

Review

Innovative application of artificial intelligence in a multi-dimensional communication research analysis: a critical review

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Abstract

Artificial intelligence (AI) imitates the human brain's capacity for problem-solving and making decisions by using computers and other devices. People engage with artificial intelligence-enabled products like virtual agents, social bots, and language-generation software, to name a few. The paradigms of communication theory, which have historically put a significant focus on human-to-human communication, do not easily match these gadgets. AI in multidimensional touch is the subject of this review article, which provides a comprehensive analysis of the most recent research published in the field of AI, specifically related to communication. Additionally, we considered several theories and models (communication theory, AI-based persuasion theory, social exchange theory, Frames of mind, Neural network model, L-LDA model, and Routine model) to explain a complex phenomenon and to create a conceptual framework that is appropriate for this goal and a voluntary relationship between two or more people that lasts for an extended period. Communication and media studies focus on human-machine communication (HMC), a rapidly developing research area. It is our intention to continue investigating the beneficial and detrimental effects of artificial intelligence on human communication as well as to identify novel concepts, theories, and challenges as the research process develops.

Keywords Artificial intelligence · Communication · Human-computer interaction · Social formations · Media studies

1 Introduction

Systems that are built by humans and consist of software and potentially also hardware can be referred to as artificial intelligence (AI) systems, for an involved objective, take action in the real world or the virtual one by gathering information about their surroundings, using acquired information to draw conclusions based on the obtained data's organization or lack thereof, or analyzing the data, produced from this facts, and deciding upon the most effective action(s) to take in order to accomplish a predetermined objective [213]. AI systems have the ability to either apply symbolic rules or learn a mathematical model, and they also have the ability to adjust their behavior by analyzing the ways in which their prior actions have influenced the surrounding environment [29]. AI, an area of study and practical application that emerged in the middle of the twentieth century, has always had a tight link with the art of effective communication. The theoretical basis for cybernetics may be traced back to cybernetics, a multidisciplinary discipline based on the idea of communication [141].

Interpersonal communication was transformed with the introduction of computer-mediated communication (CMC), which gave people a variety of forms and channels to engage with others in real-time and across distances [147]. The

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medium and its characteristics play a significant role in modeling how actors utilize technology to achieve interpersonal objectives in the traditional social science concept of CMC [32]. It is still up to the communicator to get their point across, their efforts to craft messages and shape public perception are generally accepted as means to that end. As with the sender, the recipient of the communication is supposed to be aware of and comfortable with the agency involved. AI in interpersonal communication might upend existing beliefs about agency and mediation as well as raise new ethical concerns [66]. These days, it's not enough for technology to just convey interpersonal communication, AI-MC, or artificial intelligence-mediated communication, modifies, augments, or even generates communication to accomplish certain aims [20].

Today's most popular social media sites have been permeated by AI technology, giving robots the ability to act as agents in users' interactions [21]. Social media platforms' AI-based algorithms, which operate invisibly in the background, autonomously learn users' preferences and interests by analyzing their actions and inputs on the platforms. Based on this newfound knowledge, the algorithms then choose and curate relevant material for each social network user. Work, life, and problem-solving are all being affected by the rise of AI [122, 243]. AI may be used for social media (SM) management and growth. Due to SM's widespread use, businesses now have more opportunities than ever to collect timely and relevant data to boost their productivity [91]. AI also makes it easier to create material by giving intelligent editing options like face detection filters and clever sound enhancement software. Recommendations provided by AI can aid users in establishing and growing their social circles [206]. Therefore, on AI-based social media platforms, user agency and machine agency interact with one another and jointly build user experiences [277].

The term "social chatbot" refers to a kind of AI dialogue system that can have social and empathic discussions with people [2]. They are appropriate as discussion companions, friends, or even love partners because of their human-like demeanor [188]. As a result, human friendship with artificial intelligence entails a whole new personal connection with technology, which has the potential to change the meanings and roles traditionally connected with human relationships [37, 51]. It is likely that the design and execution of the software that makes friendship possible will also confine and guide that friendship. It is possible that the human relationship with artificial intelligence may be defined in several different ways, depending on the platforms that make it possible to do so [17, 245]. It is common for friendships to originate because of shared experiences, during which the individuals involved discover that their affiliation with one another is enjoyable for both [69]. Human-machine communication (HMC) differs from other approaches because it emphasizes human interactions with technology as communicative subjects rather than just interacting objects. Taking the computer in the role of communicator as our starting point [63].

According to Vinuesa et al. [255] artificial intelligence was and still is a type of communication research. AI requires interaction between machines as a prerequisite for intelligence. HMC is a relatively new subfield of communications research that aims to better understand how humans communicate with intelligent devices like robots and other agents, as well as to build and enhance theories to explain these interactions [41, 160]. Two objectives form the foundation of our work HMC. First, we describe communication and its many components. Then, we consider several theories and models to explain a complex phenomenon and to create a conceptual framework that is appropriate for this goal and a voluntary relationship between two or more people that lasts for a considerable amount of time and in which the participants typically prioritize addressing the needs and interests of the others while also pursuing their own interests. This research also investigates the interaction between users and machine agencies in two crucial areas of social media use: online networking and mediated and human communication. Our study also explains the interactions between human and AI agency via trade-offs between human and machine agency and/or mutual augmentation, as well as how the human-AI dynamics affect user engagement.

2 Communication and aspects of communicator

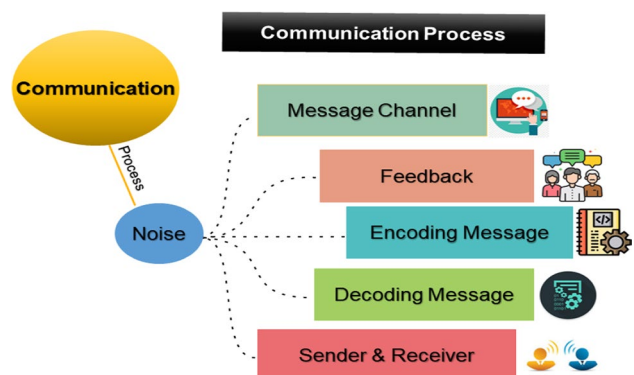
Transferring knowledge from one location, person, or group to another is what we mean when we talk about communication. There must be a sender, a message, and a receiver for there to be any communication [263]. There must be a sender, a message, and an audience for any communication to take place. Although it may seem straightforward at first glance, effective communication is in fact a tricky topic [175]. The message is "encoded" by the sender, often using a combination of verbal and nonverbal cues. It is sent somehow (for instance, orally or in writing), and the receiver "decodes" it [214]. The intricacy of communication also implies that many recipients may get somewhat different versions of the message. Words and/or gestures may be interpreted in many ways, leading to widely varying conclusions. They may not have the same concept as the sender, either [134]. There is no clear delineation between the sender and the receiver in

interpersonal communication. Two individuals will take turns playing both characters while they converse [32]. Subtle signals are sent between the participants, including eye contact (or lack thereof) and other forms of body language. However, the source and receiver are more clearly differentiated in written communication [100].

The use of words to convey meaning verbally A language is a set of symbols, whether they be sounds, gestures, or letters, that are used to convey meaning [200]. The sharing of ideas and thoughts via non-verbal means does not require the use of words [98]. The finest illustration is provided by silence. Silence may be taken to express a variety of different meanings depending on the circumstances, including respect, apathy, emotional distance, rudeness, thoughtfulness, humility, and aggression. A greater range of feelings may be conveyed through silence than through words alone. Non-verbal communication comprises body language, gestures, symbols, signs, etc. [256]. In our day-to-day lives, we meet many different modes of communication (Fig. 1). The actions of declaring one's expertise and experiences, offering advice and directives, and asking questions are all examples of communication content that occurs between parties. These actions may be carried out in a variety of ways, such as by gestures, including sign language, nonverbal communication, and body language, or by writing or speaking [81]. The shape is determined by the symbol systems that are used. Content and manner of communication work synergistically to produce messages that are then sent toward a specific location. Either oneself, another person, or even another entity (such as an organization or group) could be the target of the attack. A speech act refers to a specific occurrence of people communicating with one another [137]. There is a set of rules that a speech act usually adheres to in terms of how it is delivered. Dialogue is the most typical and often the most effective method. Dialogue is a two-way exchange of information between people who are both actively participating in the conversation. Dialogue is preferable to other modes of communication because it allows for more precise expression via mutual response [234]. Feedback is information that has been encoded and sent back to its original source (now the receiver for decoding). Every day, whether directly or indirectly, most of us have conversations with anywhere from ten to a thousand individuals. Lack of communication is a common cause of failures which we all have experience. In certain cases, this may occur due to difficulties in communicating [240].

First, different languages used in verbal and nonverbal communication may be a barrier to human communication. This involves being unfamiliar with the idioms used by a different group or subculture. Body language cannot be comprehended if the language is not understood. Various people may welcome one another in different ways. A communication gap may develop if the two parties cannot comprehend one another [14, 109]. Second, being unaware of or oblivious to relevant background information on a certain event, relationship, or cultural norm. The recipient's interpretation of the sender's intent may vary from the sender's original intent [82]. Third, sending a message that is deliberately hard to decipher [217]. Fourth, A divertissement that digests a message with insufficient attention or focus. This is not confined to discussions or broadcasts that are happening in real time. Any individual can process any communication in an incorrect manner if they do not concentrate enough. Sometimes because of "static" or because of real-life events that cause distractions [15]. The best way to avoid disengagement and misunderstanding is to choose a type of communication that encourages participation, such as one in which questions and responses are used to clarify points [254]. Therefore, communicating is a crucial action in life. Everyone wants to express their thoughts, feelings, and ideas, whether they are humans or animals, and so they invent various means of communication [269].

Fig. 1 Communication process



3 Applications in communication

Since the days of Morse code, communication technology has come a long way [140]. Only a couple of generations ago, long-distance communication was painfully sluggish and primitive. The creation of the internet was the single most significant technical achievement during the previous 50 years. Other gear, such as satellite capabilities and fiber optic cable, has aided in increasing internet capacity and advancing internet-based communication at a fast rate. Communication technology continues to develop quickly (Fig. 2). The Internet's advent has made communication more democratic than ever before [199]. Now, anybody with Internet access may publish their views online. However, with increased information sharing capability comes new challenges. The growth of "fake news" underscores the need to be skeptical of information disseminated via internet media and the necessity of relying on credible, trustworthy, and scientific sources of information to enlighten ourselves [45].

Social media sites let users set up profiles, share photos and status updates with friends, and connect with others who share their interests. In 1997, 6 Degrees was released as the first social networking site [225]. In 2003, MySpace was introduced and quickly became the first large-scale social networking site. Between 2005 and 2008, it dominated the global social media scene [143]. *Facebook* has surpassed MySpace as the most popular social networking site, and its user base continues to grow by the billions every day. *Twitter* is yet another major social media platform where users may instantly communicate with one another by posting and sharing brief messages. *Twitter* is used by major organizations, prominent personalities, and governments to instantly disseminate information and react to breaking news and other matters of public interest [209]. Blogs, short for "web logs," are individual websites on which anybody with an internet connection may write or "log" anything for the benefit of readers anywhere in the world. A blog is a kind of website often used for personal reflection and expression [253]. Media outlets, businesses looking to increase their visibility, and professional bloggers that rely on advertising and affiliate programs are some examples of the types of organizations that maintain more specialized or commercial blogs. The advent of the blog was a game-changer in the field of mass communication [23]. In 1994, Justin Hall published the first ever blog on the website links.net. Even though Justin didn't recognize it as a blog at the time, he nonetheless used all the standard blogging conventions. Weblog was coined by Jorn Barger in 1997. The term was derived from "logging the web," which was shortened to "log" [52, 259].

Fig. 2 Communication application in various fields



Vlogs are just “*video logs*.” They developed as a natural progression of weblogs when Internet speeds finally became sufficient for casual video sharing. Typically, a vlogger may record oneself talking into a hand-held camera or a built-in camera on their computer display [35]. Blogging gained popularity with the 2005 launch of YouTube. YouTube enabled anyone to share videos online and embed them into their own websites. The widespread availability of low-cost smartphone cameras was another important enabler [53]. Vlogging has evolved into live video to satisfy viewers’ need for real-time, unscripted experiences [22]. Advanced *conference equipment* facilitates global business communication. In modern live conferencing setups, video feeds are often used with elaborate sound systems. Blackboard collaboration and similar live lecture technologies let a university professor simultaneously address hundreds of students from all over the globe [132]. *Wikis* are collaborative websites where anyone may contribute or change information. Wikipedia is the most well-known wiki site. In a nutshell, wikis facilitate the crowdsourcing of knowledge. In this way, wiki users may collect a large amount of data rapidly. Because of the ease with which everyone can access the accumulated information on Wikis, a kind of “hive mind” may be formed. When individuals pool their knowledge and make it available to one another, this is called a “hive mind” [267].

People may pose questions and provide answers in a group forum, and the other members can then comment on the thread. Like *Reddit*, many online discussion boards are organized according to subject, allowing users with similar interests to connect with one another [108]. Online courses often include group discussion boards, with students responding to a weekly prompt question. When major companies like Android and Apple entered the tablet computer industry in 2008 and 2010, it marked the beginning of a new era in technology that has given us the sleek, sophisticated tablets we use today [153]. The technology behind *podcasts* has its roots in radio. In contrast to radio, which relies on radio waves for transmission, podcasts use the more flexible and feature-rich internet to reach their audiences. This has enabled features like on-demand downloading, rather than requiring viewers to watch at a set time [201]. As a result of *wearable technology*, it is now simpler than ever to have a conversation. Any piece of electronic equipment that may be worn on the person is considered “wearable technology.” [177]. *Smart watches*, such as the Apple Watch, may be controlled using voice commands. Exercise wristbands and other wearable health trackers delve into the bodies of individuals to assess vital signs and sleep patterns. Augmented reality may be integrated into a person’s daily life via smart glasses. When a person is wearing smart glasses, the glasses may display information directly onto their retina, such as their journey speed or internet search history. *Smart speakers* are computerized personal assistants installed in companies and homes to aid individuals in doing chores without using their hands [194].

Even though it has been available since the beginning of the internet, online chat has recently seen a comeback in popularity as a means of business-to-consumer (B2C) communication [195]. *MSN Messenger*, one of the first online chat programs, quickly became popular among teenagers and young adults in the early 2000s. MSN Messenger was discontinued in 2012 due to competition from Facebook and Facebook Messenger [112]. *E-mail* has been available since the 1970s, yet it still makes the cut because of its usefulness in the modern day. The origins of email predate the birth of the internet by several years. The first emails were transmitted on local area networks (LANs) inside government and academic archives. In 1971, the first email was sent using an “@” sign to indicate which servers should receive the message [162].

4 Artificial intelligence

Since its inception in the middle of the twentieth century, AI has maintained a tight association with the area of study and application known as communication. The theoretical groundwork for the area was established by the multidisciplinary science of cybernetics, which was structured on the idea of communication [210, 227] and Alan Turing’s groundbreaking thought experiment, dubbed the “Turing Test,” which envisioned a scenario in which machines and humans come into communication with one another [224]. The word “AI” is polysemous and refers to both attempts to simulate a mind within a computer to comprehend human intelligence and efforts to create technologies that can do activities that need some degree of human intellect [40]. AI stands for “machines that simulate intelligent human behavior” [221] including the fields of deep learning, neural networks, and machine learning [157, 244]. Artificial intelligence has been stressed in current literature AI [13, 144] and its implications [174, 212] as well as the significance of big data [90, 207] and its consequences [148]. Work, life, and problem-solving are all being affected by the rise of AI [125, 255].

Since both “artificial” and “intelligence” are vague concepts, defining AI may be challenging. Scholars from a wide range of fields have difficulty articulating what artificial intelligence really is [104], in computer engineering in communication, [275] in legal studies, and [211] in AI research). AI is a fast-expanding discipline that encompasses several subfields, such as decision making, reasoning, planning, knowledge representation, optimization, metaheuristic algorithms, and

machine learning (ML). Broad and specific AI are two common classifications (or strong and weak). Strong artificial intelligence (AGI) refers to fully agentic technologies (i.e., those capable of doing several tasks simultaneously) that mimic human thinking and intellect. In the norm in science fiction, there is no such thing as AGI (artificial general intelligence) [39], if it happens at all. Existing artificial intelligence is limited, meaning that it can only carry out “extremely particular computing tasks more quickly and more precisely than humans” [33].

5 Using artificial intelligence

The many kinds of AI we may use will now be discussed. This extensive work is broken down into many classes for easier perusal [71]. Weak artificial intelligence is also known as “narrow AI.” It is an AI system designed and trained to carry out a certain function [2, 270]. Poor examples of artificial intelligence are Siri and Alexa. The data is classified using unsupervised programming. They classify objects in accordance with the responses they have previously been taught. If you ask Alexa to play music, you should really listen to it. To respond, the algorithm will play a song, but it will only do so because it has been instructed to [36, 203]. Artificial general intelligence (also known as “strong AI”) more closely resembles the human brain. Its intelligence comes in handy while carrying out fresh instructions. It can figure out a solution to a problem without using a set procedure. It’s possible that advanced AI may be demonstrated in areas such as seeing, hearing, talking, deciding, and talking [127, 215, 249].

Figure 3 shows applications of AI in different industries. Companies are using AI to improve their customer service and automate manual processes that can be completed more quickly by computers [261]. In addition, websites are using machine learning algorithms to find out how to offer their clients the most effective service possible. One of the many ways AI is being used in business is via chatbots, which are being integrated into websites to provide instantaneous support to clients [10, [126]. Artificial intelligence could increase revenue, do predictive analysis, strengthen relationships with customers by providing a more satisfying experience overall, and design more streamlined and productive business



Fig. 3 Applications of AI

procedures [105]. AI has introduced game-changing innovations that have transformed conventional approaches to education. Smart content, such as online study materials, e-conferencing, etc., may be successfully provided and graded using digital technology [120, 231]. In addition, admissions websites like Leverage Edu make effective use of AI to match students with schools and programs that will best advance their professional and personal aspirations. Online courses, learning platforms, digital apps, intelligent AI tutors, online career counseling, virtual facilitators, and many more are just a few of the many ways that AI is being used in the classroom today [59, 198].

With its revolutionary effects on medical equipment, diagnosis, and research, AI has established itself as a pivotal and effective technology in the healthcare industry [103]. Aside from the obvious benefits of using computers to make diagnoses more quickly and accurately, AI has many other important uses in the medical field, including the use of complex algorithms that mimic human cognition to analyze and interpret otherwise difficult data in the healthcare and medical fields [54, 229]. AI systems can process larger data sets and evaluate them to recommend the most effective treatments. The healthcare industry has also produced a plethora of digital apps like Lybrate, WebMD, etc., via which users may record their symptoms and connect with doctors [9, 102]. The number of ways AI is being used in banking is likewise rising rapidly. Several financial institutions across the globe have already begun using AI to aid with online banking and the prevention of credit card fraud [273]. Almost all financial institutions now provide their customers with mobile applications that allow them to monitor their accounts, make payments, and even spot signs of money laundering or other types of fraud. Artificial intelligence and deep learning are relied on by well-known businesses such as MasterCard and RBS WorldPay [167].

Financial market trends of the future are being heavily influenced by artificial intelligence [79, 145]. The primary goal and purpose of AI-based technology in the financial industry is to assess the volatility of stock trading in detail. The financial sector is increasingly using AI-based technologies such as adaptive intelligence, algorithm trading, and machine learning to improve efficiency and accuracy in a variety of tasks. These aid people in making informed choices considering future market projections [19, 62]. Many problems stemming from climate change are having devastating effects on farmers and agricultural yields [16]. Several pieces of artificial intelligence (AI) equipment, such as robots and algorithms, are at the forefront of helping farmers practice sustainable agriculture and put an end to food shortages [142, 204]. To that end, they aid farmers in locating more efficient weed control methods. An excellent example of the practical use of AI in agriculture is provided by the company Blue River Technology, which has developed “see and spray” devices that can identify the presence of weedicide on cotton plants. With the use of computer vision technology, these robotic sprayers apply herbicide to plants [228, 248].

There should also be special attention paid to the use of AI in video games. AI has experienced amazing progress in the game business itself. Using machine learning and algorithms, a dreamlike gaming experience may be pushed forward for gamers [49, 56]. By incorporating augmented and virtual reality into gaming to create a more realistic setting for players, AI can turn even the most basic video games into dynamic, interesting, and interactive experiences. The AlphaGo program developed by DeepMind is widely regarded as one of the most impressive and groundbreaking advancements in the history of artificial intelligence [7, 196]. Some of the most prominent instances of autonomous vehicles are smart automobiles. It’s one of the most well-known uses of AI in the automotive industry [18]. Prolific businesses like Waymo have put their product through its paces in a series of test rides [218]. To create and regulate signals for vehicular movement, they used cameras, cloud services, GPS, and a vehicle range system. Another excellent example of autonomous vehicles is Tesla’s self-driving automobiles, which are solely based on artificial intelligence [185]. As AI continues to advance, robots are becoming more capable of carrying out activities that were formerly considered beyond their capabilities [180]. When AI is used, the concept of fully automated systems becomes a reality, with no human interaction required in the monitoring, inspection, or improvement of the system’s performance [195]. With the use of artificial intelligence (AI), robots may be taught to function independently of humans. This is since robots can do routine jobs far more quickly and accurately than humans can.

This is one of the AI applications that has been discovered to be widely used. Logistics, demand forecasting, smarter marketing, improved personalization, chatbot utilization, and other e-commerce departments are just a few examples [246]. AI is causing disruption. One of the first businesses to use AI was the e-commerce sector, with Amazon as a notable participant. With time, this may make effective use of AI [166]. Additionally, NASA is using AI applications for space exploration to automate picture processing, construct autonomous spacecraft that might avoid space junk on their own, and build more effective and distortion-free communication networks [165]. Since the advent of internet streaming services like Netflix and Amazon Prime, the entertainment industry has become more dependent on consumer data. This is useful for making suggestions related to previously seen material [42]. Not only does this help ensure that ideas are spot-on, but it also helps ensure that the resulting material is something that most people like. It’s challenging to categorize and

index newly developed material as it emerges every minute. Artificial intelligence software can examine the contents of films frame by frame, picking out the subjects and determining which tags are most applicable. Media organizations are also benefiting from AI's assistance in formulating strategic judgments [237].

The purpose of social media goes much beyond simple communication and the sharing of ideas. It subtly molds our opinions, beliefs, and personalities [111]. All of this is possible because of the AI technologies that run invisibly in the background, collecting information about our search habits, and displaying content and advertisements that “may” be of interest to us based on our past engagements [252]. Instagram, for one, recently shared how it has been using AI to curate content for the Explore tab. This is helpful for social media marketing because it allows for very precise demographic and behavioral targeting in paid ad campaigns directed at platform users. We also have artificial intelligence capabilities that can create advertising for Facebook and Instagram on our behalf. Marketing campaigns on social media can be thoroughly examined and tracked thanks to the use of AI [131]. AI is disrupting several aspects of the e-commerce industry, such as logistics, demand prediction, smarter marketing, improved personalization, the usage of chatbots, etc. [170]. Amazon is a leader in the e-commerce sector, one of the first sectors to fully adopt artificial intelligence. By incorporating artificial intelligence into their design, chatbots are becoming more human-like in their interactions with customers [152].

6 Artificial intelligence applications in communication

Both the field of artificial intelligence (AI) and the field of communication studies have developed independently over the course of the last more than seven decades. The primary emphasis of research on artificial intelligence has been on developing methods to recreate features of human intellect in machines, especially the capacity to communicate [65]. On the other hand, communication has always been thought of as being first and foremost a human activity [88] mediated by technology, with the study within the field focusing on how individuals communicate with one another and the ramifications that come with that communication [189]. The gap between the study of artificial intelligence and research into communication is gradually closing because AI devices have been intended to operate as communicators. Recent advancements in artificial intelligence have resulted in technologies that are more potent and significant being incorporated into everyday life [123]. Conversations with digital assistants like Alexa from Amazon, Siri from Apple, and others are commonplace, and they are only likely to increase as the Internet of Things develops [173].

Describe how algorithms and people interact in the setting of a “hybrid media system,” which includes algorithmic communicators like Twitter bots in addition to human news providers like journalists and social media users. They discovered that, across a wide variety of themes, including political challenges and public health debates, bot actions in the online news ecosystem tended to selectively enhance certain human discourses [58]. However, it is not entirely clear whether the agenda is that of the public, the machine, or some combination of the two. It appears that the engagement metrics generated by bots predict ideologically consonant coverage by partisan news outlets, suggesting the possibility of “reverse agenda-setting.” Industry-wide, news producers and distributors are using AI-enabled technology, including the Associated Press [123]. Because of the growing interest among communication academics in the study of human–robot and human–agent interactions (HRI and HAI, respectively), as well as the existing body of work in human–computer interaction (HCI), HMC has emerged as a distinct field of study [163]. Since this is the case, HMC is often defined as including elements of both human–robot interaction (HRI) and human–animal interaction (HAI). It's worth noting that although HMC does borrow ideas from other fields of study, such as HCI and HRI, it doesn't fully include them. For instance, Human–Computer Interaction (HCI) is a multi-disciplinary study of how people connect with one another via the use of various mediating and communicative technologies [99]. HMC, on the other hand, is concerned with communication issues as they pertain to technology meant to play the role of communicator. Scholars in the Humanities, Arts, and Cultures (HMC) investigate the societal effects of technology by drawing on research traditions that have highlighted the significance of the medium, such as the study of the “medium as message” and the cultural values encoded in technology [266].

6.1 Attitude towards technology

AI, or “artificial intelligence,” is the study of giving computers the ability to learn and make decisions on their own. AI, as defined by Trunk et al. [250], is the process of simulating human cognition and action. To put it another way, AI is a means through which robots may be taught to carry out work traditionally associated with humans [262]. Public perception of AI is becoming more relevant as it relates to the proliferation of AI applications and the likelihood of the technology's

long-term success [95]. By analogy, studies have shown that public opinion may affect both individual decisions and governmental policy when it comes to new technology [159, 274]. Recent polls reveal that Americans are aware of the potential advantages and dangers of artificial intelligence [257, 268]. These polls also show that there is a divide in how people of different political and racial backgrounds feel about AI. However, previous studies haven't given much thought to how various modes of communication can influence public perceptions of AI or how they might work together. The following analysis concentrates on three communication channels that jump out as possible candidates, but there are likely many more that might affect such views as well: science fiction, news coverage, and interpersonal dialogue. Prior studies have demonstrated that each of these elements may influence opinions of other new technologies [8, 28, 93]. In this instance, research demonstrates how narratives found in the media and works of science fiction provide stories for comprehending AI. For instance, audience members may be persuaded by news coverage to see the technology in one of two ways: either as an instrument of advancement or, conversely, as an existential danger to mankind [117]. In a similar vein, science fiction movies and shows on television may either contribute to the idea that AI is dangerous or that it is helpful [74]. Concurrently, for members of the public to make sense of technology, including AI, they may also draw on their own experiences and interpersonal dialogues [241].

6.2 Conceptualizing the role of AI in communication

The use of AI in communication may generally be divided into two areas, according to its conceptual underpinnings: interaction between humans and AI as well as communication mediated by AI [78]. At first glance, this classification may seem like the historical distinction established between computer-mediated communication (CMC) and human-computer interaction (HCI), the two primary domains of communication technology research in our subject. That difference is determined by the answer to a significant query on the "source orientation" locus [61]. Is the computer the endpoint of our communication and the subject of our engagement when people use it (HCI), or does it only serve as a route for communication between several humans (CMC)? Recent advancements in artificial intelligence, notably in the fields of machine learning and natural language processing, have made that prediction a reality [30]. Technology has advanced to the point that machines may be relied upon as trustworthy messengers. As a result, using social norms while engaging with them is not strange, but rather necessary.

The conventional divide between human-computer interaction and computer-mediated communication (i.e., computer as communicator vs. channel) needs revision considering AI's growing involvement in human communication processes. AI is increasingly being used to replace, assist, and/or augment human communicators across a wide range of functional domains and contexts, rather than simply serving as a conduit for message exchanges between humans, with potential consequences for the nature and outcomes of these interactions. As illustrated in Table 1, one possible framework for categorizing AI's contribution to communication involves thinking about (a) AI's function in the communication process (communicator vs. mediator) and (b) the type of communication (interpersonal vs. mass). Like this, the hopes of early CMC researchers about the ability of computers to relay social signals conveyed by human interactants have already been fulfilled, due in large part to the increased fidelity and bandwidth of contemporary communication technologies. To further facilitate this process, AI has taken on the role of our algorithmic personal assistants, reminding us to send social communications (such as birthday wishes through our social network), interacting with us as we type messages, and making edit suggestions [230, 238].

Persuasion is an essential part of communication, but according to [64], AI makes it more difficult to achieve desired results. Their theory is that AI will be able to mask the original source of influence when it is not obviously involved, as is the case with AI-mediated communication (also known as "Thin AI"). Confusion about the source and probable misattribution would have major ramifications for message processing and persuasion results, given the well-documented significance of source-related signals in the persuasion processes. Direct interactions between people and AI are more likely to develop when AI's presence is more obvious on the interface, as in the case of a robot ("Thick AI"). This may influence the paths of persuasion and the elements determining the result of persuasion. This article explores the friction between human and machine agency in the context of corporate communication by claiming that AI algorithms have a mind of their own and are not just tools we use to facilitate our own planning and decision-making. They rely on information that is frequently skewed. The way they work is secretive and influenced by politics. Using the term "relational agency," the authors explain how algorithms are not static entities but rather communicative beings that are entangled with people in a business setting and whose connection with humans is dynamic. Algorithms, in conclusion, are "co-actors in organizations," meaning they work with people in achieving their goals [113]. All of this conjures up the

Table 1 The Interaction between Humans and Artificial Intelligence: A Taxonomy

	Interpersonal (one-to-one)	Mass (one-to-many)	References
Communicator	Chatbot, Virtual Assistant, Smart Speaker are examples of AI Converser	Virtual Influencer, AI Anchor, Robot Reporter considered as AI Creators	[222]
Mediator	Auto-Completion, Auto-Correction, Automated Response Suggestion are AI Co-Author	Content Moderator, AI Fact-checker, Recommendation System are also called AI Curator	[67]

idea of a machine that is always present and sets off a complex dialectic between machine activity and human agency. Such an interagency conflict might be seen as a chance rather than a danger.

6.3 AI-measurements MC's

Several potential variables for describing interventions in Artificial Intelligence-Mediated communication (AI-MC) are shown by the cases (see Table 2). To start, there's the AI agent's level of participation. There is a wide spectrum of suggested alterations, from minor ones (such as phrasing tweaks) to whole new content creation. The medium of expression, whether written, spoken, or visual, is still another crucial factor. Automatic editing tools and filters now in use, such as those used to identify and correct photographs in which the subject is blinking, are steppingstones toward the development of technologies that might make a sender seem more appealing, trustworthy, or comparable to the recipient. It is possible to alter audio files to make the speaker seem more relaxed or authoritative, or even to synthesize completely new speech for a certain speaker. Other methods will be developed to let people create convincingly fake videos of themselves engaging in misleading behaviors, such as weightlifting or dancing. An additional crucial aspect of AI-MC systems is their synchronicity. New developments in real-time audio and video manipulation point toward a future in which synchronous kinds of CMC are mediated by AI. "Filters" for real-time video will soon make it possible for people to alter their looks and emotions during computer-mediated chats in progress. Similarly, the optimization goal for which AI-MC is used can be used to categorize the type of AI-MC. Many purpose taxonomies have been developed to categorize the various purposes to which interpersonal communication can be put. It is possible that AI could be taught to maximize communication for critical social purposes such as projecting a positive image of oneself in social situations. Another critical factor is the extent to which the communicator trusts the AI to act on his or her behalf. Like in the principal-agent model, the human communicator acts as the principal and gives the AI agent some freedom and responsibility. In smart answers, for instance, the principal keeps a lot of control; they get to decide whether to use the recommended message, and they may even edit it if they want to. Personalized and automatic birthday greetings, automated appointment setting, and online dating chats are just a few examples of the kinds of communication duties that future AI systems may be allowed to do without direct human oversight [258]. Finally, the AI agent's role orientation is crucial. While most existing AI-powered communication solutions are geared toward the sender, we expect this to change as more and more people begin to utilize AI at the receiving end. Google Translate acts as a mediator between the sender and the recipient, utilizing artificial intelligence. Other technologies that promise to aid recipients may, hypothetically, include ones that extract social signals [11] or that use real-time speech analysis to identify emotions, dishonesty, and lying [135]. We anticipate that this first set of characteristics will develop as research on AI-MC progresses.

Facebook's "Newsfeed," as well as other content rating, recommendation, and categorization algorithms (email filters, friend recommendations), leverage AI to facilitate human interactions. This level of conceptualization is too broad to provide a practical study framework, so we don't include algorithmic tools that facilitate human communication in a roundabout way. Finally, the social and ethical issues of AI-MC systems become more pressing when they are used in more intimate contexts. Here, we provide an overview of these components. The context of the application further muddies the waters of the agency issue. When employed to increase readability, such as in auto-correct or cross-lingual machine translation, AI mediation enjoys widespread acceptance [251]. It's unclear how much people will embrace AI to help them perfect their public persona. As a result, it is crucial to investigate the settings in which AI-MC is deployed, the objectives it serves, and the reactions it elicits from its senders and recipients. Artificial intelligence and machine translation may also alter the way humans adapt to one another in conversation. Modifying one's conduct to suit the needs of one's conversational partner, or interpersonal adaptation, is essential to any kind of social contact [186]. When AI-MC is introduced, this procedure may be altered or accelerated. What happens when one of the communicators uses AI-MC to propose or generate messages? There is a need for further research into the potential effects of these recommendations and other AI-MC language developments, such as shifts in register (such as gender styles, regional dialects, and ingroup languages used in online groups), politeness, and rudeness.

6.4 Social media

In contrast, AI is "a system's capacity to accurately read external input, to learn from such data, and to apply those learnings to fulfill specified objectives and tasks via flexible adaptation." It was also clarified that AI extends beyond machine learning since it allows for more sophisticated forms of control and manipulation of things based on what the system has learned [169]. "Encoded techniques for converting input data into the intended output, depending on defined

Table 2 Measurements of AI-MC

Parameters	Descriptions	Examples	Reference
Scale/degree	The scope of the modifications AI makes to messages	Difference between proofreading for typos and writing new messages	[3]
Media classification	The channels via which AI functions (e.g., video, text, audio)	Advising textual responses as opposed to altering one's physical presentation in video	[110]
Optimization goal	To achieve this aim, AI is optimizing communications	make a good impression by coming out as handsome, trustworthy, witty, dominating, etc	[116]
Autonomy	How much AI can process communications independently of human input	Sender selects from AI-suggested texts vs AI engaging in dialogue with minimum input from the sender	[1]
Role orientation	Purpose for which the AI is being deployed (e.g., receiver vs. sender)	Receiver: determining if the sender may be dishonest vs. Sender: giving messages to improve reply to effectiveness	[25]

computations,” as the definition of an algorithm puts it [87]. The backbone of every modern computer system is an intricate collection of algorithms, and social media platforms are no exception. In other words, algorithms are the driving force behind the development of the online environment, and as such, they play a pivotal role in determining how interaction, knowledge, and connections are facilitated, blocked, or otherwise managed. In addition, the social media sector has aggressively implemented AI into its algorithms to get consumers to spend more time on these sites [119]. Therefore, the incorporation of AI into social media algorithms has significantly altered the social media user experience.

Since its inception, social media has had a profound effect on how we utilize communication technologies for both production and reception, empowering users to create and distribute content rather than only receiving it. To this end, “active user” or “user agency” [181] has emerged as a central theoretical pillar in the field of communication studies, providing a framework for investigating the methods by which social media users react to content posted online [75]. Using the uses and pleasures theory as an example, research has shown that the primary reasons people use social media are to express themselves and expose themselves to others [138]. In the last several years, AI has been integrated into the algorithms that underpin social media platforms, resulting in dramatic changes in how users engage with and communicate through social media. The “fundamental functionalities of social media applications, notably search, surveillance, aggregation, predictions, recommenders, content development, scores, filtering, and resource allocation,” are all made possible by the AI-based algorithms of social media platforms [276]. Indeed, those fundamental features of social media have been transformed by the introduction of AI-based algorithms. As a result of user preferences and interests acquired through online activity, social media algorithms have developed to create customized newsfeeds for each user. For instance, Facebook’s algorithms analyze the connections between users’ friends and prioritize the appearance of status updates from those users’ closest social connections. Based on the information it has gathered about its users’ preferences, Instagram also presents a list of short video clips (i.e., “recommended reels”) in the center of their Instagram feeds. Research shows that our daily information intake on social media is primarily determined by algorithms powered by artificial intelligence [130, 164].

According to research by Javornik et al. [124], utilizing a face filter satisfies the content-creation and connection-seeking needs of social media users. Lastly, AI facilitates simple networking between people with common interests. AI-based features that promote online networking are becoming common on social media platforms, such as “Who to follow” lists on Twitter and “People you may know” recommendations on Facebook. TikTok’s ranking algorithms, which categorize material based on past user involvement, make it easier for people to bond via shared sadness, as shown by an analysis of posts tagged with the hashtag “#grief” by [236]. For instance, adding a user’s name and/or favorite topics to an online portal site increases the likelihood that they will utilize the site. Increased brand engagement and attachment, as well as favorable brand perceptions, are all results of social media advertising that is tailored to the individual user [77]. Users, however, may rather steer platforms themselves than be directed by automated systems. According to [208], coining the phrase “algorithmic sovereignty,” argued that the algorithm powering today’s most popular social media platforms prevents people from having a say in the algorithm’s ultimate decisions. Because satisfying people’s demand for autonomy is a key psychological factor behind a good user experience with interactive technology, this may be a problem when it comes to adopting algorithm-based social media platforms. Users understand that the Facebook platform is based on algorithms that might affect how they feel and how they see themselves in different contexts. To explain how Facebook users are always trying to make sense of and understand what social media algorithms are and how they operate, she proposed a notion she named the “algorithmic imagination” [46]. Algorithmic imagination was revealed to be the key through which certain Facebook users made their preferences and requirements known to the platform’s algorithms. Past research has mostly focused on examining how the increased user agency made possible by social media increases user engagement. To keep up with the rapid development of social media platforms that include AI technology, we need to investigate the mutual influences of machine agency and user agency on user engagement [197].

6.5 Health communication

Among all methods of nonverbal expression, facial expressions are among the most significant. Confusion, tension, pain, and empathy are all emotional states that may be encoded by facial expressions and are thus very relevant and significant in healthcare communication. Recently, Glyn Elwyn and coworkers have offered a helpful summary of how AI may be used in medical communication education [233]. In a secure and private environment, the authors propose using AI to analyze features of communication, including words and phrases, turn-taking, tone, and style, to give thorough feedback and peer comparison to trainees at regular intervals. In addition, these techniques might be included in formal evaluations of communicative proficiency based on consistent, repeatable, and objective measures. These and

other writers have emphasized the need for developing automated methods that can affordably offer feedback on the communication skills of all health practitioners. There will be more parity in the medical field thanks to these easily replicable communication training courses. Others have advocated for the use of avatars (computerized images of people inside a virtual reality environment), in this case a patient, to practice communication skills, citing advantages over SP interactions in roleplay [92]. When compared to SPs, avatars are easier to build to reflect physical ailments and deformities, have a higher likelihood of being used repeatedly to improve behavior, and offer a safe, private, low-risk setting in which kids feel less threatened [133]. Effective clinical diagnosis, therapeutic decision-making, and the attainment of optimal patient outcomes all rely heavily on the ability to effectively communicate with one another in the healthcare setting. Medical advice retention, self-management of chronic conditions, and the adoption of preventative health practices are all positively correlated with the health care provider's ability to communicate with the patient [187].

Additionally, studies have shown that the clinician's capacity to pay attention to and understand the emotions of the patient may have a significant impact on the patient's psychological and functional results, as well as their experience with and pleasure from the treatment they get [114]. Additionally, the degree to which physicians are comfortable communicating with patients and feel confident doing so may have an influence on their own feelings of professional satisfaction as well as stress and burnout [80]. The danger of getting sued by unhappy patients increases when a doctor has trouble communicating with them. Most litigious patients see their doctors as indifferent, poor deliverers of medical information, and poor listeners, according to a study of plaintiff depositions, which indicated that 71% of malpractice claims were launched due to a fault in the physician–patient relationship [101]. Doctrines such as informed consent, shared decision-making, and patient-centered care were developed in part because of the central role that communication plays in health care, these doctrines are now enshrined in law in many countries, making it mandatory for health practitioners to adhere to these approaches. However, there is solid evidence that the communication abilities of health professionals' range greatly and do not automatically increase with experience and practice alone [83]. Most modern medical and nursing programs, as well as those for specialty trainees in fields like medical oncology and palliative care, include instruction in communication skills as a means of addressing these well-documented gaps in the healthcare workforce. However, some research has shown that the abilities learned in such programs aren't maintained after students enter clinical practice [146]. Training in communication skills should be supported by theory and supported by evidence, and present abilities should be reliably and legitimately measured. In addition, instructors need to provide their students with constructive criticism, and long-term audits of students' abilities should be conducted reliably. This, however, is not a simple task. There are many ways to communicate, including with words, para-verbal cues (such as tone of voice), and non-verbal cues (such as eye contact and facial expressions). It's possible for there to be several people participating in the exchange (doctor, nurse, patient, caregiver), all of whom may have unique perspectives, priorities, skillsets, and needs [96]. Consultations may include a wide variety of activities, such as learning, teaching, deciding, connecting with others, and dealing with feelings. Prognosis, end-of-life care, pain, and infertility are just a few examples of emotionally charged issues that might come up in medical consultations. Consequently, it might be challenging to construct a thorough theory and collect empirical evidence to support training [239] (Table 3).

7 Theoretical framework

7.1 Communication theory

The interactions between humans and artificial intelligence (AI) in the form of virtual agents, social bots, and language-generation software do not easily fit into the established paradigms of communication theory, which have traditionally centered on human-to-human contact [265]. This article is an attempt to bridge the gap between the theoretical foundations of communication and the rapidly developing field of human–machine interaction by outlining the key distinctions between communicative AI and earlier technologies and introducing a theoretical framework from the field of human–machine communication (HMC) upon which to base practical decisions of communication and the rapidly developing field of human–machine interaction by outlining the key distinctions between communicative AI and earlier technologies and introducing a theoretical framework from the field of HMC upon which to base practical decisions. Communication scholars will need to work together more closely in the future as artificial intelligence (AI) technologies take on communication roles traditionally reserved for humans. This is because understanding the nature of these interactions and their larger implications for society and public life will require a wide range of theories and concepts. We use an HMC framework to lay out a plan for future research into three important areas of communicative AI technology: (1)

Table 3 Theories and model

Name of Theories & Models	Description	References
Communication Theory	Relational dynamics, Functional dimensions, Metaphysical implications	[265]
L-LDA Model	Text and codes to predict codes in psychotherapy	[43]
Routine model	Four stages for customer engagement of social media (1) social media engagement, (2) types of engagement, (3) dealing with engagement, (4) closure of engagement	[91]
Neural network model	Uses a "bootstrap" approach to effectively solve the problem of gradient disappearance when the deep learning network is too deep	[50]
Persuasion Theory	(1) Thin AI exhibits, (2) Thick AI exhibits, AI presence is obvious, and communication is direct and interactive	[64]
Social exchange theory	Revealed the mediating mechanism (perceived warmth and perceived competence)	[271]
Frames of mind	Examines the public's perception AI	[39]

the practical axes along which users of these tools for communication make sense of them; (2) how people's connections to these tools affect their relationships with others and themselves; and (3) the philosophical ramifications raised by the fuzziness of the distinctions between what makes a person, a computer, and communication. The functional, relational, and metaphysical aspects of this agenda, although each deserving of a separate work, were not our primary focus in this discussion. Rather, we aimed to provide researchers with a broad overview of the implications of communicative AI for the study of communication. As AI communication technologies are still in their infancy, they serve as the foundation for the research agenda presented here. This goal will undoubtedly be further honed when new important aspects are found as technology develops. We wish to emphasize that none of the components of HMC are independent; rather, they are interwoven, just as the relational, functional, and metaphysical components of human communication are. Therefore, communication researchers will have to contend with both more general concerns about the relationships between each topic as well as more ones within each one [99].

7.2 AI-based persuasion

The persuasiveness of AI systems is the medium of transmission between humans and persuasive AI [129]. Persuasive AI in AI-based persuasion must have some involvement in message production [155], such as creating the complete message, adapting a message shell for various listeners, or filling out a message template [260]. According to Dehnert and Mongeau [64], the Computers Are Social Actors (CASA) paradigm, the Modality, Agency, Interactivity, and Navigability (MAIN) model, and the heuristic-systematic model of persuasion are all effective theoretical approaches for investigating AI-based persuasion. To begin, thin AI shows little to no machinic (i.e., AI) signals, social cues may be provided, and communication is restricted and indirect. Second, thick AI provides many mechanical and social clues, makes its existence known, and engages in open, two-way dialogue. It's possible (but not certain) that the persuading AI will also be responsible for sending the communications to their intended audiences.

Some sets of social cues in the HMC may start a behavioral and cognitive script when they are regarded as social signals [27]. Then, focusing on signals, heuristics, and scripts, we offer two ways to understand AI-based persuasion: the MAIN (Modality, Agency, Interactivity, and Navigability) concept and the idea Computers Are Social Actors [184, 242]. With CASA, researchers in the field of AI-based persuasion may examine the ability of AI-based sources and the social signals they create (in addition to persuasive messages) to activate heuristics and scripts. This objective is in line with the recent trend in the literature on computer-mediated communication away from focusing on specific platforms like Facebook or TikTok and more on the broader effects and affordances of these and other similar platforms [2, 129]. Focusing on affordances, (Sundar 2008) MAIN model classifies human-machine interaction heuristics into four broad categories: modalities (M), agency (A), interactivity (I), and navigability (N). The affordances of agency and interaction are especially important for AI-based persuasiveness. The agency advantage takes advantage of the difficulty of determining who is responsible for a piece of internet communication. The social signals that allow for natural dialogue between humans and AI are the primary emphasis of the affordance of interaction.

This error in attribution is probably brought on by the fact that communications produced by thin AI include very few mechanical signals but might contain many social cues [99]. However, unlike the artificial entities that created the message, these social signals lead directly to a specific individual or group (Ault et al. 2017). As a result, social signals are deceptive and might mask the origin of an issue [86]. In this paper, we argue that the advent of AI necessitates a fundamental reappraisal of the nature and limits of persuasion, as well as the impact that individual differences, context, and sociotemporal dynamics have on how people perceive and respond to AI-based persuasion [57].

7.3 Social exchange theory

Since AI technologies are becoming more commonplace in the hotel and tourism sectors [161], the emergence of the phenomenon of AI service failure [47] is worthy of empirical investigation [158]. As Pitardi et al. [202] uses six scenario-based tests to confirm why and how hilarious answers from AI agents improve consumers' tolerance of AI service failure. Additionally, this research contributes new information to the field of humor research in tourist service marketing by investigating the restorative power of laughter in the context of artificial intelligence and its interaction with customers. Third, this work develops an integrated theoretical model of AI service recovery based on social exchange theory, which reveals the mediating mechanism underlying the influence of hilarious reactions on customer tolerance.

According to the theory of social exchange, consumers' propensity to engage in social exchange is influenced by their estimations of the utility they would get from the transaction in question [172]. Motivation might come from inside or

from outside [179]. This research employs the concepts of competence and warmth to demonstrate the mental processes clients go through while interacting with hilarious AI agents, given that these agents are imbued with human-like traits. By analyzing the impact of a hilarious answer on customers' tolerance, we were able to isolate the moderating role played by two aspects of the customer's experience that are essential to social exchange theory: their perceptions of the seller's warmth and expertise [38]. The results of this study explain how a funny answer might have a beneficial impact on customer tolerance by showing that the connection between the two is mediated by customers' perceptions of the business's warmth and expertise [235]. Customers are more forgiving of service failures if they feel that the businesses care about them and are competent [193]. Because of this method, a unified theoretical model for restoring AI services has been developed [216]. This research solidifies the promise of social exchange theory as a means of illuminating complex tourist phenomena in human-AI interaction and extends its application to the context of service failure and recovery in tourism. Because of this, clients who have been immunized benefit more from the amusing replies provided by AI agents.

7.4 Frames of mind

By expanding theoretical models of communication and attitudes toward new technologies, this research contributes to our understanding of the factors that influence public perception concerning artificial intelligence. This article examines the public's perception of artificial intelligence (AI) by applying framing theory [70, 149] to the ways in which the news media influence readers' perceptions of AI and the beliefs and attitudes of those who consume the news. This research expands on prior work that has examined the ways in which exposure to certain media genres [39, 139] and conversational exchanges [5, 55] might affect perspectives on science and technology.

The research, based on framing theory [85, 223], looked at how the general population framed AI using their own words. Open-ended responses were analyzed to reveal that many respondents approached AI from a scientific or technological perspective. The social development frame, which portrays AI in a favorable light, and the Pandora's box frame, which portrays AI in negative terms, were both often cited by respondents as examples of the frames used in news coverage. Subsequent research has expanded on a reinforcing model of interpersonal influence [128, 232] to suggest that, when media signals about upcoming technologies are generally favorable, talking about science and technology ought to strengthen support for such technologies. In addition to the demographic factors, science fiction consumption was also accounted for in the model as a possible source of media signals regarding AI. The model included key communication variables such as exposure to technology-related news, science fiction viewing, and technology-related conversation, as well as background factors that may predict attitudes toward artificial intelligence, such as whether the respondent mentioned a science fiction portrayal.

The findings corroborate two of the study's hypotheses about the indirect linkages between the frames people employ to think about technology and their attitudes about artificial intelligence. The results imply that public perceptions about AI, and hence the long-term viability of the technology, may be influenced by messages from media producers and informal conversation. Support for AI may be increased by offering frameworks for societal progress [182]. When considering the total impact of technology news consumption, respondents who carefully followed such news were more likely to declare their support for AI during the time it was discussed and to show a favorable shift in that support. Additionally, both the consumption of science fiction and social interaction might undermine support for AI. Therefore, it is crucial for researchers and communicators to consider how news is framed, how science fiction is portrayed, and how people interact with one another as influences that not only shape one another but also take place within a larger framework of communicative and cultural forces.

7.5 L-LDA model

The ability to effectively communicate has a significant influence on the results for both patients and physicians but is difficult to analyze and educate. Due to the high cost and long turnaround time of human-based coding and auditing systems, there is growing interest in applying AI to these processes by means of machine learning, namely supervised and unsupervised learning algorithms [264]. In their introduction to health communication, [43] discuss its significance for patient and healthcare professional outcomes as well as the necessity for reliable empirical evidence to support this discipline. The use of artificial intelligence (AI) to automate interaction coding in the health environment has recently made progress, which is also discussed.

In a study, [226] patients with advanced cancer were analyzed; this research was conducted by Durieux et al., who listened to audio recordings of their first three meetings with palliative care providers. Using a machine learning technique,

the researchers were able to pick out a single, easily identifiable trait: pauses, which were then manually coded to determine whether they were connective silences (which are seen as reassuring, encouraging, and safe). The investigation's findings revealed that the machine learning technique was somewhat too dependable and failed to detect any instances of connective silences [72]. Similarly Mayfield et al. [168] conducted a similar study, comparing machine learning to human coding of 415 audiotaped normal HIV outpatient visits. They used machine learning to teach a system to distinguish between information-giving (doctors) and information-requesting (patients) speech activities, and then they determined the ratio between the two. There was a fair degree of consistency between automated and human coding, and the ratio of information predicted by machines and humans was well correlated. In a larger study [89], investigated whether machine learning could be used to classify psychotherapy sessions based on the topics (161 potential codes) and patient symptoms (48 possible codes) stated during the sessions. A group of six graduate students also evaluated the representativeness of the symptoms.

The authors compared the abilities of a baseline lasso regression model and the semi-supervised machine learning labeled latent Dirichlet allocation (L-LDA) model to predict codes in psychotherapy sessions, learn associations between text and codes, and identify specific passages of within-session text that are representative of a session code. The L-LDA model may one day serve as an accurate automated coding system for psychotherapy sessions, according to the authors' analysis. It obviously has potential, but more work must be done to apply these discoveries in the real world to establish their usefulness.

In contrast to the theoretical framework that can direct the creation of AI analysis algorithms, unsupervised learning is unrestricted in its pursuit of patterns that optimally distinguish participants known to vary on important outcomes, which may lead to the discovery of previously unrecognized behavioral determinants of communication. The intriguing communication research conducted by Epstein and colleagues in the setting of stage 3 and 4 cancers recently employed this method [226]. This team examined 122 patient-oncologist encounter transcripts as well as post-visit patient evaluations of the doctors' communication skills. To automatically forecast whether a doctor-patient contact will have a high or low patient satisfaction rating, they utilized machine learning models and AI unsupervised grouping of conversation characteristics into "styles." This result contradicts communication theories that would suggest patient comprehension and joint decision-making would be facilitated by certain behaviors. The authors draw the conclusion that more study is necessary to learn more about the situation, as well as patient and physician variables that may have an impact on these findings. It is obvious that the use of AI and machine learning in the communication between health professionals is a new subject with a lot of room for growth. Such limitations are addressed, and the stigma associated with requesting practice or assistance to improve communication is removed through an AI-driven training system that is accessible anytime and wherever.

7.6 Integrated routine model

Since businesses are using social media (SM) more often, it is still difficult for businesses to effectively communicate on SM in the digital age. About artificial intelligence (AI), this paper examines the many social media interactions that businesses have and suggests a paradigm that has been experimentally verified. A model emphasizing the prompt, effective, and efficient response to client inquiries on social media is being developed with AI integration. The phrase "Artificial Intelligence Integrated Routine Model" The three processes in this routine's four-stage paradigm are as follows: Social media engagement The Variety of Participation, Managing Commitment, Concluding the interaction) between the customer's social media interaction and the proper follow-up [91]. This research demonstrates that SM improves enterprises' digital skills, motivates individuals and organizations to study digital marketing, and fills a knowledge vacuum about the "microfoundations of SM usage," a term defined by Ray Chaudhury in 2021. At the granular level of SM implementation, AI handles each client separately, and we propose a set of procedures and practices based on the principle of customer equality [6]. A significant percentage of SM use is often driven by companies' need to strengthen relationships with and better communicate with their clientele [68]. Customer loyalty, contentment, equality, commitment, connection, trust, inspiration, and intimacy are all positively impacted by open lines of communication that are effectively addressed and closed [76, 183, 190]. Having regular interactions with consumers is a great way to bond with them.

7.7 Neural network model

Rapid progress in AI technology is now being implemented throughout all of civilization [12]. As current science and technology continue to advance, so too will the rate at which digital media may transmit knowledge and the variety

of available channels of expression [156]. For digital media art to continue growing and innovating, designers need to push the medium's boundaries [121]. This will allow for works to take on traits like intelligence [97], networking [94] and content diversification [171] making them more useful in today's digital communication and opening exciting new possibilities for visual art [31]. As Chen [50] suggests a system that is based on the convolutional neural network as he examines the fundamentals of the development of the core of the mutual integration of artificial intelligence technology and digital media art. The primary contributions are an algorithm for digital and multimedia art creation based on a convolutional neural network, a framework for a neural network model, and a method for extracting creative styles for fusing with mundane photos.

One of the most useful tools for creating computer graphics that aren't meant to be realistic is the skill of converting digital styles to multimedia formats [60]. In the field of texture synthesis, preexisting nonparametric algorithms may resample the pixels of a given source texture to generate synthetic natural textures that look remarkably like the originals [4, 178]. Most previously developed texture transfer algorithms make use of these nonparametric approaches for the purpose of texture generation while using other methods to maintain the structure of the target picture [150]. To achieve texture transfer (also known as style transformation) while maintaining the destination image's semantic information, [50] employed a deep convolutional neural network to build a generic feature representation. The "bootstrap" method is used in the generative network model that is used in the art of integrating digital and multimedia style networks [136]. This strategy is used to successfully handle the issue of gradient disappearance that occurs when the deep learning network is too deep [151, 154]. A further advantage of building the network with the residual layer is that the residual layer has a faster training speed than the general convolutional layer does, despite having the same convolutional effect. This is one of the reasons why using the residual layer to build the network is advantageous [205, 247].

They can employ the enormous processing power of artificial intelligence to help them use historical big data to extensively study human demands [272] support people in solving practical issues via design, and use data to gain design thinking [107]. People will be driven to passively accept new items [192] new technologies [191] and new forms of digital life because of the extraordinarily rich and diversified nature of the global information that is already available [115, 176]. Because there has been a lack of thorough investigation into how to properly categorize existing multi-class art images, this study proposes a solution based on convolutional neural networks that both addresses this issue and yields superior classification results for such images compared to existing network models and more conventional approaches [50]. Traditional designers will be pushed out of business by intelligent robots as AI continues to advance, therefore, it's imperative that they take stock of the situation, make necessary changes, and become better before it's too late [34, 44]. The accuracy of art image classification and the effectiveness of network model classification will be further enhanced in the ensuing work as we optimize the art image classification network model, increase the art image sample library, and extend the art image classification sample set.

8 Discussion and conclusion

As [26] analyzed how AI may be used to combat issues like hate speech and misinformation in the public sphere. Scholars in the field of communication are obligated to assess the usefulness and applicability of previously established theories and research findings, as well as to propose new ones, when necessary, considering the rapid and seemingly fundamental shifts in how communication is carried out. When AI is tightly integrated into mediated communication, it may either bring up new problems or make current ones worse. One example is the "authenticity crisis" in communication that was brought up by [48] who were concerned about the growing role of AI in the creation and distribution of information online in the form of deepfakes and message bots without it being fully understood by the public. As technology evolves from mediators' people who speak to communicators people who communicate with each other simultaneously academics in the field of communication face both theoretical challenges and theoretical opportunities. As we have outlined, the primary difficulty lies in the fact that communicative AI departs from the traditional role of technology in communication theory, which has been founded on ontological assumptions based on anthropocentric definitions of communication in terms of both its physical appearance and its human interpretation. Things perform numerous social functions, and humans often give them agency and even personality, not only computers. Therefore, it is necessary to reevaluate the significance of various agents, including but not limited to AI, in the context of the conversation. HMC researchers are tackling this issue head-on by considering new uses for existing technologies. It is important to note that the constituent parts of HMC are not independent from one another, rather, they are connected in the same way as the practical, social, and philosophical dimensions of human communication are. Scholars in the field of communication

will therefore need to grapple not just with narrow concerns within each domain but also with more general ones about the interrelationships between them. Artificial intelligence may aid viewers in determining if a technological picture is threatening or not [39]. The technology being used (e.g., where it falls on the thick-thin continuum), the organizational source (real or claimed), the receiver's HMC history, their HMC and/or AI-based heuristics and scripts, and their attitude towards AI are just a few examples of the many mediators and moderators that will likely affect how persuasive AI is perceived and what it can accomplish. When researching AI-based persuasion, it is important to consider both individual variations and environmental influences [220]. In addition, as the relationships between people and robots continue to evolve, the HMC scripts will also undergo shifts [84]. At last, one assertion we can make with certainty is that AI will continue to develop at a rapid pace. There will be significant differences between the AI of 2022 and the AI of 2025, 2030, and beyond. As a result, AI forces us to reconsider how personality, environment, and socio-temporal dynamics influence how people understand and respond to AI-based persuasive interventions.

In addition, keeping up with technological developments via news outlets was a moderating factor in the connection between tech discussion and evolving attitudes about AI. This symbiotic relationship is in line with a positive feedback loop model of interpersonal effect on attitudes toward developing technologies [118]. When talking about these technologies increases support, as is often the case when the media is reporting positively on them. It's possible that people's favorable social progress frameworks regarding AI were formed via their exposure to technology news. The way the news is framed influences how people interact with it and whether they support new technology [73, 106]. However, AI also has the potential to enhance human communication by enhancing our innate capacity for interpersonal communication and enhancing the opportunities for such interactions through CMC channels. There is no doubt that this growing subject of AI and machine learning in health professional communication has a lot of room for growth. An AI-driven training system that is accessible whenever and wherever is developed to overcome these limitations and remove the stigma associated with asking for practice or assistance to improve communication.

People will passively accept new goods, new technology, and new ways of living their digital lives because of the incredibly rich and diversified nature of the information that is already available on a worldwide scale. Art designers need to look at the shifting periods with their own knowledge to experience the difference in the lives of people throughout different eras so that they may conduct in-depth research on the aesthetics and wisdom of digital media design. Despite this, user agency and machine agency were able to influence one another, which resulted in user–AI synergy. The users consciously affect the algorithms that curate the information to make it cater more exactly to their requirements; AI also promotes the users' content production and networking. The partnership between AI and users on TikTok has a huge impact on the platform's medium engagement as well as its social-interactive engagement. Friendship between humans and AI might facilitate profound relationships and in-depth dialogues rather than shared experiences. Additionally, it may be accessed at any time and in any location, unlike human friendship. Distinct digital settings allow for different conceptualizations of friendship, and this view of human-AI friendship compares with that of the human–human relationship [219]. In today's digital world, businesses utilize social media as a valuable resource and integral part of their marketing plan to provide a better experience for their clientele. This strengthens a company's marketing capacity. Convergence in social computing and communication will allow IoT devices to use social context to enhance service provision and content personalization. The SM's microfoundation drives companies' repetitive customer-focused behavior on SM. As a result, the company and the user develop a consistent routine because of this behavior. As the company's reputation as a customer-focused enterprise grows on SM, the corporation takes on more responsibility and feels more pressure to maintain this stance. From the user's point of view, a company's demonstrated commitment to catering to their needs inspires admiration, which may pave the way for the user to develop a preference for engaging with the company routinely through SM on their smart devices.

9 Future directions

Future research might investigate the many forms and degrees to which machine agency is deployed throughout the affordances of social media, as well as how this agency evolves in response to interactions with human agency. There must be a more concentrated effort by communication experts, relying on a wide range of ideas and concepts to describe a complex phenomenon as AI devices progressively take over communication functions formerly performed by humans. Studies may look at how SM usage varies by industry and company type, which provides valuable context for examining the underlying microfoundations of these trends. Second, how authentic computerized feedback is for learners and whether machine learning can effectively portray the intricacy of health professional–patient dialogue need more

study. Academics and communicators must consider how news framing, science fiction portrayals, and interpersonal interactions affect each other and other communication and cultural aspects. Third, more study is required when AI-MC is seen as either a filter on human representation or an independent social actor. The second premise is that there will be a difference between results and performance before and after the adjustment. An academic study might focus on societal issues, including the effect of different types of human-AI relationships on AI-based persuasion. The way in which various cultures see and react to one another may be a major factor in determining the nature of. Some examples of ethical concerns include the appraisal of the degree of openness, Legal issues may investigate the role of AI-sources in terms of persuasive authorship, agency, and liability (for example, in the context of fake news). It's possible that questions of politics and psychology might shed light on the specific characteristics and contexts that can limit the persuasive power of AI stimuli.

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Data availability The data associated with this study have not been deposited into a publicly available repository, However, they will be made available on request.

Declarations

Competing interests The authors declare no competing interests.

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