI products. When exploring the behavioral consequence of human-ChatGPT's love, we focus on humans' emotional dependencies on ChatGPT. It may be interesting to consider other behavioral consequences. Such dependency might have further potential negative consequences and risks. Future studies could explore other potential outcomes and impacts.

CRediT authorship contribution statement

Qian Chen: Writing – review & editing, Writing – original draft, Validation, Supervision, Methodology, Investigation, Formal analysis, Conceptualization. **Yufan Jing:** Writing – original draft, Validation, Software. **Yeming Gong:** Writing – review & editing, Supervision. **Jie Tan:** Writing – review & editing, Project administration, Funding acquisition.

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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Appendix A

See Table A1-A4.

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Qian Chen -Email address: chen_qian@mail.hzau.edu.cn-Mailing address: School of Economics and Management, Huazhong Agricultural University, China. Dr. Qian Chen is an Associate Professor at the School of Economics and Management, Huazhong Agricultural University. Her research focuses on user experience and behavior of smart products and smart service, generative AI ethics, platform economics. She has published several research papers in journals including *MIS Quarterly, European Journal of Information Systems, Journal of Business Research, Information & Management, Internet Research, International Journal of Information Management, Information Technology & People,* and *ACM Transactions.*

YufanJing -Email address: yufan_jing@webmail.hzau.edu.cn-Mailing address: School of Economics and Management, Huazhong Agricultural University, China. Yufan Jing is an undergraduate student at the School of Economics and Management, Huazhong Agricultural University. Her research interests focus on human-AI emotional interaction.

YemingGong * (Corresponding Author) -Email address: gong@em-lyon.com -Mailing address: Artificial Intelligence in Management Institute, EMLYON Business School, Lyon, France Yeming (Yale) Gong is a Professor of Management Science at EMLYON Business School, France. He is institute head of "Artificial Intelligence in Management Institute" (AIM) and director of "Business intelligence Center" (BIC). He holds a Ph.D. of Management Science from Rotterdam School of Management, Erasmus University, Netherlands. He was a post-doc researcher at University of Chicago, USA. He has published two books in Erasmus and Springer. He published 130+ Web of Science articles in journals, including *Journal of Business Research, MIS Quarterly, Production and Operations Management, Transportation Science*, various *IEEE Transactions, IISE Transactions*, and *ACM Transactions.* He received "2010 the Best Paper Award in Design and Manufacturing" from IISE, 2019 "Outstanding Paper Award" from ASCOM, "Erasmus Scholarship for Teaching" from European Union, and 2024 "Emerald Literati Award" (Outstanding Paper).

JieTan -Email address: jietan@szpu.edu.cn. -Mailing address: School of Management, Shenzhen Polytechnic University, Shenzhen, China. Dr. Jie Tan is now a lecturer at the School of Management, Shenzhen Polytechnic University. He received his Ph.D. degree in management science from Huazhong University of Science and Technology, China. Then he worked as a postdoctoral at Sun Yat-sen University from 2019 to 2021, concentrating on the research of generative AI management. He has published research articles in international journals such as *Physica A: Statistical Mechanics and its Applications, Transportation Research Part E: Logistics and Transportation Review, Simulation: Transactions of the Society for Modeling, and Simulation International,* and *Journal of Cleaner Production.*.