

2025 International Conference on Fiscal Management, Holistic Social Studies (FMHSS 2025)

Article

Cross-Cultural Characteristics of Human-Machine Parasocial Interaction and Its Impact on Social Substitution Behavior

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Abstract: With the rapid proliferation of intelligent agents, conversational artificial intelligence, and virtual companions, human-machine parasocial interaction has emerged as a critically important research topic in the contemporary digital era. As these technologies become increasingly anthropomorphized, users frequently develop profound, one-sided emotional attachments to machines. Crucially, cultural background fundamentally shapes how individuals perceive, trust, and engage with artificial intelligence, thereby influencing the extent to which such digital interactions might substitute for traditional, interpersonal social relationships. This study comprehensively explores the cross-cultural characteristics of human-machine parasocial interaction, meticulously examining its differentiated manifestations across various global cultural contexts. By investigating established cultural dimensions such as individualism versus collectivism and high-context versus low-context communication, the research elucidates how distinct cultural paradigms dictate user expectations, relational dynamics, and emotional investments in machines. Furthermore, it critically assesses the subsequent impact on social substitution behaviors, analyzing whether artificial intelligence companions effectively alleviate human loneliness or inadvertently exacerbate societal isolation. By integrating cultural theory, communication studies, and human-computer interaction research, this paper constructs a robust comparative framework for future empirical investigations. Ultimately, the study proposes actionable governance strategies and ethical design guidelines aimed at balancing rapid technological innovation with long-term social well-being, ensuring that artificial intelligence serves to augment rather than replace genuine human connection.

Keywords: parasocial interaction; human-machine interaction; cross-cultural context; social substitution; intelligent agents

Received: 14 May 2026

Revised: 18 June 2026

Accepted: 28 June 2026

Published: 01 July 2026



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1. Introduction

1.1. Research Background

The rapid development of generative AI technologies has led to the emergence of embodied conversational agents, virtual companions, and other intelligent systems that simulate natural social interactions. These AI-driven agents differ significantly from traditional human-computer interaction systems due to their ability to exhibit emotional responsiveness, engage in adaptive dialogue, and utilize multimodal expressions. Such capabilities enable these systems to foster interactions that closely resemble human companionship. The concept of parasocial relationships, which was historically associated with celebrities and media figures, has now expanded to include interactions with AI systems [1]. These relationships are increasingly being integrated into various domains,

including daily communication, psychological counseling, health management, and educational settings. However, the social and psychological impacts of these interactions are not universally consistent. Cultural factors, such as norms surrounding social intimacy, communication styles, and levels of trust in technology, play a critical role in shaping how individuals perceive and interact with AI companions. This highlights the importance of cross-cultural analysis in understanding the broader implications of human-machine parasocial interactions.

1.2. Research Significance

Investigating cross-cultural differences in parasocial interaction with AI companions offers significant theoretical and practical contributions. Theoretically, it deepens the understanding of intercultural communication, human-AI interaction, and social psychology by examining how cultural norms influence the development and perception of quasi-social relationships with machines [2]. This perspective sheds light on the nuanced ways in which cultural frameworks shape human engagement with artificial entities. Practically, such research provides valuable insights for the ethical design and implementation of AI systems, particularly as they become increasingly embedded in sensitive aspects of daily life. By analyzing the potential for these interactions to result in social substitution behaviors—where individuals may prioritize AI companionship over human relationships—it becomes possible to anticipate and address risks such as social isolation, emotional over-reliance, and cultural misalignment. This study not only contributes to ongoing academic discussions but also informs strategies to ensure that AI companionship evolves in a manner that is socially responsible, culturally adaptive, and inclusive of diverse societal needs.

2. Theoretical Foundation of Human--Machine Parasocial Interaction

2.1. Concept and Evolution of Parasocial Interaction

The concept of parasocial interaction was initially introduced to describe the phenomenon where audiences develop one-sided, seemingly intimate relationships with media figures, such as television hosts or celebrities. These interactions were characterized as illusionary experiences, where individuals perceived a sense of reciprocity despite the absence of actual two-way communication. Over time, advancements in digital technologies have significantly transformed this concept [3, 4]. Social media platforms have introduced greater interactivity, effectively blurring the lines between mediated and face-to-face communication. This shift has allowed users to engage in more dynamic exchanges, fostering a deeper sense of connection. More recently, the emergence of artificial intelligence, particularly embodied conversational agents, chatbots, and virtual companions, has further revolutionized parasocial interaction. Unlike traditional media figures, AI systems are capable of responding to user input in real time, simulating empathy, and adapting to individual preferences. These capabilities create a more convincing illusion of reciprocity and engagement. This evolution highlights a transition from static observation to continuous human-machine co-construction, expanding the scope of parasocial interaction in the context of intelligent communication. The integration of adaptive AI technologies underscores the growing complexity and depth of these interactions, marking a significant milestone in the understanding of human-machine relationships.

2.2. Cross-Cultural Communication Theories

Theoretical frameworks in intercultural communication offer valuable insights into how parasocial interactions unfold across diverse cultural contexts. One approach identifies key cultural variables such as individualism versus collectivism, power dynamics, and attitudes toward uncertainty, which significantly shape perceptions of technology and mediated relationships [5]. For example, in collectivist societies, there is often a strong emphasis on relational harmony and shared identity, which can influence how individuals perceive and engage with AI companions. In contrast, individualistic

cultures may prioritize personal autonomy and direct benefits, potentially leading to different interaction styles with such technologies. Another perspective examines communication styles, distinguishing between high-context and low-context cultures. High-context cultures rely heavily on implicit communication cues, nonverbal signals, and shared meanings, suggesting that AI companions designed with empathetic and nuanced responses may resonate more effectively. Conversely, low-context cultures favor explicit communication and task-oriented interactions, requiring AI systems to prioritize clarity and efficiency. By systematically applying these theories, researchers can better understand cultural variations in AI adoption, parasocial attachment, and interaction preferences, enabling more tailored and effective technological designs.

2.3. Human--Machine Interaction in Diverse Cultural Settings

Empirical studies have highlighted that cultural differences play a significant role in shaping how individuals accept and interact with AI companions. In societies that emphasize group-oriented values, people tend to be more receptive to forming close and even dependent relationships with AI agents. These agents are often seen as tools that enhance social cohesion and contribute to the well-being of the community [6, 7]. AI companions in such settings may serve as substitutes for social interaction, helping to alleviate feelings of loneliness while promoting shared values and harmony. On the other hand, in cultures that prioritize individual-focused ideals, interaction with AI companions often reflects a focus on personal goals. Users in these contexts may utilize AI for tasks such as improving efficiency, managing emotions, or exploring personal interests, but they are less inclined to view AI as a replacement for human relationships. Furthermore, variations in societal attitudes toward authority influence how AI agents are perceived. In environments where hierarchical structures are deeply respected, AI systems designed to provide guidance or authoritative input are more likely to be trusted. Conversely, in settings where egalitarian principles dominate, there is often greater skepticism toward automated systems that assume authoritative roles. These observations underscore the importance of cultural context in determining the purposes and expectations associated with human-machine interactions.

3. Cross-Cultural Differentiation of Parasocial Interaction

3.1. Emotional Expression and Cultural Norms

Emotional resonance with AI companions is shaped by cultural values, which influence how users perceive and engage in parasocial interactions [8]. In societies that emphasize collective well-being and relational harmony, emotional expressions are often moderated and context-sensitive. Users in such environments may prefer AI responses that exhibit empathy, subtlety, and alignment with group-oriented norms, fostering a sense of shared understanding and mutual respect. On the other hand, in societies that prioritize individualism and personal expression, authenticity and direct communication are more highly valued. Users in these contexts may favor AI interactions that validate personal emotions, encourage self-expression, and support individual decision-making. These cultural distinctions highlight the importance of tailoring AI-generated emotional cues to align with the values and expectations of different user groups, as this can significantly impact the level of attachment and satisfaction experienced during interactions.

3.2. Trust and Dependency Characteristics

Trust represents a fundamental aspect of parasocial interactions with AI systems, deeply influenced by cultural attitudes toward authority. In societies characterized by high power-distance, hierarchical structures are more readily accepted, fostering trust in systems or entities perceived as authoritative. This cultural orientation often leads to greater reliance on AI agents positioned as authoritative advisors, such as those utilized in healthcare or educational contexts. Conversely, in cultures with low power-distance, individuals are more inclined to question authority and prioritize transparency. AI

systems that lack clarity or appear overly directive may provoke skepticism, thereby weakening parasocial connections. These variations underscore the pivotal role of cultural frameworks in shaping both the intensity and nature of trust and dependency in interactions with AI [9]. By understanding these dynamics, developers can better tailor AI systems to align with diverse cultural expectations and enhance user engagement.

3.3. Communication Style and Interaction Preferences

Cross-cultural communication theories highlight significant variations in interaction styles across different cultural contexts. In high-context cultures, communication often relies on implicit meanings, shared experiences, and nonverbal cues. Individuals from such cultures may prefer AI companions that can generate responses imbued with subtlety, emotional depth, and contextual adaptability. These users value interactions that simulate empathy and demonstrate relational awareness, as such qualities align with their communication preferences. Conversely, low-context cultures emphasize directness, clarity, and efficiency in communication. Users from these backgrounds may favor AI systems that deliver straightforward, task-oriented responses, prioritizing functional utility over emotional engagement. These contrasting preferences underscore the importance of designing AI systems that are culturally adaptive, ensuring they can cater to the diverse expectations and interaction styles of users from varying cultural frameworks.

3.4. Generational and Subcultural Variations

Variations in parasocial interactions extend beyond national cultural frameworks, encompassing differences at both generational and subcultural levels. Younger generations, often characterized by higher levels of digital literacy and familiarity with emerging technologies, may exhibit a greater willingness to engage with AI companions and form parasocial bonds. This openness can be attributed to their frequent exposure to digital environments and their adaptability to technological advancements. In contrast, older generations may approach such interactions with caution or skepticism, influenced by differing levels of technological familiarity and trust. Subcultural groups also play a significant role in shaping unique interaction norms. For instance, gaming communities often integrate AI-driven avatars as collaborative partners, fostering teamwork and engagement within virtual environments. Similarly, online therapeutic spaces may utilize virtual therapists as confidential companions, offering support in mental health contexts. These generational and subcultural dynamics intersect with broader cultural patterns, creating a diverse and multifaceted spectrum of parasocial interaction styles. Acknowledging this complexity underscores the importance of nuanced analysis that considers both overarching cultural influences and localized social dynamics, thereby avoiding overgeneralization and promoting a more comprehensive understanding of human-machine interactions.

4. Impact on Social Substitution Behaviors

4.1. Emotional Substitution

Emotional substitution refers to situations in which individuals rely on AI systems to address the absence of human companionship. This phenomenon is particularly noticeable among groups experiencing feelings of isolation or challenges in forming social connections. For instance, elderly individuals who live alone may frequently engage with social robots or conversational agents to reduce feelings of solitude. Similarly, younger individuals who face difficulties such as peer exclusion or academic stress may turn to AI chatbots as a means of emotional expression, perceiving them as non-critical and supportive listeners. The effectiveness of this substitution lies in the ability of AI systems to deliver immediate, adaptive, and personalized interactions that mimic the warmth and empathy typically associated with human communication. However, it is important to note that emotional substitution does not equate to the full replacement of human companionship; rather, it serves as a temporary coping mechanism to alleviate the

psychological impact of limited social ties [10]. Additionally, cultural factors play a significant role in shaping perceptions of emotional substitution. In societies that emphasize collective values and social harmony, AI may be more readily accepted as an emotional proxy, whereas in societies that prioritize individualism, reliance on AI for emotional support might be viewed as a sign of personal inadequacy or social disconnection.

4.2. Behavioral Substitution

Beyond providing emotional support, AI systems are increasingly capable of substituting for human interactions in behavioral and task-oriented contexts. In the field of education, intelligent tutoring systems are designed to offer personalized learning experiences, often replacing traditional peer collaboration and reshaping the dynamics of classroom engagement. Similarly, in the realm of entertainment, virtual idols, AI-driven gaming companions, and live-streaming avatars are fulfilling social and recreational needs that were once met through interactions with friends or community groups. Within professional environments, AI-based virtual assistants are taking over communicative and organizational tasks previously handled by colleagues, such as scheduling, brainstorming, and problem-solving. This shift not only redefines interpersonal practices but also has broader implications for organizational and societal structures. For example, the collaborative creativity that traditionally emerged from human interactions may be increasingly replaced by human-machine co-production. While these advancements enhance efficiency and accessibility, they may simultaneously diminish the depth and richness of human-to-human connections by prioritizing task completion over relational engagement.

4.3. Cognitive Substitution

Cognitive substitution represents a significant extension of the impact of parasocial human-machine interaction, influencing beliefs, values, and worldviews. Through repeated engagements, individuals may gradually internalize the discourses, norms, or cognitive frameworks presented by AI systems. For instance, recommendation algorithms and conversational AI tools often play a role in shaping how people assess social issues, make decisions, or conceptualize interpersonal relationships. Over time, this process can lead to the integration of machine-generated perspectives into an individual's cognitive schema, subtly altering their identity formation and social imagination. In multicultural settings, the cultural biases embedded within AI systems may further complicate this dynamic by reinforcing or distorting cross-cultural perceptions. For example, an AI trained predominantly on data from individualistic societies may inadvertently transmit norms that conflict with collectivist values, thereby reshaping users' cognitive approaches to social interaction. This phenomenon is particularly impactful as it influences the foundational lens through which individuals interpret and navigate their social environments, often without conscious awareness.

4.4. Risks of Over-Substitution

While substitution through AI may provide immediate advantages, an over-reliance on such technologies as replacements for human relationships introduces considerable challenges. Emotional over-substitution can intensify tendencies toward social isolation, reducing the drive for in-person interactions that are vital for emotional well-being. Behavioral over-substitution risks eroding essential interpersonal skills, such as the ability to negotiate, empathize, or collaborate effectively—skills that are critical for success in both professional and personal spheres. Cognitive over-substitution poses an even deeper concern, as it may lead to the uncritical acceptance of biases embedded within algorithms, potentially narrowing users' perspectives and critical thinking abilities. Furthermore, the normalization of AI companionship over time could foster new forms of dependency, where individuals become emotionally or cognitively reliant on artificial entities. This dependency not only weakens the robustness of social networks but also raises ethical questions regarding the potential for undue influence and the commercialization of

human emotional connections. It is essential to approach parasocial substitution as a supplementary tool rather than a complete replacement for human interaction. To address these risks, initiatives that emphasize digital literacy, promote responsible AI development, and encourage the strengthening of offline social bonds are indispensable for fostering a balanced integration of AI into daily life.

5. Evaluation and Future Prospects

5.1. Evaluation Indicators

The systematic evaluation of parasocial human-machine interaction requires the establishment of clear and multidimensional indicators that effectively capture both quantitative behaviors and qualitative experiences. One of the primary indicators is interaction frequency, which measures how often individuals engage with AI companions or systems [11]. While frequent engagement may suggest the development of stronger parasocial bonds, it does not necessarily correlate with universally positive outcomes. Another significant dimension is emotional reliance, which explores the extent to which users seek comfort, companionship, or emotional support from AI systems during periods of stress or loneliness. This aspect highlights the potential psychological implications of such interactions. Closely related to this is substitution intensity, which assesses the degree to which AI systems replace human relationships across emotional, behavioral, and cognitive dimensions. This indicator is particularly valuable in identifying risks associated with over-reliance on digital interactions, such as diminished human connections or dependency on technology. Additionally, cultural adaptability plays a pivotal role in evaluating whether AI systems align with users' cultural values, communication preferences, and social norms. For example, an interaction style perceived as empathetic in a collectivist cultural context might be considered intrusive in an individualist setting. By integrating these indicators, a comprehensive framework can be developed to analyze both the advantages and potential challenges of parasocial human-machine relationships across diverse cultural environments.

5.2. Evaluation Methods

To operationalize these indicators, researchers utilize diverse methodological approaches that integrate qualitative and quantitative strategies to ensure comprehensive analysis. Cross-cultural surveys serve as a prominent tool for capturing large-scale patterns related to AI adoption, trust, and interaction preferences across various societies. These surveys are meticulously designed to measure variables such as emotional attachment, trust in AI systems, and perceptions of authenticity in interactions. Beyond surveys, ethnographic fieldwork offers valuable, in-depth insights into the ways individuals in specific cultural contexts integrate AI into their daily routines. For instance, immersive studies conducted in elder-care facilities employing social robots can reveal intricate practices of emotional substitution that may not be evident through survey data alone. Experimental designs further enhance the understanding of causal relationships by manipulating factors such as AI communication style, voice tone, or response delay, and observing their impact on user perceptions across diverse cultural groups. Additionally, the advent of digital platforms has amplified the significance of big-data-based sentiment analysis, which facilitates the large-scale monitoring of emotional expressions and interaction patterns in real-time. This method enables researchers to identify cultural trends, generational variations, and evolving public attitudes toward AI companionship. By integrating these methodologies, a robust and multi-dimensional framework is established for evaluating parasocial interactions in a technologically interconnected and globalized world [12].

5.3. Future Prospects

Looking ahead, parasocial human-machine interaction is poised to evolve into increasingly intricate and immersive forms, driven by advancements in multimodal generative AI. Unlike earlier systems that were confined to text or speech, future models

are expected to integrate voice, vision, gesture, and even haptic feedback, enabling interactions that more closely resemble human communication. This progression presents both promising opportunities and significant challenges. On one hand, AI systems have the potential to act as facilitators of cross-cultural understanding, aiding individuals in overcoming language barriers, adapting to unfamiliar cultural contexts, and fostering global connectivity. On the other hand, the ability of these systems to adapt across cultures will be a critical determinant of their acceptance. Without adequate cultural sensitivity, there is a risk of perpetuating biased perspectives or reinforcing stereotypes. Furthermore, ethical considerations will become increasingly important as these technologies substitute emotional and cognitive functions, raising concerns about data privacy, commercialization of personal interactions, and the potential for undue influence. The future trajectory of parasocial interaction must prioritize a balanced approach, ensuring that AI augments rather than replaces human relationships. By supporting community, empathy, and social resilience, these systems can contribute to sustainable human-machine interactions that complement rather than undermine human-centered connections in a globalized context [9].

6. Conclusion

This study examined the cross-cultural characteristics of human-machine parasocial interaction and their influence on social substitution behaviors in a more systematic and comparative manner. The findings indicate that cultural norms significantly shape emotional expression, trust formation, communication preferences, and expectations toward AI systems, thereby producing distinct patterns of parasocial engagement across different contexts. These variations further affect the degree and form of emotional, behavioral, and cognitive substitution associated with AI companionship. At the same time, the results underscore potential risks related to excessive reliance, weakened interpersonal balance, and overdependence on mediated interaction. Accordingly, future governance and design strategies should prioritize cross-cultural adaptability, reinforce ethical safeguards, and support a balanced integration of AI companionship with stable, meaningful, and authentic human social relationships.

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