



Decoding Silence in Digital Cross-Cultural Communication: Overcoming Misunderstandings in Global Teams

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Decoding Silence in Digital Cross-Cultural Communication: Overcoming Misunderstandings in Global Teams

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Abstract

This study investigates the role of silence in digital cross-cultural communication, emphasizing its potential for misinterpretation due to cultural differences and the absence of non-verbal cues. Silence, often perceived differently across high- and low-context cultures, plays a crucial role in conveying emotions and intentions. In digital spaces, the lack of immediate feedback and non-verbal richness increases the complexity of silence interpretation. This research employs a comprehensive literature review to explore how silence is used in virtual communication platforms like Zoom and Slack and its impact on global teams. The study analyzes various existing research on silence in intercultural communication and digital communication tools. Key findings reveal that silence in high-context cultures, such as Japan and China, is seen as reflective and respectful, while in low-context cultures like the United States, it is often interpreted negatively, leading to miscommunication. Furthermore, the absence of non-verbal cues in digital environments exacerbates these misunderstandings. The study also explores the potential of emerging technologies like artificial intelligence (AI) to mitigate these communication barriers by detecting and interpreting silence more effectively. The results underscore the need for cultural sensitivity in virtual teams and highlight the limitations of current AI tools in understanding cultural nuances. This research contributes to the ongoing discourse on improving intercultural communication in digital settings, offering practical implications for global teams and suggesting future directions for AI integration in digital communication platforms.

Keywords: Silence; Digital Communication; Cross-Cultural Communication; Intercultural Misunderstandings; Artificial Intelligence; Non-Verbal Cues

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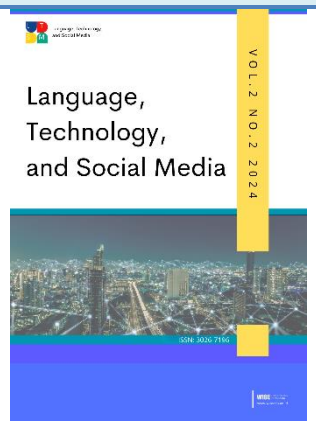
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INTRODUCTION

Silence has long been an essential yet underexplored aspect of communication, particularly in intercultural contexts. Defined as the absence of verbal communication, silence is often filled with various meanings depending on the cultural framework. While words remain the primary medium of communication across cultures, silence also plays a significant role in conveying emotions, thoughts, and intentions [1], [2], [3]. The complexity of silence increases in digital spaces, where non-verbal cues, including silence, are frequently misinterpreted due to the lack of immediate feedback and the absence of physical presence. Understanding how silence functions in digital cross-cultural communication is crucial in an increasingly globalized world where digital tools and social media dominate interactions [4], [5].

The growing reliance on virtual communication platforms like Zoom, Slack, and social media networks such as Facebook and Twitter highlights the need to study silence in this context [6], [7]. Digital communication strips away much of the non-verbal richness present in face-to-face interactions, making silence, or the absence of speech, even more ambiguous and prone to misinterpretation. As global teams work more collaboratively through these digital platforms, understanding how silence is interpreted across different cultures is critical [8], [9], [10]. Misunderstandings resulting from silence can create friction in intercultural collaborations, as what one culture perceives as respectful or contemplative may be seen as disengagement or indifference in another.

The importance of this study lies in its exploration of silence within the digital realm, where communication dynamics differ significantly from face-to-face interactions. Previous research has extensively examined silence in traditional intercultural communication [2], [11], [12], highlighting how silence can express politeness, thoughtfulness, or conflict avoidance in high-context cultures, such as Japan and China, while it is often seen as uncomfortable or a sign of disengagement in low-context cultures like the United States [13], [14]. However, there is a gap in understanding how these interpretations translate into digital communication, where non-verbal cues are minimized, and pauses in dialogue are often misconstrued.

Several recent studies have begun to touch on this area, particularly in the context of virtual work environments. For example, Olga Laini et al. [15] examine how silence functions in online meetings between Dutch and Chinese teams, noting that cultural differences in silence interpretation can lead to delays and conflicts. Similarly, Wim Biemans [16] highlights that silence in chat-based communication, such as in Slack or email, is frequently perceived as negative, especially when there is an expectation of quick, real-time responses. AI-driven communication tools, which increasingly mediate digital conversations, are also not yet sophisticated enough to understand the cultural significance of silence. Debbie G. E. Ho et al. [17] suggests that AI tools may misinterpret silence as confusion or lack of engagement, contributing to miscommunication in virtual environments. These studies underscore the need for a deeper investigation into silence in digital intercultural communication settings.

The novelty of this research stems from its focus on the intersection of silence, digital communication, and intercultural interactions. While silence in traditional communication has been well-explored [9], [18], [19], [20], [21], the digital context presents new challenges and opportunities for understanding how silence is interpreted and managed. This study contributes to the existing body of knowledge by analyzing how silence functions in online communication platforms and how cultural differences in interpreting silence can lead to misunderstandings.

Furthermore, the study explores the role of emerging technologies, such as AI and machine learning, in potentially mitigating these misunderstandings through better analysis of silence and non-verbal cues in digital communication [10], [22], [23], [24], [25].

In terms of practical implications, this research offers strategies for improving intercultural communication in virtual teams by focusing on cultural sensitivity and awareness of how silence is used and interpreted. As noted by Abdallah et al. [26], miscommunication due to cultural differences is one of the leading causes of project delays and conflict in global teams. Understanding the role of silence in these interactions can improve collaboration and reduce friction, especially as digital communication continues to grow in importance. The development of AI tools that account for cultural nuances in silence interpretation could further aid in creating more effective communication strategies for global organizations [27], [28], [29]. In conclusion, this research fills a critical gap in the study of intercultural communication by focusing on the underexplored area of silence in digital contexts. By examining how silence is interpreted across cultures in online interactions and exploring the potential role of technology in addressing these issues, the study offers new insights into the dynamics of digital cross-cultural communication. As global teams increasingly rely on digital tools for collaboration, understanding how silence functions in these interactions is vital for improving communication efficiency and reducing misunderstandings.

METHODS

This study employs a literature review methodology to explore the role of silence in digital cross-cultural communication and its implications for intercultural misunderstandings. The literature review method was selected due to its effectiveness in synthesizing existing research, providing a comprehensive overview of the field, and identifying gaps in the current knowledge base. By analyzing multiple sources, this study aims to provide a detailed understanding of how silence is interpreted across different cultures in digital communication settings and how these interpretations influence communication outcomes.

Data Collection

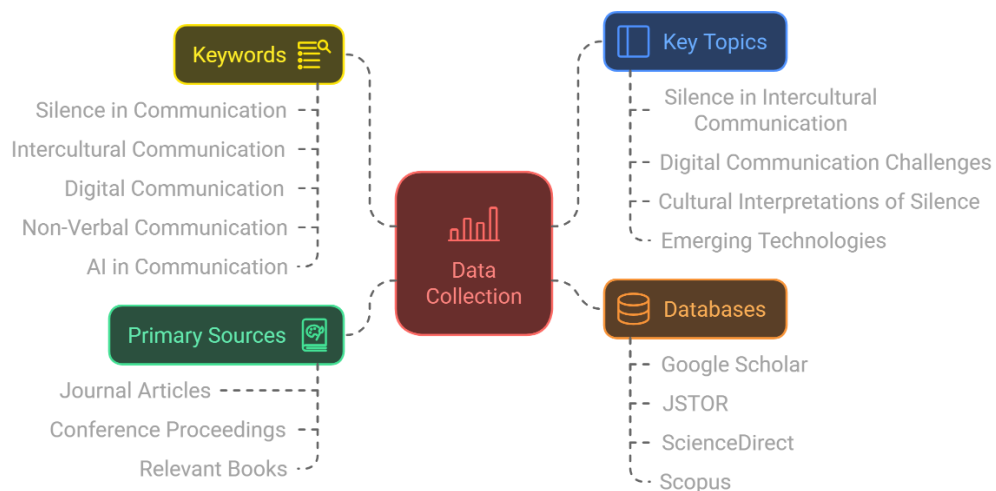


Figure 1. Data collection

The literature review was conducted by systematically gathering and analyzing existing research on intercultural communication, silence in communication, and digital communication tools. The primary sources include journal articles, conference proceedings, and relevant books that discuss: a) The role of silence in intercultural communication [9], [30]; b) Digital communication and its unique challenges, such as the absence of non-verbal cues [31], [32]; c) Studies focusing on how silence is interpreted across different cultures [23], [33]; d) Emerging technologies like AI and machine learning in communication, particularly in detecting and interpreting non-verbal cues, including silence [10], [34].

Databases used for data collection include Google Scholar, JSTOR, ScienceDirect, and Scopus. Keywords such as "*silence in communication*," "*intercultural communication*," "*digital communication*," "*non-verbal communication*," and "*AI in communication*" were employed to locate relevant sources. Only literature published between 2019 and 2024 was considered to ensure the inclusion of recent technological advancements in the field of digital communication.

Inclusion and Exclusion Criteria

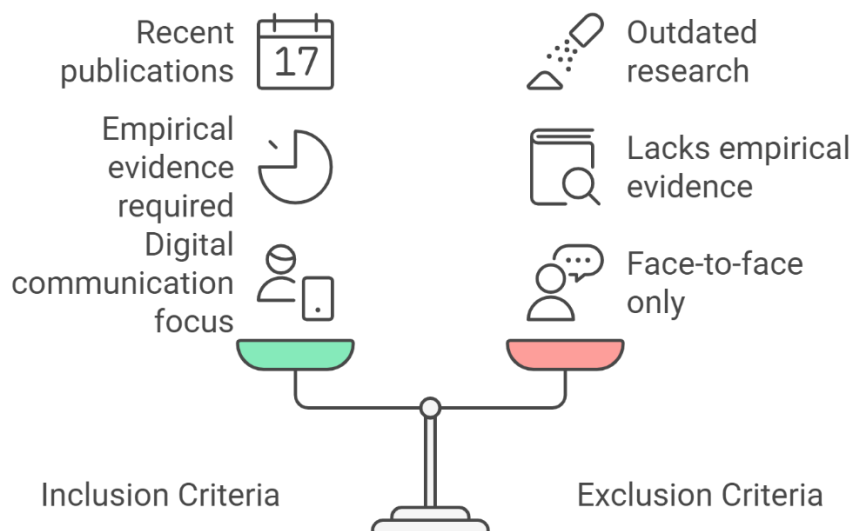


Figure 2. Balancing inclusion and exclusion criteria in research selection

To ensure the relevance and quality of the sources, specific inclusion and exclusion criteria were applied during the selection process. The inclusion criteria encompassed articles and books that discuss silence in communication, both traditional and digital, as well as studies focusing on intercultural communication in virtual or digital settings. Additionally, research exploring the role of AI and other technologies in detecting and managing non-verbal cues, specifically silence, was considered. Only articles published in English within the last 6 years were included to capture recent developments in the field. On the other hand, the exclusion criteria filtered out articles that solely discuss face-to-face communication without addressing digital or intercultural contexts. Sources that lack empirical evidence or theoretical frameworks related to communication were also excluded, as well as outdated research published before 2019, unless the work provided foundational theories still relevant to the discussion.

Table 1. Detailed Review of Key Literature on Silence in Intercultural Digital Communication

Focus Area	Title	Article Description	Year	Author Name(s)	Publication Details
The role of silence in intercultural communication	The Presence and Absence of Speech in the Communication of Gender	This article explores the role of silence in intercultural gender communication. Silence varies across cultures, symbolizing politeness, respect, or defiance. Gender norms often influence silence, with women sometimes expected to remain quiet, while in patriarchal settings, silence may act as a subtle form of resistance.	2020	Penelope Harvey [9]	Bilingual Women: Anthropological Approaches to Second Language Use, 44-64
	Current trends and the way forward on call center research in a post-covid world: An introduction	This article explores current trends in call center research post-pandemic, with a focus on the role of silence in intercultural communication. Silence serves as a crucial tool in understanding cultural differences, preventing misunderstandings, and fostering more effective interactions in multicultural settings.	2022	Johanna Tovar [30]	Sociolinguistic Studies, 16(1), 7-17
Digital communication and its unique challenges, such as the absence of non-verbal cues	Resisting the Silence: The Impact of Digital Communication on Young People's Talk About Suicide	Digital communication presents unique challenges, especially for sensitive topics like suicide. The absence of non-verbal cues, such as body language and tone, can make it difficult for young people to fully express emotions, potentially leading to misunderstandings and limiting effective conversations about mental health.	2019	Kerry Gibson, Jan Wilson, Jade Le Grice, and Fred Seymour [31]	Youth & Society, 51(8), 1011-1030
	Digitalization of Communication And The Spiral Of Silence Theory	Digital communication presents unique challenges, including the absence of non-verbal cues, making it harder to interpret tone, emotions, and intentions. This limitation can lead to misunderstandings and contribute to the Spiral of Silence, where individuals hesitate to express opinions online.	2020	Anahit Hakobyan [32]	WISDOM, 14(1), 19-30
Studies focusing on how silence is interpreted across different cultures	Ethnographies of Silence	Studies on how silence is interpreted across cultures show that silence holds different meanings, such as a tool for communication, power dynamics, or respect, depending on cultural norms and contexts. This research explores silence's significance in both individual and collective cultural experiences	2021	Katja Hrobat Virloget and Nevena Škrbić Alempijević [23]	Cultural Analysis, Volume 19.1, 2021

	Emotion, Silence and Meaning Making in Translanguaging Towards Social Justice in Strangers	Studies focusing on how silence is interpreted across different cultures reveal that silence holds diverse meanings, including respect, discomfort, or even power, shaping interactions and communication styles distinctively	2023	Nara Hiroko Takaki [33]	Rev. Bras. Ling. Apl., Belo Horizonte, v. 23, n. 1, 2023, e22026
Emerging technologies like AI and machine learning in communication	Four Misconceptions About Nonverbal Communication	This article discusses the challenges of understanding nonverbal communication and how virtual technologies, such as the metaverse, are changing the context of nonverbal interactions.	2023	Miles L. Patterson, Alan J. Fridlund and Carlos Crivelli [10]	Perspectives on Psychological Science, Vo 18, Issue 6, November 2023, Pages 138 8-1411
	Innovative application of artificial intelligence in a multi-dimensional communication research analysis: a critical review	This research discusses innovative applications of AI in multidimensional communication analysis. It highlights how AI and machine learning are transforming communication, especially in human-machine interaction, social media, and online social interaction, while considering related theories, such as AI-based persuasion theory and neural network models.	2024	Muhammad Asif and Zhou Gouqing [34]	Discover Artificial Intelligence, vol 4 no 37, 2024

Data Analysis

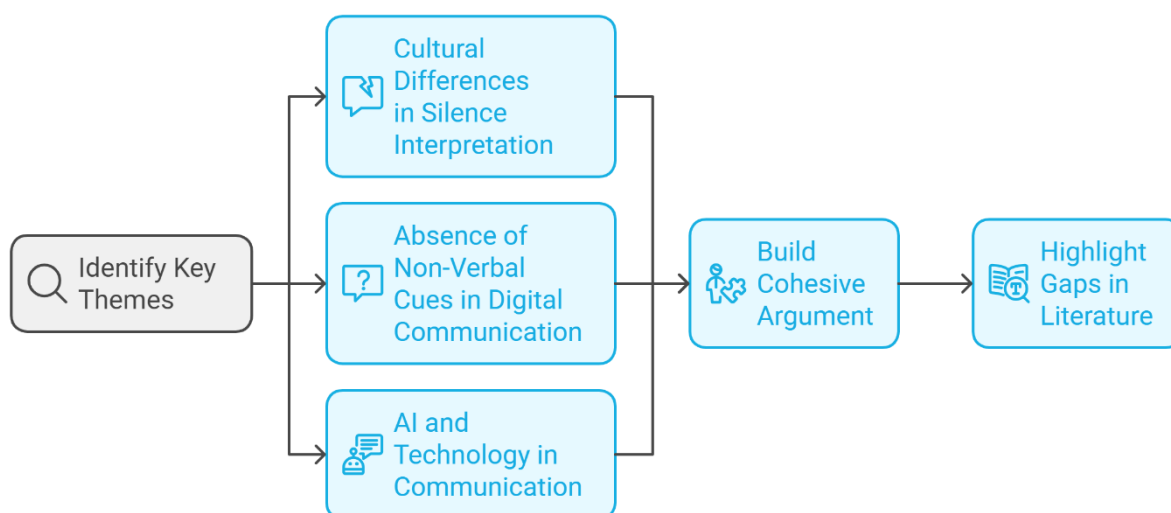


Figure 3. Key themes in silence and digital communication

The collected literature was analyzed using a thematic analysis approach to identify key themes and patterns related to the interpretation of silence across cultures in digital communication. Several recurring themes emerged from the analysis, including:

- **Cultural Differences in Silence Interpretation:** Many studies highlight that silence can be perceived as positive (respectful, thoughtful) in high-context cultures and negative (disengaged, uncomfortable) in low-context cultures [35], [36], [37], [38].
- **The Absence of Non-Verbal Cues in Digital Communication:** Research demonstrates that digital platforms like email, instant messaging, and video calls often lack the non-verbal richness present in face-to-face communication, leading to greater misinterpretations of silence [39], [40], [41].
- **AI and Technology in Communication:** Emerging research suggests that AI can potentially bridge gaps in intercultural communication by analyzing silence and other non-verbal cues. However, these tools are still in their early stages and are not fully capable of interpreting cultural nuances related to silence [41], [42], [43], [44].

These themes were used to draw connections between the different studies and build a cohesive argument about the role of silence in digital intercultural communication. By integrating these sources, the study highlights existing gaps in the literature, particularly the need for more focused research on how technology can assist in understanding silence in intercultural digital communication.

Limitations of the Study

The literature review method, while comprehensive, has its limitations. Firstly, the review is limited to published research and does not include empirical data from new fieldwork. This means the study relies on the interpretations and conclusions of other scholars, which may introduce bias. Additionally, while the search was extensive, it was constrained by language and publication date, potentially excluding relevant studies published in other languages or before the selected time frame. Furthermore, while the study touches on AI and emerging technology's role in interpreting silence, there is limited empirical research in this area, reflecting a broader gap in the literature. As AI continues to evolve, future studies should aim to empirically test the effectiveness of AI in understanding silence across cultures.

RESULTS AND DISCUSSION

The results of this literature review reveal several important insights into how silence functions in digital cross-cultural communication. By analyzing previous research, key themes have emerged that elucidate the complex role of silence in digital settings, particularly in intercultural interactions. The themes discussed include cultural differences in the interpretation of silence, the role of digital communication tools, the challenges posed by the absence of non-verbal cues, and the potential role of emerging AI technology in mitigating misunderstandings.

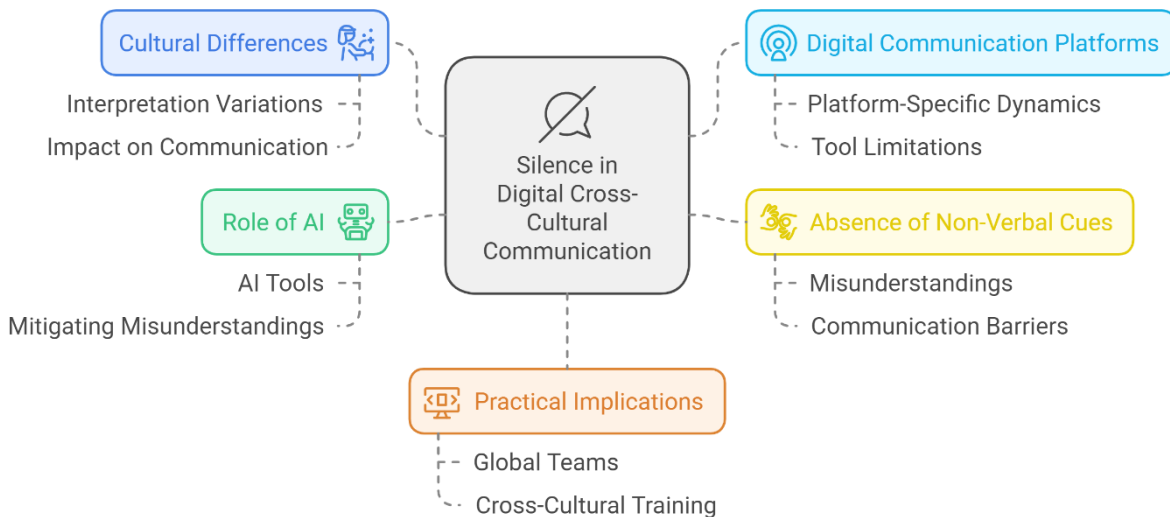


Figure 4. Silence in digital cross-cultural communication

Cultural Differences in the Interpretation of Silence

The interpretation of silence varies significantly across different cultures, which can lead to misunderstandings when individuals from distinct cultural backgrounds communicate, especially in digital environments where non-verbal cues are reduced. High-context cultures, such as those found in many East Asian countries, tend to view silence as an important and often respectful component of communication. In Japan, for instance, silence is frequently used as a way to show respect, reflect on a statement, or avoid conflict. Individuals may pause for thought before speaking to ensure their response is carefully considered, and this silence is often seen as a sign of wisdom and contemplation [45], [46]. In contrast, low-context cultures, such as the United States and many Western European countries, typically interpret silence in a less favorable light. In these cultures, silence may be perceived as awkward, a sign of discomfort, or an indication of disengagement. Communication in these settings often prioritizes directness and efficiency, with pauses in conversation being filled with further clarification or additional input. The absence of speech can be unsettling and may lead to negative interpretations, such as indifference or disagreement [47], [48]. In digital communication, these cultural differences become even more pronounced. For example, during virtual meetings, team members from high-context cultures may remain silent as they reflect on the conversation, while their low-context counterparts may misinterpret this silence as a lack of engagement or unwillingness to contribute. This miscommunication can create friction, especially in global teams where collaboration depends on clear and effective communication [42], [49], [50], [51].

Silence in Digital Communication Platforms

The nature of digital communication, particularly through platforms like email, instant messaging, and video conferencing, complicates the interpretation of silence. Digital communication tools often strip away the non-verbal cues that accompany silence in face-to-face interactions, such as body language, facial expressions, or eye contact, which can provide important context for understanding the reasons behind silence. In face-to-face interactions, individuals may use silence as a communicative tool, but these non-verbal cues help clarify whether the silence is positive (e.g., thoughtful, respectful) or negative (e.g., awkward, disengaged). In digital spaces, however, these contextual cues are often absent, making it more difficult to interpret silence accurately. For

instance, a delayed response in an email chain or instant messaging conversation may be seen as a sign of disinterest or procrastination, even if the delay is simply due to the individual taking time to reflect on their response or due to technical reasons such as connectivity issues [24], [52], [53]. Furthermore, digital platforms that encourage quick, real-time communication, such as Slack or WhatsApp, may exacerbate misunderstandings around silence. In cultures where silence is valued as a means of reflection, the expectation for immediate responses in these platforms can create pressure and lead to miscommunication. Participants from low-context cultures may expect a prompt reply, while those from high-context cultures may require time to think before responding. This discrepancy in communication styles can lead to frustration, misunderstandings, and even conflict in virtual teams [54], [55].

The Absence of Non-Verbal Cues

One of the biggest challenges in digital communication, particularly in intercultural settings, is the absence of non-verbal cues. Non-verbal communication such as gestures, facial expressions, and body language plays a crucial role in conveying meaning and providing context for silence. In digital environments, especially in text-based communication, these cues are largely absent, making it more difficult to interpret pauses or silences in the conversation. For example, in a face-to-face meeting, a pause before speaking might be accompanied by non-verbal cues such as nodding, thoughtful facial expressions, or gestures that indicate contemplation or agreement. In a digital setting, however, these cues are missing, and the silence may be misinterpreted. The absence of such non-verbal indicators in digital communication, particularly in text-based formats like email or instant messaging, can lead to a breakdown in understanding [56], [57], [58]. In video conferencing, while some non-verbal cues are present, such as facial expressions and gestures, the digital medium still creates barriers to fully interpreting silence. Connectivity issues, time lags, or poor video quality can obscure important visual cues, making it harder to discern the meaning of silence. As a result, team members from different cultural backgrounds may find it challenging to navigate these digital interactions, leading to misinterpretations of intent [59], [60].

The Role of AI and Technology in Interpreting Silence

As digital communication continues to dominate global interactions, AI and machine learning technologies offer promising potential for improving intercultural communication by interpreting silence and other non-verbal cues. Emerging technologies are being developed to analyze patterns of communication, including pauses, response times, and even facial expressions during video calls, to provide a more nuanced understanding of silence in digital communication. However, current AI tools are still limited in their ability to fully grasp the cultural significance of silence. Most AI-driven communication tools, such as chatbots or virtual assistants, are designed for efficiency and often interpret pauses or delays in communication as errors or disengagement, particularly in cultures that value direct, immediate responses. As Zhang [42] points out, AI systems need to be trained to recognize cultural differences in communication styles, including the role of silence, to avoid perpetuating misinterpretations in digital interactions. There is potential for AI to be developed further to accommodate these cultural variations. For example, AI could be programmed to detect when a pause or silence is culturally significant, such as in high-context cultures, and adjust its responses accordingly. This could help mitigate misunderstandings by providing more accurate interpretations of communication patterns in digital spaces. Additionally, incorporating

machine learning algorithms that analyze historical communication data could allow AI tools to predict and adapt to different cultural communication styles, improving cross-cultural communication in virtual teams [61], [62], [63].

Practical Implications for Global Teams

The findings of this literature review underscore the need for cultural awareness and sensitivity in global teams, particularly when using digital communication platforms. Misunderstandings due to silence can lead to delays in project timelines, decreased team cohesion, and even conflict. Therefore, it is essential for global organizations to invest in cultural sensitivity training that highlights the role of silence in communication and teaches team members how to navigate cultural differences effectively. In addition, global teams should establish clear communication norms and expectations when working in digital environments. For example, setting guidelines on how long to wait for a response during email exchanges or virtual meetings can help alleviate anxiety around silence and prevent premature assumptions about disengagement. By creating an inclusive communication environment that respects different cultural interpretations of silence, global teams can improve collaboration and reduce misunderstandings [27], [49]. Moreover, companies should consider integrating AI tools that are designed to handle cultural nuances in communication. AI-driven communication platforms could be programmed to account for different cultural expectations around silence, ensuring that pauses or delayed responses are interpreted more accurately. This would enable smoother intercultural communication and help avoid potential conflicts in virtual teams [23], [42], [64].

Discussion

The findings of this study provide significant insights into the complex role of silence in digital cross-cultural communication. Our analysis confirms that silence, as a non-verbal communication tool, is interpreted differently across cultures, particularly between high-context and low-context settings. This distinction, previously established in traditional intercultural communication studies, is amplified in digital environments, where the absence of non-verbal cues such as facial expressions, gestures, and tone complicates the interpretation of silence. In high-context cultures, such as Japan and China, silence is often regarded as a thoughtful and respectful pause, used to convey contemplation or deference. This form of silence is embedded in social norms that prioritize non-verbal communication. However, in low-context cultures, such as the United States and much of Western Europe, silence is typically perceived as awkward, disengaging, or a sign of discomfort. This divergence in interpretation can lead to significant misunderstandings, especially in virtual meetings or digital communication platforms where immediate responses are expected.

The findings align with previous research by Alizadeh Afrouzi [65] and Takaki [33], which highlight the cultural nuances of silence in communication. In high-context cultures, silence serves as a vital communicative tool, signaling respect and reflection. In contrast, the misinterpretation of silence in low-context cultures as indifference or a lack of commitment is well-documented [66], [67]. Our study extends this understanding by demonstrating how these cultural norms are magnified in digital spaces, where the absence of face-to-face interaction further complicates communication dynamics. The digital communication platforms used in this study such as email, instant messaging, and video conferencing present unique challenges in interpreting silence. As pointed out by Biemans [16] and Ho et al. [17], digital tools often lack the non-verbal cues that

facilitate the accurate interpretation of silence. In text-based communication, such as emails or chats, silence is often misunderstood as disinterest or neglect, even though it may merely reflect the time taken for thoughtful reflection or technical delays.

The absence of non-verbal cues is particularly problematic in video conferencing, where connectivity issues or low-quality video can obscure essential visual signals. This aligns with the work of Zhang [42], who notes that misinterpretations in video-based communication are more common when visual cues are unclear. Furthermore, the study by Abdallah et al. [26] emphasizes the need for cultural sensitivity training in virtual teams to mitigate these misunderstandings. Emerging technologies, especially artificial intelligence (AI), present promising solutions to these communication challenges. While current AI tools are still limited in their ability to comprehend the cultural significance of silence, future advancements may help bridge this gap. As noted by Patterson et al. [10], AI systems that analyze response patterns, pauses, and other communication behaviors could improve understanding by considering cultural context. This suggests that AI could play a crucial role in detecting when silence is culturally significant, particularly in high-context cultures, and adjust its response accordingly.

The novelty of this research lies in its exploration of AI's potential to address intercultural misunderstandings related to silence. Previous studies have primarily focused on silence in face-to-face interactions [37], [71], but few have examined its role in digital communication or AI's capacity to interpret silence effectively. The integration of AI in digital communication platforms could provide more culturally sensitive tools, helping virtual teams navigate the complexities of intercultural communication. This study underscores the importance of cultural sensitivity in global teams and digital communication. Misunderstandings related to silence can delay projects, create friction, and reduce team cohesion. Therefore, global teams must establish clear communication norms and expectations, particularly in digital environments. This includes defining response times, setting guidelines for interpreting silence, and training members to recognize cultural differences in communication. AI-driven tools that account for these differences could also help improve the efficiency and clarity of cross-cultural communication. In conclusion, the findings of this study offer several practical implications for improving digital cross-cultural communication. By enhancing cultural awareness and integrating AI tools that consider the cultural nuances of silence, global teams can reduce miscommunication and foster more effective collaboration. As digital communication continues to evolve, the role of AI in bridging intercultural gaps presents an exciting avenue for future research and application [72], [73].

CONCLUSION

This study highlights the critical role of silence in digital cross-cultural communication, particularly in global teams. The findings underscore the cultural differences in interpreting silence, with high-context cultures viewing it as a sign of respect and reflection, while low-context cultures often perceive it negatively. These differing interpretations, compounded by the lack of non-verbal cues in digital communication, can lead to misunderstandings, affecting collaboration and team dynamics. The research contributes to the existing literature by exploring how silence functions in digital settings and how these cultural differences are amplified online, offering insights into the challenges faced by global teams. The implications of this study are significant for organizations and virtual teams, suggesting that cultural sensitivity training is essential to navigate these communication challenges effectively. Additionally, integrating AI tools that recognize cultural

nuances in silence could improve communication and reduce misunderstandings in digital environments. The study also recommends further research into the empirical testing of AI tools for interpreting silence across cultures and expanding the scope to include a wider range of digital platforms. By addressing these issues, future research can enhance intercultural communication strategies, improving collaboration and reducing friction in digital cross-cultural interactions.

LIMITATIONS

This study, while providing valuable insights, has several limitations. Firstly, it relies on a literature review methodology, which may introduce biases due to the secondary nature of the data and the exclusion of research in languages other than English. The review is also limited to studies published between 2019 and 2024, potentially overlooking recent advancements in AI and digital communication technologies. Additionally, while the potential of AI in interpreting silence is discussed, empirical evidence on its effectiveness is sparse, making it largely theoretical. Finally, the study focuses primarily on platforms like Zoom and Slack, and does not explore other emerging digital tools or social media, which could provide further insights into the interpretation of silence in diverse online contexts.

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AUTHOR CONTRIBUTION

D.H. was responsible for conceptualizing the study, designing the research methodology, and conducting the literature review. S.S. contributed to data analysis, result reporting, and writing the discussion and conclusion sections. Both authors collaborated on the interpretation of the results and the final revision of the manuscript. All authors read and approved the final version of the manuscript for publication.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

DECLARATION OF USE OF AI IN SCIENTIFIC WRITING

The authors utilized ChatGPT for sentence rephrasing and Napkin AI to generate images. The content was carefully reviewed and edited by the authors, who take full responsibility for the publication's content.

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