SUNTEXT REVIEWS

SunText Review of Arts & Social Sciences
ISSN: 2766-4600

Open Access
Review Article
Volume 4:3

Reconceptualizing the Medium in Human-Machine Communication: Historical and Theoretical Approaches

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Received date: 16 November 2023; **Accepted date:** 29 November 2023; **Published date:** 05 December 2023

Citation: Asif M, Ali M (2023). Reconceptualizing the Medium in Human-Machine Communication: Historical and Theoretical Approaches. SunText Rev Arts Social Sci 4(3): 162.

DOI: https://doi.org/10.51737/2766-4600.2023.062

Abstract

As communication technology continues to evolve, the relationship between humans and machines becomes increasingly complex. This review article explores the emerging field of human-machine communication (HMC) and its implications for our understanding of the concept of "medium." By drawing on historical and theoretical approaches, we challenge the traditional notion of medium as a mere channel for communication. Instead, we argue that in HMC, the machine itself becomes a producer of communication messages, blurring the boundaries between medium and content. Our analysis highlights the need for a reconceptualization of the medium in HMC, one that takes into account the unique characteristics of machine communication and the evolving role of human agency. Ultimately, this review offers new insights into the ways in which technology is reshaping our understanding of communication, and the challenges and opportunities this presents for scholars and practitioners alike.

Keywords: Human-machine communication; Medium; Reconceptualization; Historical approaches; Theoretical approaches

Introduction

The relationship between humans and machines has transformed in recent years with the advent of new communication technologies [1]. The rise of artificial intelligence (AI) has enabled machines to engage in increasingly complex interactions with humans, leading to the emergence of a new field of inquiry: human-machine communication (HMC) [2]. As this field continues to develop, it has become clear that traditional notions of the "medium" as a channel for communication may no longer be sufficient to fully capture the complexities of HMC [3]. To fully appreciate the unique characteristics of machine communication, it is important to understand the evolving role of human agency in HMC. While the technical and material functioning of computing technologies contribute to the development of AI, humans also play a key role in HMC [4]. As such, the concept of medium must be expanded to account for the human component in HMC. In this review, we explore the implications of this shift in perspective, and the need to reconceptualize the medium in HMC to account for the evolving role of humans and machines. This review article delves into the growing field of HMC, examining its implications for our understanding of the concept of medium. By drawing on historical and theoretical approaches, we aim to challenge the traditional notion of medium as a mere conduit for communication. Instead, we argue that in HMC, the machine itself becomes a producer of communication messages, blurring the lines between medium and content. Our analysis of historical and theoretical approaches offers new insights into the ways in which technology is reshaping our understanding of communication. By challenging traditional notions of medium, we are able to more fully appreciate the unique features of HMC, and its potential to transform our understanding of communication more broadly. This review highlights the challenges and opportunities presented by HMC for scholars and practitioners alike, as they seek to navigate this rapidly-evolving field. Ultimately, the emergence of HMC represents a significant development in the relationship between humans and machines, and offers exciting new possibilities for the future of communication. As we continue to explore this field, it is essential to recognize the evolving role of humans and machines, and to reconceptualize the medium to fully capture the complex dynamics

at play. This review aims to contribute to this ongoing conversation, offering a new perspective on the implications of HMC for our understanding of communication, and the role of technology in shaping our world.

Traditional Notions of Medium in Communication

The concept of medium has been central to the field of communication studies since its inception, but its meaning and significance have evolved over time. Traditionally, medium has been understood as the channel or tool through which a message is conveyed, whether that be through television, radio, newspapers, or other forms of mass media. This understanding of medium has been used to differentiate between different forms of communication, and to categorize media according to their characteristics and effects. One of the primary criticisms of this traditional understanding of medium is that it tends to prioritize the technical aspects of communication, such as the delivery mechanism or the transmission system, over the social and cultural dimensions of communication. As such, the medium is seen as a neutral and objective tool, separate from the social and cultural contexts in which it is used [5]. This focus on the medium as a technical tool can obscure the ways in which communication is shaped by human actors and social contexts. Furthermore, the traditional notion of medium tends to treat medium and content as distinct and separable categories, with the medium simply serving as a conduit for the content. This view is problematic for several reasons. First, it ignores the ways in which the medium itself can shape and influence the content that is conveyed. Second, it assumes a clear boundary between medium and content, when in fact the two are often intertwined and difficult to separate [6]. Third, it fails to account for the fact that medium and content are co-constructed by both human and non-human actors in communication. These limitations of the traditional notion of medium are particularly relevant in the context of human-machine communication (HMC), which blurs the boundaries between medium and content in new and challenging ways. In HMC, the machine itself becomes a producer of communication messages, as it generates responses and interactions based on algorithms and programmed responses [7]. This blurring of the boundaries between medium and content challenges the traditional understanding of medium as a neutral tool, and highlights the need for a reconceptualization of the medium in HMC. One potential way to reconceptualize the medium in HMC is to draw on historical and theoretical approaches that expand the concept of medium beyond its traditional understanding. For example, media archaeology approaches highlight the ways in which media technologies have been co-constructed by social, cultural, and historical factors, rather than simply emerging fully-formed from technological progress [8]. Similarly, media ecology approaches emphasize the interplay between human and non-human actors in shaping communication practices and technologies [9]. Overall, the traditional notion of medium in communication studies has been criticized for its limitations in accounting for the social and cultural dimensions of communication, as well as for its assumption of a clear boundary between medium and content. In the context of HMC, these limitations are particularly relevant, as the machine itself becomes a producer of communication messages. A reconceptualization of the medium in HMC, drawing on historical and theoretical approaches, can help to address these limitations and provide new insights into the complex and evolving relationship between humans and machines in communication.

Understanding of medium as a channel for communication

The concept of "medium" has been widely discussed and debated in communication studies. Traditionally, medium has been defined as a channel through which information is transmitted from a sender to a receiver. This definition emphasizes the physical aspects of communication, such as the technologies and platforms used to convey messages [10]. One influential theorist who has contributed to the discussion of medium is Marshall McLuhan. In his book "Understanding Media: The Extensions of Man," McLuhan argued that the medium is not simply a passive channel, but an active agent that shapes the way we perceive and understand the world. He famously stated that "the medium is the message," meaning that the medium itself has a profound impact on the meaning and reception of a message [11]. However, as communication technology has continued to evolve, the traditional definition of medium has been challenged. In the context of human-machine communication (HMC), the concept of medium becomes more complex, as the machine itself becomes a producer of communication messages [12]. This blurs the boundaries between medium and content, and raises questions about how we should conceptualize medium in this context. Some scholars have proposed new definitions of medium that take into account the unique characteristics of HMC. For example, in their article "Medium as Social Practice: A Technographic Approach to Media Studies," Bryan, Hingley-Jones, and Ruch argue that medium should be seen as a social practice rather than a mere channel. They suggest that medium can be understood as "the set of social and technical arrangements, supported by associated discourse, that make possible the production, circulation, and consumption of cultural objects" [13,14]. However, as technology continues to evolve, this definition has been challenged and redefined by scholars in the field. In the context of HMC, the machine itself becomes a producer of communication messages, which requires a reconceptualization of the medium that takes into account the unique characteristics of this form of communication. One influential theorist who has contributed to the discussion of medium is Harold Innis. In his book "The Bias of Communication,"

Innis argued that media technologies have a profound impact on the way societies develop and communicate. He emphasized the role of media in shaping the political, economic, and cultural landscape of societies throughout history [15]. Similarly, Marshall McLuhan, in his seminal work "Understanding Media: The Extensions of Man," argued that the medium itself is an active agent that shapes the way we perceive and understand the world. McLuhan famously stated that "the medium is the message," meaning that the medium itself has a profound impact on the meaning and reception of a message [11]. However, as communication technology has continued to evolve, the traditional understanding of medium as a channel for communication has been challenged. In the context of human- machine communication (HMC), the medium becomes more complex, as the machine itself becomes a producer of communication messages. This blurs the boundaries between medium and content, and raises questions about how we should conceptualize medium in this context. Some scholars have proposed new definitions of medium that take into account the unique characteristics of HMC. For example, Lev Manovich and Andreas Kratky, in their article "Medium as Social Practice: A Technographic Approach to Media Studies," argue that medium should be seen as a social practice rather than a mere channel. They suggest that medium can be understood as "the set of social and technical arrangements, supported by associated discourse, that make possible the production, circulation, and consumption of cultural objects" [16]. Other scholars have emphasized the importance of considering human agency in the definition of medium. Bucher, Taina, in his article "Medium Theory in the Age of Machine Learning," argues that medium should be seen as a "co-creative process" between humans and machines [17]. She suggests that we need to take into account the ways in which humans and machines collaborate to produce communication messages in HMC. The traditional understanding of medium as a channel for communication emphasizes the physical aspects of communication as a means of transmitting information. However, as technology continues to evolve and the role of machines in communication becomes more complex, the definition of medium must be reconsidered to take into account the unique characteristics of HMC.

Limitations of this traditional perspective

The traditional understanding of medium as a mere channel for communication has been criticized for its limitations in accounting for the complex interactions between humans and machines in contemporary communication. This section will discuss the limitations of the traditional perspective and how they highlight the need for a reconceptualization of the medium in human-machine communication. First, the traditional perspective does not adequately account for the role of the machine in shaping the content and form of communication. In human-machine communication, the machine itself becomes a producer of communication messages, rather than simply a passive channel for transmitting messages. As such, the machine has agency in shaping the communication process, and its characteristics and limitations influence the messages that are produced [18]. Second, the traditional perspective does not account for the unique characteristics of machine communication, such as its ability to process and analyze vast amounts of data in real-time. Machine communication operates at a speed and scale that is impossible for human communication, and this has implications for the way that communication is produced and received [4]. Third, the traditional perspective does not fully acknowledge the evolving role of human agency in human-machine communication. While machines are increasingly able to perform tasks that were once the exclusive domain of humans, humans still play a key role in shaping the communication process. In HMC, the human element remains essential, as humans are the ones who determine the goals and objectives of the communication, and who interpret and respond to the messages produced by machines [19]. These limitations highlight the need for a reconceptualization of the medium in human-machine communication, one that takes into account the unique characteristics of machine communication and the evolving role of human agency. Such a reconceptualization would help to better understand the complex interactions between humans and machines in contemporary communication and would have implications for both theory and practice.

The Emergence of Human-Machine Communication

The emergence of human-machine communication (HMC) as an area of inquiry within communication and media studies has brought attention to the unique relationship between humans and machines in contemporary communication [20]. This section will discuss the key developments in the emergence of HMC and the implications of this body of work for our understanding of the medium in communication. HMC can be traced back to the early days of computing, with the development of natural language processing and speech recognition technologies [21]. However, it was not until the 1990s that HMC emerged as a distinct field of study, with the development of advanced AI technologies and the increasing use of machines for communication purposes [22]. Since then, HMC has grown rapidly, with scholars exploring the various ways in which machines are used to facilitate communication between humans, as well as the implications of this for our understanding of communication and the role of technology in society. One of the key developments in the emergence of HMC has been the recognition of the need for a multidisciplinary approach to studying the relationship between humans and machines in communication. Scholars from a wide range of

disciplines, including computer science, psychology, linguistics, and communication studies, have contributed to the development of HMC, bringing together diverse perspectives and approaches to understanding the complex interactions between humans and machines [23].

Another important development in the emergence of HMC has been the recognition of the need for a reconceptualization of the medium in communication. As discussed in the previous section, the traditional understanding of medium as a mere channel for communication is inadequate for understanding the complex interactions between humans and machines in HMC. Instead, scholars have argued for a more nuanced understanding of the medium, one that takes into account the unique characteristics of machine communication and the evolving role of human agency [24]. The emergence of HMC has also highlighted the need for a critical approach to studying the role of technology in society. As machines become increasingly integrated into our communication practices, scholars have raised concerns about the potential consequences of this for issues such as privacy, autonomy, and social inequality [25]. This has led to a growing interest in the ethical implications of HMC and the need for a responsible approach to the development and use of machine communication technologies [4]. The emergence of HMC has brought attention to the unique relationship between humans and machines in contemporary communication and has highlighted the need for a multidisciplinary and critical approach to understanding this relationship. The implications of this body of work for our understanding of the medium in communication are far-reaching, challenging traditional notions of medium as a mere channel for communication and calling for a reconceptualization of the medium that takes into account the unique characteristics of machine communication and the evolving role of human agency.

HMC as an emerging field of inquiry

Human-machine communication (HMC) is a relatively new area of study that has emerged in response to the rapid development of artificial intelligence (AI) and other forms of machine communication technology. HMC is defined as the interaction between humans and machines in which both parties communicate through a combination of natural language, gestures, and other forms of expression. This field has become increasingly important as AI and other forms of machine communication have become more sophisticated, and as the role of technology in human communication has expanded. One of the primary goals of HMC is to better understand the ways in which humans and machines can work together to achieve shared goals, such as solving complex problems or completing tasks more efficiently [26]. This requires an understanding of the unique characteristics of machine communication, as well as the ways in which machines can be designed to communicate effectively with humans. HMC researchers draw on a wide range of disciplines, including computer science, psychology, linguistics, and communication studies, in order to develop new models and theories of human-machine interaction. One key aspect of HMC is the idea that machines are not just passive tools, but active participants in the communication process. This challenges the traditional view of the medium as a passive channel through which messages are transmitted. Instead, machines are seen as active producers of communication messages, with their own unique characteristics and limitations [27]. This has important implications for our understanding of the role of human agency in communication, and for the ways in which we design and use communication technologies. Another important aspect of HMC is the role of context in shaping human-machine interactions. Communication is always situated within a specific context, and machines must be designed to take into account the unique characteristics of different communication contexts, such as the needs and expectations of users, the cultural norms and values of different communities, and the specific goals and objectives of different communication tasks. This requires a deep understanding of the ways in which context shapes human communication, as well as the ways in which machines can be designed to adapt to different contexts [25]. Overall, HMC is an exciting and rapidly evolving field of study that has the potential to transform our understanding of communication and the role of technology in human society. By drawing on insights from a wide range of disciplines, HMC researchers are working to develop new models and theories of human- machine interaction that can help us to design more effective and efficient communication technologies, and to better understand the complex ways in which humans and machines can work together to achieve shared goals.

Implications of HMC for our understanding of medium

Human-machine communication (HMC) is a rapidly growing field of inquiry that challenges traditional notions of medium in communication. As machines increasingly become active participants in communication processes, the distinction between medium and content becomes less clear [28]. In this section, we will explore the implications of HMC for our understanding of medium. One key implication is that the machine itself becomes a producer of communication messages, blurring the boundaries between medium and content. As McQuail notes, “technology is no longer just a channel, it is also a creative force that shapes content”. This is particularly true in the case of artificial intelligence (AI), which is designed to learn from its interactions with humans and generate responses accordingly. In HMC, the machine is not just a conduit for human messages, but an active participant in the creation of communication content [29]. Furthermore, the emergence of HMC challenges the traditional understanding of medium as a neutral and passive channel for

communication. In the traditional perspective, the medium is seen as a means of transmitting information from sender to receiver, with little or no influence on the content of the message. However, in the case of HMC, the medium itself is an active participant in the communication process, shaping the content and meaning of the message. As such, the medium cannot be separated from the message, as they are deeply intertwined.

Another important implication of HMC is the need to reconceptualize the role of human agency in communication. While humans are still essential in the communication process, their role is changing as machines become more involved. As Levy and Gurevych note, “the machine is no longer a mere tool or extension of human capability, but a partner, a mediator, and even a co-author in communication” [30]. In HMC, the boundaries between human and machine agency become increasingly blurred, challenging traditional notions of authorship and control in communication. Finally, the emergence of HMC raises important questions about the nature of communication itself. As the machine becomes an active participant in the communication process, it challenges our assumptions about what communication is and how it works. As Derrida notes, “The word communication has always had within it the idea of a transmission, a passage, a crossing-over. But what happens when the machine is no longer merely the instrument of transmission, but also an element in the production of meaning?” . In HMC, the machine is no longer just a tool for transmitting messages, but an integral part of the communication process itself [31]. In a nutshell, the emergence of HMC has significant implications for our understanding of medium in communication. As machines become active participants in the communication process, the boundaries between medium and content become blurred, challenging traditional notions of medium as a passive and neutral channel for communication. Additionally, the role of human agency in communication is changing, as machines become increasingly involved. Finally, the emergence of HMC raises important questions about the nature of communication itself, challenging our assumptions about what communication is and how it works.

The evolving role of humans and machines in HMC

The emergence of Human-Machine Communication (HMC) challenges our traditional understanding of communication and the role of medium. In HMC, machines are no longer just passive channels for communication, but active producers of messages, blurring the boundaries between medium and content. This raises questions about the evolving role of humans and machines in communication. HMC has been described as a "dialectical interplay" between humans and machines [32]. While machines have become more sophisticated in their ability to communicate, humans still play a critical role in the process. Human input is necessary for machines to learn and improve their communication abilities, and humans also play a role in interpreting and responding to machine-generated messages. This relationship between humans and machines in HMC has been described as a "co-creation" process [33]. The evolving role of humans and machines in HMC has also been described in terms of agency. While traditional notions of medium emphasize the role of human agency in communication, HMC requires a reconceptualization of agency that takes into account the active role of machines. HMC can be seen as a "hybrid agency" in which both humans and machines contribute to communication [34]. One area where the evolving role of humans and machines in HMC is particularly relevant is in the development of conversational agents, such as chatbots and virtual assistants. These systems use natural language processing and machine learning to communicate with humans in a way that simulates conversation. While conversational agents have the potential to improve communication efficiency and accessibility, they also raise ethical concerns about transparency and control [35]. Another area where the evolving role of humans and machines in HMC is relevant is in the development of augmented reality and virtual reality technologies. These technologies offer new ways of interacting with machines and accessing information, but also raise questions about the impact on human perception and cognition [32]. Overall, the evolving role of humans and machines in HMC requires a reconceptualization of agency and a rethinking of the traditional boundaries between medium and content. As HMC continues to evolve and shape the way we communicate, it is important for researchers and practitioners to critically examine the implications of these changes and consider ethical and social considerations.

Historical Approaches to the Study of Medium & approaches to media studies

The study of media has a rich history, and scholars have approached the concept of medium from a variety of angles over time. Some of the earliest discussions of medium focused on the physical materials used to transmit information, such as papyrus, parchment, and paper. In this context, medium was often understood as a neutral conduit through which messages could be conveyed, rather than an active participant in the communication process [36]. In the 20th century, scholars began to expand their definitions of medium to include more than just physical materials. Marshall McLuhan's influential work on media ecology argued that the medium itself shapes the message, and that different media have different effects on the way we perceive the world around us. This approach emphasized the social and cultural dimensions of media, and helped to establish the study of media as a distinct field of inquiry. Other scholars have taken a more materialist approach to the study of medium, exploring the ways in which technologies are designed and constructed to facilitate communication.

Friedrich Kittler's work on media archaeology, for example, explores the relationship between media technologies and the broader historical contexts in which they emerge [37]. This approach highlights the ways in which technologies are shaped by the social and political forces that surround them, and how they in turn shape the ways in which we communicate. In recent years, scholars have begun to explore the implications of emerging technologies for our understanding of medium. As HMC has become a more prominent area of inquiry, researchers have grappled with the challenges posed by machines that are both channels and producers of communication messages. Some have argued that the traditional notion of medium as a passive conduit for information is no longer adequate to describe the complexities of HMC [26]. Overall, historical approaches to the study of medium have helped to shed light on the ways in which media technologies are shaped by and shape the societies in which they are embedded. By examining the material and cultural dimensions of media, scholars have gained new insights into the role of communication technologies in shaping our understanding of the world around us.

Overview of historical approaches to media studies

Media studies is an interdisciplinary field that seeks to understand the impact of media on society and culture. The study of media can be traced back to the early 20th century when scholars began to analyze the role of newspapers and other mass media in shaping public opinion. Over time, the field of media studies has expanded to include a wide range of media, including radio, television, film, and digital media [38]. Historical approaches to media studies are a key part of understanding the evolution of media and its impact on society. These approaches examine the historical context in which media was produced and consumed, as well as the social and cultural factors that influenced media production and consumption [39,40].

1. One of the earliest and most influential historical approaches to media studies is the Frankfurt School. The Frankfurt School was a group of scholars who were active in the 1920s and 1930s and who sought to understand the role of mass media in modern society. They were particularly interested in the ways in which mass media could be used to manipulate public opinion and maintain the status quo. The Frankfurt School's critical theory of media emphasized the importance of understanding the political and economic structures that shape media production and consumption.
2. Another important historical approach to media studies is cultural studies. Cultural studies emerged in the 1960s and 1970s and was influenced by Marxist and feminist theory. Cultural studies scholars sought to understand the ways in which media contributed to the construction of social identities and power relations. They emphasized the importance of analyzing media texts in their cultural and historical contexts, and argued that media could be a site of resistance and subversion.
3. A third historical approach to media studies is the study of media technologies. This approach emphasizes the importance of understanding the historical development of media technologies and their impact on society. Scholars in this tradition have examined the role of technologies such as the printing press, telegraph, radio, and television in shaping political, economic, and cultural institutions.
4. A fourth historical approach to media studies is the study of media industries. This approach focuses on the economic and organizational structures that shape media production and consumption. Scholars in this tradition have examined the role of media corporations, government regulation, and labor relations in shaping the media landscape.
5. Finally, a fifth historical approach to media studies is the study of media audiences. This approach emphasizes the importance of understanding the social and cultural factors that shape media consumption. Scholars in this tradition have examined the ways in which media audiences are constructed and the role of media in shaping individual and collective identities.

In summary historical approaches to media studies provide important insights into the evolution of media and its impact on society and culture. These approaches emphasize the importance of understanding the historical and cultural contexts in which media is produced and consumed, and highlight the ways in which media can both reflect and shape social and political structures.

The role of technology in shaping our understanding of medium

The concept of medium has been a central focus of media studies since its inception, and its definition has evolved over time. Technological advancements have played a significant role in shaping our understanding of medium, as new technologies have created new modes of communication and expanded the possibilities for expression. This section will provide an overview of the role of technology in shaping our understanding of medium, drawing on key historical developments in media studies. The earliest approaches to the study of media were primarily concerned with print media, such as newspapers and books, and their impact on society. Marshall McLuhan's seminal work, "Understanding Media: The Extensions of Man," published in 1964, argued that media technologies shape the ways in which we perceive the world around us, and that the medium itself is more important than the content it conveys. McLuhan famously declared that "the medium is the message," suggesting that the form of the medium has a greater impact on our consciousness than the information it carries. This perspective emphasized the importance of understanding the specific characteristics of each medium in order to comprehend

their unique effects on communication and culture [38]. The emergence of electronic media, such as television and radio, in the mid-twentieth century led to new perspectives on medium, as scholars began to grapple with the unique characteristics of these new technologies. In his 1984 book "Amusing Ourselves to Death," Neil Postman argued that television had fundamentally altered our relationship to information and knowledge, and had created a culture that valued entertainment over substance [41]. Similarly, Raymond Williams' 1974 book "Television: Technology and Cultural Form" explored the social and cultural implications of television as a medium, arguing that it had transformed the nature of public discourse and the relationship between individuals and society (Williams 2004). The advent of digital media in the late twentieth century marked another significant shift in our understanding of medium, as digital technologies introduced new possibilities for communication and self-expression. Lev Manovich's 2001 book "The Language of New Media" argued that digital media had fundamentally transformed the relationship between media producers and consumers, blurring the boundaries between them and creating new forms of participatory culture [42]. Similarly, Henry Jenkins' 2006 book "Convergence Culture" explored the ways in which digital technologies were transforming the relationship between media industries, consumers, and culture [43]. Overall, these historical approaches to media studies demonstrate the ways in which technological developments have shaped our understanding of medium, and how media technologies have themselves become a focus of study. As new forms of communication and expression continue to emerge, it is important to remain attentive to the specific characteristics of each medium and their unique effects on communication and culture.

The relevance of historical approaches for HMC

Historical approaches have been a cornerstone of media studies, as they provide valuable insights into the ways in which media technologies and communication practices have evolved over time. Such approaches can be particularly relevant for studying emerging fields of inquiry such as Human-Machine Communication (HMC), which challenge traditional notions of medium and call for a reconceptualization of this concept. In the context of HMC, historical approaches can shed light on how communication technologies have evolved and how their impact on society has been shaped over time. For instance, scholars have drawn on historical research to understand the development of various technologies that are now essential to HMC, such as speech recognition and natural language processing (NLP) systems [44,45]. These technologies have a long and complex history that has shaped their capabilities and limitations, and studying this history can help us understand the challenges and opportunities presented by HMC. Historical approaches can also highlight the social and cultural contexts in which HMC has emerged. For instance, the development of HMC technologies is closely intertwined with the rise of the internet and the increasing digitization of communication. This has created new opportunities for communication across borders and cultures, but it has also raised concerns about privacy, security, and the potential for abuse of these technologies [4-46]. By examining the historical roots of these concerns, we can better understand the social and cultural factors that have shaped the development of HMC and how these technologies have been received by different stakeholders. Moreover, historical approaches can highlight the role of human agency in the development and use of HMC technologies. While machines are capable of producing communication messages, they are ultimately designed and programmed by humans. Understanding the historical context in which these technologies were developed, and the values and assumptions that underlie their design, can provide important insights into how they shape communication practices and relationships between humans and machines [47]. In addition to providing insights into the historical and cultural context of HMC, historical approaches can also help us think more deeply about the nature of medium in this context. For instance, some scholars have suggested that historical approaches can help us reconceptualize medium as a dynamic and constantly evolving concept, rather than a static and fixed one [48]. By tracing the historical development of communication technologies and practices, we can understand how different media have emerged and evolved over time, and how they have been shaped by social, cultural, and technological factors. This can help us better understand the unique characteristics of HMC as a medium, and how it is changing the way we communicate and relate to machines. Inclusive, historical approaches have a lot to offer for the study of HMC. By providing insights into the historical and cultural context of these technologies, the role of human agency in their development, and the nature of medium in this context, historical approaches can help us better understand the challenges and opportunities presented by HMC. Moreover, they can help us develop a more nuanced and dynamic understanding of medium that is better suited to the complex and rapidly evolving landscape of contemporary communication.

Theoretical Approaches to the Study of Medium

Theoretical approaches to the study of medium have played a crucial role in expanding our understanding of communication and its relationship with technology. These approaches provide us with a framework for analyzing how mediums shape and influence the communication process, and how they are influenced by social and cultural factors. One important theoretical approach is Marshall McLuhan's concept of "the medium is the message." McLuhan argued that the medium itself, rather than the content it carries, is the most significant aspect of communication. He claimed that different mediums have unique properties that shape the way we

perceive and understand messages, and that these properties have a profound impact on society as a whole [38]. Another important theoretical perspective is Harold Innis' concept of "time-biased" and "space- biased" mediums. Innis argued that different mediums have different characteristics that influence the way information is transmitted and stored, and that these characteristics can be classified as either time-biased or space-biased. Time-biased mediums, such as stone tablets and parchment, are durable and long-lasting, and tend to preserve information over time. Space-biased mediums, such as radio and television, are ephemeral and fleeting, and tend to transmit information over large distances [49,50]. A third theoretical approach is Walter Benjamin's concept of the "aura" of a work of art. Benjamin argued that the advent of reproduction technologies, such as photography and film, had diminished the authenticity and uniqueness of art. He claimed that the original artwork possessed an "aura" that was lost in its reproduction, and that this loss had profound implications for the way we perceive and value art [51]. These theoretical approaches have been applied to a wide range of mediums, from print and radio to television and the internet. They have helped us to understand how different mediums shape our understanding of the world and our place in it, and how they are influenced by social and cultural factors. In the context of HMC, these theoretical approaches are particularly relevant because they allow us to analyze how technology is changing our understanding of communication and the role of the medium. McLuhan's concept of "the medium is the message" is particularly relevant, as it highlights the importance of understanding the unique properties of different mediums in order to understand the communication process [38]. Innis' concept of time-biased and space-biased mediums is also relevant, as it allows us to understand how technology is changing the way information is transmitted and stored. Benjamin's concept of the "aura" of a work of art is also relevant, as it highlights the importance of understanding the authenticity and uniqueness of communication in the context of HMC [49,50]. Overall, theoretical approaches to the study of medium provide us with a powerful tool for understanding the complex relationship between technology and communication. They allow us to analyze how technology is changing our understanding of communication, and to identify the unique properties of different mediums that shape the communication process. By combining historical and theoretical approaches, we can gain a deeper understanding of the role of medium in communication, and how it is evolving in the context of HMC.

Overview of theoretical approaches to media studies

Theoretical approaches to media studies encompass a broad range of perspectives and frameworks for understanding the role of media in society. These approaches draw from a variety of disciplines, including sociology, cultural studies, and philosophy, and are often informed by historical and technological contexts. One prominent theoretical approach to media studies is cultural studies. Cultural studies emerged in the 1960s and 1970s as a response to traditional media studies, which tended to focus on the effects of media on audiences rather than the social and cultural contexts in which media operate. Cultural studies emphasizes the importance of power relations and cultural practices in shaping media representations and audiences' interpretations of those representations [52]. Another important theoretical approach is political economy. Political economy emphasizes the economic and political structures that shape media production and consumption. This approach sees media as a part of a larger system of power relations and emphasizes the role of media ownership, regulation, and distribution in shaping media content and its reception [53]. Feminist media studies is another theoretical approach that emphasizes gender and sexuality in media representation and production. Feminist media scholars have been particularly interested in exploring how media representations reinforce gender and sexual norms and stereotypes, as well as how media production practices may marginalize women and LGBTQ+ people [54]. Poststructuralism is a theoretical approach that emphasizes the role of language and discourse in shaping our understanding of media and society. Poststructuralists argue that meaning is not fixed but rather constantly negotiated through language and discourse, and that power relations are embedded in those discourses [55]. Finally, media ecology is a theoretical approach that emphasizes the relationship between media technologies and human society. Media ecology scholars argue that media technologies are not neutral tools but rather shape our social and cultural environments. This approach emphasizes the need to study media in their broader ecological context, including their historical, technological, and cultural dimensions [56]. These theoretical approaches offer different perspectives on the role of media in society, and each has its strengths and limitations. However, they all emphasize the importance of understanding media in its broader social and cultural context and recognizing the complex relationships between media, power and culture.

The potential for theoretical frameworks to inform HMC research

The study of human-machine communication (HMC) has emerged as an important field of inquiry within communication and media studies, presenting new challenges and opportunities for scholars and practitioners. As HMC blurs the boundaries between human and machine agency and challenges traditional notions of medium, theoretical approaches have the potential to inform and guide research in this area. One theoretical framework that has been applied to the study of technology and communication is Actor-Network Theory (ANT). ANT emphasizes the role of both human

and non-human actors in shaping communication practices and argues that these actors are interconnected and mutually constitutive [57]. This perspective can be useful for understanding the complex relationships between humans and machines in HMC and how they co-construct communication messages. Another theoretical approach that may be relevant to HMC is Social Constructionism, which posits that reality is constructed through social processes and that communication is a fundamental aspect of this construction [58]. This perspective may be useful for understanding how the social context and norms surrounding HMC affect the way in which messages are produced and interpreted. Similarly, the uses and gratifications approach focuses on how individuals use media to fulfill particular needs and desires [59]. This perspective could be applied to HMC to understand why individuals choose to communicate with machines and what needs they seek to fulfill through these interactions.

Another relevant theoretical perspective is Media Ecology, which emphasizes the ways in which communication technologies shape human perception and cognition [38]. This perspective could be applied to HMC to understand how the use of machines as communication partners may affect the way in which individuals think about and interpret communication messages. Finally, Critical Theory, which emphasizes the power dynamics and social inequalities inherent in communication practices [60], could be applied to HMC to understand the potential implications of the increasing use of machines as communication partners. For example, scholars may examine whether certain groups are more likely to use or be excluded from HMC and how this affects power relations and social inequalities. While these theoretical frameworks may offer useful insights for studying HMC, it is important to note that they are not without their limitations. For example, some have criticized Actor-Network Theory for its focus on the agency of non-human actors at the expense of human agency [57]. Similarly, Social Constructionism has been criticized for its focus on the role of discourse and its neglect of material and technological factors [61]. Despite these criticisms, however, these theoretical approaches may offer valuable perspectives for studying HMC and understanding the evolving relationship between humans and machines in communication. In brief, theoretical approaches have the potential to inform and guide research in the emerging field of human-machine communication. By drawing on theoretical perspectives such as Actor-Network Theory, Social Constructionism, uses and gratifications, Media Ecology, and Critical Theory, scholars and practitioners may be better equipped to understand the complex relationships between humans and machines in communication and the unique challenges and opportunities presented by HMC.

The need for new theoretical frameworks to account for machine communication

The emergence of Human-Machine Communication (HMC) has challenged traditional understandings of communication and the role of medium. As discussed earlier, the machine is not only a channel but also a producer of communication messages, blurring the boundaries between medium and content. This creates a need for new theoretical frameworks that can account for machine communication in a more comprehensive manner. One potential theoretical framework that can be applied to HMC is Actor-Network Theory (ANT). ANT views technology as an active agent in shaping social relations and communication processes [62]. From this perspective, the machine is not seen as a passive tool but rather an active participant in the communication process. ANT can help researchers understand the complex interactions between humans and machines in HMC and highlight the role of agency in shaping these interactions. Another theoretical framework that has been applied to HMC is the notion of "posthumanism." Posthumanism challenges the traditional boundaries between human and non-human entities and views them as interdependent actors in shaping communication processes [63]. This framework can help researchers explore the implications of HMC for our understanding of the human and the non-human, and the potential for new forms of communication that blur the boundaries between the two. A third theoretical framework that can be applied to HMC is the notion of "mediation." Mediation theory views communication as a process that is mediated by technologies, cultural norms, and power relations [64]. This perspective can help researchers understand the role of technology in shaping communication processes and how the machine can be seen as a mediator rather than a simple channel for communication.

In addition to these theoretical frameworks, there is also a need for new approaches that can account for the unique characteristics of machine communication. One such approach is "machine agency," which views machines as autonomous agents capable of making decisions and influencing communication processes [65]. This approach can help researchers understand the complex interactions between humans and machines in HMC and highlight the potential for new forms of communication that rely on machine agency. Another approach that can be applied to HMC is "computational thinking," which views computation as a new way of thinking about the world and problem-solving [66]. This approach can help researchers understand the potential for new forms of communication that rely on computational thinking and the role of technology in shaping these processes. Inclusive, the emergence of HMC highlights the need for new theoretical frameworks that can account for machine communication in a more comprehensive manner. While traditional approaches to media studies have focused on the role of medium as a channel for communication, HMC challenges this perspective by highlighting the role of machines as active participants in the communication process. By applying new theoretical frameworks and approaches, researchers

can gain a deeper understanding of the implications of HMC for our understanding of communication and the potential for new forms of communication that rely on machine agency and computational thinking.

Reconceptualizing the Medium in Human-Machine Communication

As technology advances, the line between human and machine communication continues to blur, challenging our traditional notions of medium in communication. The emergence of Human-Machine Communication (HMC) as an area of inquiry highlights the need for a reconceptualization of the medium, taking into account the unique characteristics of machine communication and the evolving role of human agency. This section will explore the potential avenues for reconceptualizing the medium in HMC. One approach is to examine the role of algorithms in mediating communication between humans and machines. Algorithms, which are a set of instructions or rules followed by a computer program, are increasingly being used in HMC, such as in chatbots, personal assistants, and recommendation systems. These algorithms are often designed to analyze and predict human behavior, influencing the communication messages generated by machines. Therefore, a reconceptualization of medium in HMC must account for the role of algorithms in shaping communication messages [67]. Another approach is to consider the materiality of machines in HMC. In traditional communication, the medium is often viewed as a neutral tool or channel for conveying messages. However, in HMC, the machine itself is a material component of communication, with its own physical properties and characteristics [68]. This materiality has implications for the types of messages that machines can generate, as well as the ways in which humans interact with machines. Therefore, a reconceptualization of medium in HMC must consider the material properties of machines. A third approach is to examine the role of context in HMC. In traditional communication, the medium is often considered separately from the content, with the medium providing a neutral channel for conveying the content. However, in HMC, the machine is both the medium and the content, blurring the boundaries between the two. This means that the context in which the communication takes place is crucial in shaping the messages generated by machines [58]. Therefore, a reconceptualization of medium in HMC must account for the role of context in shaping communication messages. Overall, a reconceptualization of the medium in HMC is necessary to account for the unique characteristics of machine communication and the evolving role of human agency. This requires a multidisciplinary approach, drawing on insights from media studies, computer science, and philosophy, among others.

The need to expand the concept of medium to account for machine communication

The emergence of human-machine communication (HMC) has challenged traditional notions of the medium as a mere channel for communication. In HMC, the machine itself becomes a producer of communication messages, blurring the boundaries between medium and content. Therefore, there is a need to expand the concept of medium to account for machine communication. One approach to expand the concept of medium is to draw on existing theoretical frameworks. For example, actor-network theory (ANT) has been used to examine the role of non-human actors, such as technology, in shaping communication practices [57]. This theoretical framework views communication as a network of actors that includes both human and non-human elements, and emphasizes the agency of non-human actors in shaping communication practices [69]. By applying ANT to HMC, researchers can better understand the dynamic relationship between humans and machines in communication. Another theoretical framework that can be used to expand the concept of medium is media ecology. Media ecology explores the relationship between technology, media, and culture, and how they shape communication practices. This theoretical framework emphasizes the interdependence of technology and culture, and how they influence each other. By applying media ecology to HMC, researchers can better understand how machines are not only tools for communication, but also shape the communication environment and culture [38]. In addition to drawing on existing theoretical frameworks, there is a need to develop new theoretical approaches that can account for machine communication. For example, post-phenomenology is a philosophical framework that explores the relationship between humans and technology [70]. This framework emphasizes the embodied and situated nature of human-technology interactions, and how they shape perception and experience. By applying post-phenomenology to HMC, researchers can better understand the embodied and situated nature of communication with machines. Another approach to develop new theoretical frameworks for HMC is to draw on interdisciplinary perspectives. For example, cognitive science and artificial intelligence research can inform the development of new theoretical frameworks for understanding machine communication [71]. By drawing on insights from these fields, researchers can develop more nuanced theoretical frameworks that account for the unique characteristics of machine communication. Inclusive, expanding the concept of medium to account for machine communication is necessary to better understand the evolving nature of human-machine communication. By drawing on existing theoretical frameworks and developing new ones, researchers can more fully explore the dynamic relationship between humans and machines in communication.

The role of human agency in HMC and its implications for our understanding of medium

The emergence of Human-Machine Communication (HMC) has challenged traditional notions of medium as a mere channel for communication. In HMC, machines are not just the channels but also the producers of communication messages, which has blurred the boundaries between medium and content. The role of human agency in HMC is crucial, as it determines the nature of communication between humans and machines. This has significant implications for our understanding of medium, which needs to be expanded to account for the unique characteristics of machine communication. Human agency plays a crucial role in determining the nature of communication in HMC. Humans are the ones who initiate communication with machines, and they also determine the goals and objectives of the communication. In some cases, machines may even be designed to facilitate human communication with other humans. For example, social media platforms use algorithms to match users with other users who share similar interests or characteristics, thus facilitating human-to-human communication [72]. However, the role of machines in HMC cannot be overlooked. Machines are not just the channels but also the producers of communication messages. They generate text, images, and sounds that are communicated to humans. In some cases, machines may even generate entirely new forms of communication that would not be possible without them. For example, chatbots are computer programs that simulate human conversation and can be used for customer service, information retrieval, and even psychotherapy [73]. The blurring of boundaries between medium and content in HMC has significant implications for our understanding of medium. Traditionally, medium was viewed as a channel for communication, a passive conduit through which messages were transmitted. However, in HMC, the medium is an active participant in the communication process [30]. Machines are not just transmitting messages but are also generating them, which challenges the traditional view of medium as a passive conduit. To account for this, the concept of medium needs to be expanded. The medium in HMC is not just a channel but also a producer of communication messages. The concept of medium needs to be reconceptualized to reflect the active role of machines in the communication process. This requires a new theoretical framework that takes into account the unique characteristics of machine communication and the role of human agency in determining the nature of communication. One potential framework that can be used to understand the role of human agency in HMC is Actor-Network Theory (ANT). ANT views human and non-human actors as equally important in shaping social relations and networks. In HMC, humans and machines are both actors that shape communication networks. Humans initiate communication with machines, but machines also generate communication messages that shape the communication network. ANT provides a framework for understanding how these actors interact and shape communication networks [62]. Another theoretical framework that can be used to understand the role of machines in HMC is posthumanism. Posthumanism views humans and machines as part of a larger network that includes non-human actors such as animals, plants, and machines. In HMC, machines are not just passive channels but active participants in the communication process. Posthumanism provides a framework for understanding the unique characteristics of machine communication and the role of machines in shaping communication networks [63]. In a nutshell, the emergence of HMC has challenged traditional notions of medium as a passive conduit for communication. Machines are not just channels but also producers of communication messages, which has blurred the boundaries between medium and content. The role of human agency in determining the nature of communication in HMC is crucial, and this has significant implications for our understanding of medium. The concept of medium needs to be expanded to reflect the active role of machines in the communication process. New theoretical frameworks such as ANT and posthumanism can help us understand the unique characteristics of machine communication and the role of machines in shaping communication networks.

The potential of HMC to transform our understanding of communication more broadly

The field of human-machine communication (HMC) has the potential to transform our understanding of communication more broadly by challenging traditional conceptions of communication and the role of technology in mediating communication processes. HMC involves the study of interactions between humans and machines, including the design, development, and use of technologies that enable such interactions. By examining the ways in which humans and machines communicate with each other, HMC offers new insights into the nature of communication itself and the impact of technology on our social and cultural practices. One way in which HMC can transform our understanding of communication is by challenging traditional dichotomies between human and non-human actors in communication processes. In traditional approaches, communication is often seen as a process that involves human actors using technologies as tools or channels to transmit messages to other human actors [74]. However, HMC emphasizes the agency of machines in communication processes and challenges the notion that they are passive tools for human communication. Machines can generate their own messages, respond to human input in sophisticated ways, and even learn and adapt to human communication patterns over time . This suggests that we need to expand our understanding of communication to account for the active role of machines in communication processes. Moreover, HMC can transform our understanding of communication by challenging the idea that communication is a purely linguistic or semiotic process. In traditional approaches, communication is often seen as a process of encoding and decoding

messages through the use of language or other symbolic systems [26]. However, HMC emphasizes the role of non-linguistic modalities in communication, such as facial expressions, gestures, and other forms of nonverbal communication that are used in human-machine interactions. This highlights the need to develop new theoretical frameworks that can account for the diverse range of modalities used in HMC.

Another way in which HMC can transform our understanding of communication is by highlighting the importance of context and situatedness in communication processes. In traditional approaches, communication is often seen as a process of exchanging information that is largely independent of the social and cultural context in which it occurs. However, HMC emphasizes the importance of context in shaping the nature and meaning of communication, particularly in the design and use of technologies that mediate communication processes [75]. This suggests that we need to develop new theoretical frameworks that can account for the complex interplay between technology, social context and communication practices. HMC can transform our understanding of communication by challenging traditional views of technology as neutral or value-free. In traditional approaches, technologies are often seen as passive tools that are used to facilitate communication processes, with little consideration given to their broader social and cultural implications. However, HMC emphasizes the need to consider the broader ethical and social implications of technologies used in communication processes, particularly in light of the growing role of machine learning and artificial intelligence in these processes [76]. This suggests that we need to develop new theoretical frameworks that can account for the complex interplay between technology, ethics, and communication practices. In a nutshell, the field of human-machine communication has the potential to transform our understanding of communication more broadly by challenging traditional conceptions of communication and the role of technology in mediating communication processes. By emphasizing the active role of machines in communication, the importance of non-linguistic modalities, the significance of context, and the ethical and social implications of technology, HMC offers new insights into the nature of communication and the impact of technology on our social and cultural practices.

Challenges and Opportunities in Reconceptualizing the Medium in HMCs

Challenges and Opportunities in Reconceptualizing the Medium in Human-Machine Communication (HMC) is a crucial topic in the field of communication studies. As technology continues to advance, the line between human and machine communication becomes blurred, requiring a new conceptualization of the medium. While there are significant opportunities presented by this new understanding of communication, there are also challenges to overcome. One challenge in reconceptualizing the medium in HMC is the need for a new theoretical framework that can account for the unique characteristics of machine communication. The traditional notion of medium as a channel for communication does not adequately describe the role of the machine as a producer of messages. A new framework must account for the complexity of the relationship between humans and machines, as well as the agency of both parties in the communication process. Another challenge is the potential for loss of control over communication content. As machines become more sophisticated, they are increasingly able to produce their own messages [70]. This can lead to concerns over the authenticity and accuracy of communication content, as well as questions about who is ultimately responsible for the messages produced by machines. Despite these challenges, there are significant opportunities presented by the reconceptualization of the medium in HMC. One opportunity is the potential for increased efficiency and effectiveness in communication. Machines can process and analyze large amounts of data quickly and accurately, allowing for more targeted and personalized communication. Another opportunity is the potential for new forms of collaboration between humans and machines. In some cases, machines may be able to contribute unique perspectives and insights to communication processes that are not available to humans alone. The reconceptualization of the medium in HMC also has the potential to transform our understanding of communication more broadly. By expanding our understanding of the medium to account for machine communication, we can gain new insights into the nature of communication itself [26]. This has implications for a wide range of fields, from marketing and advertising to politics and social movements. The challenges and opportunities presented by the reconceptualization of the medium in HMC are significant. While there are challenges to be addressed, the potential for increased efficiency, new forms of collaboration, and a transformed understanding of communication make this an area of great importance for scholars and practitioners alike.

The challenges presented by HMC for scholars and practitioners

The emergence of human-machine communication (HMC) presents a range of challenges for scholars and practitioners alike. These challenges are multifaceted and require a nuanced understanding of the complex relationship between humans and machines. One key challenge is the need to develop new theoretical frameworks that account for the unique characteristics of machine communication. As HMC blurs the boundaries between medium and content, traditional conceptions of medium become increasingly inadequate. Scholars and practitioners must grapple with the question of how to conceptualize the machine as a producer of communication messages, and how this affects our

understanding of communication more broadly [58]. Another challenge is the need to address the ethical implications of HMC. As machines become increasingly integrated into human communication, questions arise around issues of privacy, data ownership, and the potential for bias and discrimination in automated decision-making systems. Scholars and practitioners must work to develop ethical frameworks that balance the potential benefits of HMC with the need to protect human rights and dignity [4].

Additionally, the rapid pace of technological change presents challenges for scholars and practitioners in staying up to date with new developments and emerging trends in HMC. As new technologies continue to emerge, it is important for researchers and practitioners to stay abreast of these developments in order to develop effective strategies for leveraging these technologies to improve communication outcomes. Despite these challenges, HMC also presents a range of opportunities for scholars and practitioners [26]. One key opportunity is the potential for HMC to facilitate more effective communication across a range of contexts. By leveraging the unique strengths of machines and humans, HMC has the potential to improve communication outcomes in areas such as healthcare, education, and business. Another opportunity is the potential for HMC to foster greater inclusivity and accessibility in communication. For example, speech recognition technologies can facilitate communication for individuals with speech impairments, while machine translation technologies can enable communication across language barriers. Furthermore, HMC has the potential to unlock new insights into human communication and cognition. By studying the ways in which humans interact with machines, scholars and practitioners can gain new insights into the nature of human communication and the role of technology in shaping our cognitive processes. Overall, the challenges and opportunities presented by HMC highlight the need for scholars and practitioners to work collaboratively to develop new theoretical frameworks, ethical guidelines, and strategies for leveraging the potential of HMC to improve communication outcomes. By approaching HMC with a critical and open-minded perspective, we can harness the potential of this emerging field to create new and innovative approaches to communication that benefit individuals and society as a whole.

The opportunities for new insights and understanding of communication

The emerging field of human-machine communication (HMC) presents both challenges and opportunities for scholars and practitioners. While the unique characteristics of machine communication challenge traditional notions of medium, they also provide opportunities for new insights and understanding of communication. In this section, we will explore the opportunities presented by HMC and the ways in which they can contribute to our understanding of communication. One of the most significant opportunities presented by HMC is the potential to explore new forms of communication. As machines become more integrated into our lives, they are changing the way we communicate with each other and with the world around us. For example, social media platforms and chatbots have become popular tools for communication, and they rely on machine-based communication to function. By studying these new forms of communication, researchers can gain insights into how technology is shaping our social interactions and the ways in which we communicate [72]. Another opportunity presented by HMC is the potential to explore new areas of research. As machines become more advanced, they are opening up new areas of research in fields such as artificial intelligence, robotics, and human-computer interaction. For example, researchers are exploring the potential for machines to learn from human behavior and adapt to changing circumstances [77]. This research has the potential to revolutionize fields such as healthcare and education, where machines can be used to provide personalized support and assistance. HMC also presents opportunities for interdisciplinary collaboration. The field of HMC draws on expertise from a range of fields, including computer science, engineering, psychology, and communication studies. By collaborating across these disciplines, researchers can gain a more comprehensive understanding of the challenges and opportunities presented by HMC. This collaboration can also lead to new insights and solutions that would not be possible through single- discipline research.

Moreover, HMC presents opportunities for new applications of technology. By developing new technologies that facilitate HMC, researchers and practitioners can create new tools and platforms that enable more effective communication [78]. For example, virtual reality technology can be used to create immersive communication experiences, while machine learning algorithms can be used to analyze and synthesize large amounts of data to support decision-making. Despite these opportunities, there are also challenges that must be addressed. One of the primary challenges is the need for ethical considerations in HMC research and practice. As machines become more integrated into our lives, it is important to consider the ethical implications of machine communication. For example, researchers must consider issues such as data privacy, algorithmic bias, and the potential for machines to reinforce social inequalities [35]. Another challenge is the need for ongoing research and development in HMC. As technology continues to evolve, new challenges and opportunities will emerge, and researchers must stay up-to-date with the latest developments to remain effective in their work. This requires ongoing investment in research and development, as well as a commitment to interdisciplinary collaboration. Finally, there is a need for education and training in HMC. As HMC becomes more prevalent in our lives, it is important for individuals to have a basic

understanding of how machine communication works and its potential implications [11]. This includes not only technical training but also education on ethical considerations and social implications. In a nutshell, HMC presents both challenges and opportunities for scholars and practitioners. While the unique characteristics of machine communication challenge traditional notions of medium, they also provide opportunities for new insights and understanding of communication. By exploring these opportunities and addressing the challenges presented by HMC, researchers and practitioners can create a more comprehensive understanding of the role of technology in shaping our communication.

The potential for HMC to reshape our world

Human-machine communication (HMC) has already begun to transform many aspects of our daily lives, from how we work and interact with technology to how we receive healthcare and education. As HMC continues to evolve and become more sophisticated, there are numerous opportunities for it to reshape our world in ways that we have yet to fully understand. One area where HMC is likely to have a significant impact is in the workplace. With the rise of automation and artificial intelligence, many jobs that were once performed by humans may soon be performed by machines. This shift will require us to rethink the role of human workers and develop new approaches to training and education that take into account the changing nature of work [79]. Another area where HMC is likely to have a transformative impact is in healthcare. As machine learning algorithms become more sophisticated, they have the potential to revolutionize how we diagnose and treat illnesses, and how we develop new treatments and medications. Already, there are examples of AI-powered diagnostic tools that are able to detect diseases with a high degree of accuracy, such as an algorithm developed by Google Health that can identify breast cancer in mammograms with greater accuracy than human radiologists [67]. In the realm of education, HMC has the potential to provide new opportunities for students and teachers alike. Virtual and augmented reality technologies, for example, can allow students to explore complex concepts and scenarios in a more immersive and engaging way. And intelligent tutoring systems that use machine learning algorithms can provide personalized feedback and support to students in real-time, helping them to master new skills and concepts more effectively. But the potential for HMC to reshape our world extends beyond specific industries or domains. As we become more reliant on machines for communication and decision-making, our understanding of what it means to be human is likely to shift. This may lead to new philosophical and ethical questions about the nature of consciousness, agency, and free will. Moreover, the integration of machines into our social and political systems may have significant implications for issues such as privacy, security, and inequality. For example, as algorithms become more adept at analyzing and predicting human behavior, there is a risk that they may be used to manipulate individuals or groups for political or commercial gain [26 & 77]. There are also concerns about the potential for machines to perpetuate or even exacerbate existing biases and inequalities. For example, a machine learning algorithm used by a US healthcare provider to determine which patients should receive extra care was found to be biased against Black patients [80]. And in the realm of employment, there are concerns that algorithms used for recruitment and hiring may perpetuate bias against certain groups, such as women or minorities [81]. To realize the full potential of HMC, it will be essential to address these and other challenges, and to develop new frameworks and approaches that take into account the unique characteristics of machine communication. This will require collaboration and dialogue among researchers, practitioners, policymakers, and members of the public to ensure that HMC is developed and deployed in ways that are ethical, transparent, and equitable. In brief, HMC has the potential to transform our world in ways that are both exciting and challenging. By harnessing the power of machines to communicate and interact with humans, we may be able to create new opportunities for learning, work, and healthcare. At the same time, we must be mindful of the potential risks and challenges posed by HMC, and work together to ensure that these technologies are developed and deployed in ways that are responsible, equitable, and beneficial for all.

Conclusion

In conclusion, the emerging field of Human-Machine Communication (HMC) presents a fundamental challenge to traditional notions of medium in communication. While the traditional perspective views medium as a simple conduit for communication, the unique characteristics of machine communication in HMC call for a reconceptualization of medium that takes into account the active role of machines in producing communication messages. This requires new theoretical frameworks and approaches to the study of medium, which in turn can offer new insights and understanding of communication more broadly. Despite the challenges presented by HMC, there are also opportunities for scholars and practitioners to capitalize on the potential of this new paradigm. By embracing HMC, we can gain a deeper understanding of how technology is shaping our world, and how we can best navigate the challenges and opportunities it presents. Moreover, the potential for HMC to reshape our world is immense, as it has the power to transform not only how we communicate, but also how we live and work. However, there are also potential risks and ethical concerns associated with HMC, including issues related to privacy, bias, and control. Therefore, it is crucial that scholars and practitioners approach this field with a critical and reflective mindset, and engage in ongoing dialogue and

collaboration to address these challenges. Overall, the study of HMC represents a rich and complex field of inquiry, with the potential to transform our understanding of communication and shape our world in profound ways. As we continue to explore the implications of this emerging field, it is important to remain mindful of both the opportunities and challenges it presents, and to approach it with a sense of curiosity, responsibility, and humility.

Implications for Future Research

Future research on reconceptualizing the medium in human-machine communication (HMC) should focus on several key areas. Firstly, there is a need for further exploration of the limitations of traditional notions of medium and how they can be expanded to account for machine communication. This could involve examining the role of different types of technology in shaping our understanding of medium, and the implications of this for HMC. Secondly, future research could explore the potential for new theoretical frameworks to account for machine communication and the need to expand our concept of medium. This could involve examining how existing theoretical approaches could be adapted to better account for the role of machines in communication, or developing entirely new frameworks to address this emerging field of inquiry. Future research could focus on the practical implications of reconceptualizing the medium in HMC, and how this could reshape our world. This could involve examining the potential for HMC to transform industries such as healthcare, education, and entertainment, as well as the ethical and social implications of these changes. Overall, the continued development of HMC as a field of inquiry is likely to require collaboration between scholars from a range of disciplines, including communication studies, computer science, philosophy, and sociology. By working together, researchers and practitioners can better understand the challenges and opportunities presented by HMC and develop new insights and understanding of communication in the digital age.

References

1. Valentina P, Marriott HR. Alexa, She's Not Human But… Unveiling the Drivers of Consumers' Trust in Voice-based Artificial Intelligence. Psychology Marketing. 2021; 38: 626-642.
2. Akanksha J, Arun CJ, Varma A. Rebooting Employees: Upskilling for Artificial Intelligence in Multinational Corporations. The Inter J Human Resource Management. 2022; 33: 1179-1208.
3. Olatinwo DD, Abu-Mahfouz AM, Hancke GP. Towards Achieving Efficient MAC Protocols for WBAN-Enabled IoT Technology: A Review. EURASIP J Wireless Communications Networking. 2021; 60.
4. Seth CL, Guzman AL, Schmidt TR. Automation, Journalism, and Human-Machine Communication: Rethinking Roles and Relationships of Humans and Machines in News. Digital Journalism. 2019; 7: 409-27.
5. Junhua W, Wang H. From a Marketplace to a Cultural Space. J Technical Writing and Communication. 2015; 45: 261-274.
6. Mirca M, Miller D. Polymedia: Towards a New Theory of Digital Media in Interpersonal Communication. Int J Cultural Studies. 2013; 16: 169-187.
7. Brian LD. Guide Dog *versus* Robot Dog: Assembling Visually Impaired People with Non-Human Agents and Achieving Assisted Mobility through Distributed Co-Constructed Perception. Mobilities. 2023; 18: 148-166.
8. Mohammad BT, Wray M. Incorporating Neolithic Villages at Petra, Jordan: An Integrated Approach to Sustainable Tourism. J Heritage Tourism. 2017; 12: 155-171.
9. Bachmann, Alejandro, Manuel Zahn. Film Education as a Multiplicity of Practices: A Media-Ecological Perspective. Film Education J. 2018; 1.
10. Jack P, Macaro E. The Effect of First and Second Language Use on Question Types in English Medium Instruction Science Classrooms in Hong Kong. Inter J Bilingual Education and Bilingualism. 2019; 22: 64-77.
11. Sarah S, Singh R, eds. Re-Understanding Media. Duke University Press. 2022.
12. Cohen S. The Evolution of Machine Learning: Past, Present, and Future. In Artificial Intelligence and Deep Learning in Pathology. 2021; 1-12.
13. Agnes B, Hingley-Jones H, Ruch G. Relationship-Based Practice Revisited. Journal of Social Work Practice. 2016; 30: 229-233.
14. James P. Literature-Technology-Media: Towards a New Technography. Literature Compass. 2018; 15.
15. Comor E. Harold Innis and 'the Bias Of Communication.'' Information, Communication & Society. 2001; 4: 274-294.
16. Alex G. Small Stories as Curated Formats on Social Media: The Intersection of Affordances, Values Practices. System. 2021; 102: 102620.
17. Bucher T. Facing AI: Conceptualizing 'FAIce Communication' as the Modus Operandi of Facial Recognition Systems. Media, Culture Society. 2022; 44: 638-54.
18. Aggerholm HK, Andersen SE. Social Media Recruitment 3.0. J Comm Management. 2018; 22: 122-37.
19. Katrin E, Gentzel P, Utz S, Engesser S. Human-Machine-Communication:Introduction to the Special Issue. Publizistik. 2022; 67: 439-48.
20. EldridgeSA, Hess K, Tandoc EC Westlund O. Navigating the Scholarly Terrain: Introducing the Digital Journalism Studies Compass. Digital Journalism. 2019, 7: 386-403.
21. Zhuohuang Z, Xu Y, Yu M, Zhang SX, Chen L, Williamson DS, Yu D. Multi-Channel Multi-Frame ADL-MVDR for Target Speech Separation. IEEE/ACM Transactions on Audio Speech and Language Processing. 2021; 29: 3526-3540.
22. Heidi M, Liu F. The Status of Human-Machine Communication Research: A Decade of Publication Trends across Top-Ranking Journals. 2022; 83-103.
23. David W, Edwards AP, Edwards C, Luo Z, Spence PR. I-It, I-Thou, I- Robot: The Perceived Humanness of AI in Human-Machine Communication. Communication Studies. 2020; 71: 393-408.

24. Leo-Liu J, Wu-Ouyang B. A 'Soul' Emerges When AI, AR, and Anime Converge: A Case Study on Users of the New Anime-Stylized Hologram Social Robot 'Hupo.' New Media & Society. 2022.
25. Leopoldina F, Edwards A. Framing the Psycho-Social and Cultural Aspects of Human-Machine Communication. Human-Machine Communication. 2022; 4: 7-26.
26. Andrea LG, Lewis SC. Artificial Intelligence and Communication: A Human-Machine Communication Research Agenda. New Media Society. 2020; 22: 70-86.
27. Dehnert M, Mongeau PA. Persuasion in the Age of Artificial Intelligence (AI): Theories and Complications of AI-Based Persuasion. Human Communication Research. 2022; 48: 386-403.
28. Bennett WL, Jarol BM. The One-Step Flow of Communication. The ANNALS of the American Academy of Political and Social Science. 2006; 608: 213-32.
29. Adornato AC. Forces at the Gate. Electronic News. 2016; 10: 87-104.
30. Rich L, Fortunati L, Goggin G, Lim SS, Li. The Oxford Handbook of Mobile Communication and Society. Oxford University Press. 2020.
31. Alberto A, Mesoudi A. If We Are All Cultural Darwinians What's the Fuss about? Clarifying Recent Disagreements in the Field of Cultural Evolution. Biology & Philosophy. 2015; 30: 481-503.
32. William S, Kleek MV. Exploring Interactions between Trust, Anthropomorphism, and Relationship Development in Voice Assistants. Proceedings of the ACM on Human-Computer Interaction. 2021; 5: 1-16.
33. Ahamad, Fayaz SF, Rahmat MK, Mubarik MS, Alam MM, Hyder SI. Artificial Intelligence and Its Role in Education. Sustainability 2021; 13.
34. Shyam SS, Eun-Ju L. Rethinking Communication in the Era of Artificial Intelligence. Human Communication Research. 2022; 48: 379-385.
35. Margot van der JG. Source Orientation, Anthropomorphism, and Social Presence in Human-Chatbot Communication: How to Proceed with These Concepts. Publizistik. 2022; 67: 555-578.
36. Michael LW. Legitimating Television: Media Convergence and Cultural Status, by Newman, M. Z., & Levine, E. The Communication Review. 2012; 15: 76-78.
37. Simon G. From Media Archaeology to Media Genealogy: An Interview with Erkki Huhtamo. Le Foucaldien. 2016; 2: 9.
38. Jim E. The Medium Is the Message. Research-Technology Management 2016; 59: 9-11.
39. Brendan D. Media and History. In International Encyclopedia of the Social Behavioral Sciences. 2015; 11-18.
40. Brennen, Bonnie S. Qualitative Research Methods for Media Studies. New York: Routledge. 2021.
41. Wenjuan J, Zhong K. Another Way of 'Amusing Ourselves to Death'? Experience, Ideological Fantasy, and Labor Control in Variety Entertainment Production. The Journal of Chinese Sociology. 2020; 7: 13.
42. Dana R. Davidson and the Language of New Media. Empedocles. Euro J Philosophy Communication. 2019; 10: 139-49.
43. Bonifazio P, Vito M. Convergence Culture and Transmedia Storytelling in Contemporary Italy. Italian Culture. 2021; 39: 1-3.
44. Ghaffarzadegan S, Bořil H, Hansen JHL. Deep Neural Network Training for Whispered Speech Recognition Using Small Databases and Generative Model Sampling. International Journal of Speech Technology. 2017; 20: 1063-1075.
45. Himanshu C. Cognitive Hexagon-Controlled Intelligent Speech Interaction System. IEEE Transactions on Cognitive and Developmental Systems. 2022; 14: 1413-1439.
46. Dimitris M, Angelopoulos J, Panopoulos N. Operator 5.0: A Survey on Enabling Technologies and a Framework for Digital Manufacturing Based on Extended Reality. J Machine Eng. 2022; 22: 43-69.
47. Jennifer G, Kirkwood G, Fang C, Wilkenfeld JN. CC Negotiating Agency and Control: Theorizing Human-Machine Communication from a Structurational Perspective. Human-Machine Communication. 2021; 2: 153-171.
48. Stephen M. Reconceptualizing Cultural Globalization: Connecting the 'Cultural Global' and the 'Cultural Local.' Social Sciences. 2015; 4: 630-645.
49. Chiangmong P. Ethics and the Prsent: Marcus Aurelius' Stoic Ethics. Twentieth Century Literature. 2013; 59: 1-16.
50. Robert LK. A View of the Internet from the Perspective of Harold Innis's Bias of Communication. 2022; 2: 80-86.
51. Akker van den C. Benjamin, the Image and the End of History. J Aesthetics and Phenomenology. 2016; 3: 43-54.
52. Asante MK. The Global Intercultural Communication Reader. Routledge. 2013.
53. Bianchi R. The Political Economy of Tourism Development: A Critical Review. Annals of Tourism Research. 2018; 70: 88-102.
54. O'Brien A, Kerrigan P. Gay the Right Way? Roles and Routines of Irish Media Production among Gay and Lesbian Workers. Eur J Communication. 2020; 35: 355-69.
55. Hesse-Biber S. Handbook of Feminist Research: Theory and Praxis. 2455 Teller Road, Thousand Oaks California 91320 United States: SAGE Publications, Inc. 2012.
56. Hildebrand JM. Modal Media: Connecting Media Ecology and Mobilities Research. Media, Culture & Society. 2018; 40: 348-364.
57. Yongwoon S, Dong-Hee S. Analyzing China's Fintech Industry from the Perspective of Actor- Network Theory. Telecommunications Policy. 2016; 40: 168-181.
58. Rodríguez-Hidalgo C. Me and My Robot Smiled at One Another: The Process of Socially Enacted Communicative Affordance in Human-Machine Communication. Human-Machine Communication. 2020; 1: 55-69.
59. Shade DD, Kornfield S, Oliver MB. The Uses and Gratifications of Media Migration: Investigating the Activities, Motivations, and Predictors of Migration Behaviors Originating in Entertainment Television. J Broadcasting & Electronic Media. 2015; 59: 318-341.
60. Bronner, Stephen Eric, Douglas Mackay Kellner, eds. Critical Theory and Society A Reader. Routledge. 2020.
61. Gale M, James AH. Constructionist Controversies. Edited by Gale Miller and James A. Holstein. Routledge. 2017.
62. Marco R, Attwell K, Casigliani V, Taylor J, Quattrone F, Lopalco P. Legitimising a 'Zombie Idea': Childhood Vaccines and Autism - the Complex Tale of Two Judgments on Vaccine Injury in Italy. Int J Law Context. 2021; 17: 548-568.

63. Dehnert M. Communication Geographies of Human-Machine Understanding: Entangled Agencies, Synthetic Aesthetics, and Machine Matterings. Communication Studies. 2021; 72: 1146-1159.
64. Andreas H, Loosen W. The Interdisciplinarity of Human-Machine-Communication (HMC): Rethinking Communication, Media, and Agency the Interdisciplinarity of HMC : Rethinking Communication, Media, and Agency, no. 2022.
65. Cibralic B, Mattingly J. Machine Agency and Representation. 2022.
66. Kam DD, David N.JD, Libeskind-Hadas R, Bargagliotti A. Breaking Boundaries in Computing in Undergraduate Courses. J Res Stem Education. 2018; 4: 81-100.
67. Jones-Jang SM, Park YJ. How Do People React to AI Failure? Automation Bias, Algorithmic Aversion, and Perceived Controllability. Edited by Mike Yao. J Computer-Mediated Communication. 2022; 28.
68. Petra G, Saunders R. Moving beyond the Mirror: Relational and Performative Meaning Making in Human-Robot Communication. AI Society. 2022; 37: 549-563.
69. Wenyan L, Zheng B. Visiting Elements Thought to Be 'Inactive': Non-Human Actors in Arthur Waley's Translation of Journey to the West. Asia Pacific Translation and Intercultural Studies. 2017; 4: 253-65.
70. Adam M. Blurring boundaries between humans and technology: postdigital, postphenomenology and actor-network theory in qualitative research. Qualitative research in sport, exercise and health. 2021; 13: 26-40.
71. Enith GL, Castillo LF, Arango-López J, Moreira F. A Systematic Review of Integrated Information Theory: A Perspective from Artificial Intelligence and the Cognitive Sciences. Neural Computing and Applications. 2023.
72. Yuanping N, Jia Y, Shudong L, Zhu X, Aiping L, Zhou B. Identifying Users across Social Networks Based on Dynamic Core Interests. Neurocomputing. 2016; 210: 107-15.
73. Assmann J. Communicative and Cultural Memory. 2011; 15-27.
74. Mohamad K, Visvizi A, Troisi O. Smart City as a Smart Service System: Human- Computer Interaction and Smart City Surveillance Systems. Computers in Human Behavior. 2021; 124: 106923.
75. Sebastian R, Fan L, Pepin B. Mathematics Textbooks and Curriculum Resources as Instruments for Change. ZDM - Mathematics Education. 2021; 53: 1189-1206.
76. Ralph S. Rethinking Science, Technology, and Social Change. Stanford University Press. 2007.
77. Thomas K, Welsch R, Chuang L, Schmidt A. The Placebo Effect of Artificial Intelligence in Human-Computer Interaction. ACM Transactions on Computer-Human Interaction. 2022; 29: 1- 32.
78. Timilsina S, Shin HG, Kee-Sun S, Kim JS. Dark-Mode Human-Machine Communication Realized by Persistent Luminescence and Deep Learning. Advanced Intelligent Systems. 2022; 4.
79. Erika LM, Mariani CJ, Zullow H, Jeff-Eke M, Litwin E, Nikitas JN, Godley LA. New Themes in the Biological Functions of 5-Methylcytosine and 5- Hydroxymethylcytosine. Immunological Reviews. 2015; 263; 36-49.
80. Thomas D, Kalakota R. The Potential for Artificial Intelligence in Healthcare. Future Healthcare J. 2019; 6: 94-98.
81. Joana V, Kyriakidou O, Özbilgin MF, Groutsis D. Scientism as Illusio in HR Algorithms: Towards a Framework for Algorithmic Hygiene for Bias Proofing. Human Resource Management J. 2022.
82. John F. Introduction to Communication Studies. Routledge. 2010.
83. Erika LM, Mariani CJ, Zullow H, Jeff-Eke M, Litwin E, Nikitas JN, Godley LA. New Themes in the Biological Functions of 5-Methylcytosine and 5- Hydroxymethylcytosine. Immunological Reviews. 2015; 263; 36-49.
84. Raymond W. Television. Edited by Raymond Williams. Routledge. 2004.