Memory, Mind & Media (2024), **3**, e6, 1–17
doi:10.1017/mem.2024.2

MMM
Memory, Mind & Media

RESEARCH ARTICLE

Shall the robots remember? Conceptualising the role of non-human agents in digital memory communication

Mykola Makhortykh

University of Bern, Bern, Switzerland
Email: mykola.makhortykh@unibe.ch

Abstract

The rise of digital technology has led to fundamental changes in how individual and collective perspectives on the past are transmitted and engaged. An immediate implication of these changes relates to the shift away from human communication as a single form of communication about memory towards multiple models which involve non-human (or robotic) agents. These non-human agents are primarily constituted by artificial intelligence (AI)-driven systems, such as search engines and conversational agents, which retrieve information about the past for human users and are increasingly used to generate memory-related content. To account for the growing complexity of memory-related digital communication, the article introduces three agency-based models of such communication: (1) human-to-human; (2) human-to-robot; and (3) robot-to-robot. It discusses examples of communication practices enabled by these models and scrutinises their implications for individual and collective memory transmission. The article concludes by outlining several directions for memory communication research increasingly shaped by non-human agents.

Keywords: digital memory; artificial intelligence; communication; robot; remembrance

Individual and collective remembrance have long been associated with communication between humans perpetuated by the different forms of media (e.g. printed, broadcast, or digital). Contemporary memory-related communication is shaped by online platforms ranging from crowd-sourced encyclopaedias and social media to messengers and digital archives and encompasses diverse practices which deal with the exchange of information about the past states of individual and collective entities. A number of memory theories, such as cultural memory (Assmann 2011), prosthetic memory (Landsberg 2004), post-memory (Hirsch 2008), and media memory (Neiger *et al.* 2011), acknowledge the growing reliance of individuals and societies on (mass) media for storing and transmitting memories. However, such acknowledgement does not challenge the underlying assumption that human agents play a central role in the context of communication about the past (Makhortykh 2023b). This human-centric approach is also characteristic of the recent memory-related theoretical frameworks, such as the memory of the multitude (Hoskins 2017b) or multidirectional memory (Rothberg 2009), which aim to account for the disruptive transformations caused by digital technologies and the shift of memory practices towards online networked environments.

While the current emphasis on the human agency in remembrance is not unjustified, it does not account for the increasing presence of non-human – or robotic – memory agents.

For defining robotic agents in the context of memory communication, the article relies on the broad conceptualization of robotic memory introduced by Shur-Ofry and Pessach (2019), who argued for it to include memory-related activities of both material robots and of virtual AI systems. The robotic agents are constituted by automated systems which are capable of retrieving and generating content dealing with the past and are increasingly powered by artificial intelligence (AI). Defined by Nilsson (1998) as the ability of human-made artefacts to engage in intellectual behaviour, AI has become an integral component of major online platforms and, through them, robotic agents curating memory-related information. The diversity of AI technologies and their applications (e.g. content generation using foundation models or content moderation using automated detection of offensive and harmful content) is reflected by robotic memory agents. These agents encompass a diverse range of systems, including search engines (Makhortykh *et al.* 2022), recommender systems (Prey and Smit 2018), editing bots (Ferron and Massa 2011), and conversational agents (Kansteiner 2022).

In the context of memory communication, robotic agents are usually seen as reactive entities which are involved in communication under human supervision, with humans initiating the communication with them and then evaluating its outputs. Communication between human and robotic agents is often realised via platform-specific user interfaces. An example of such communication is a human user asking Bing Chat (also known as Copilot), a generative AI-based system from Microsoft which utilises the Generative Pre-trained Transformer (GPT) models developed by OpenAI to retrieve a list of suggested information sources about the Holocaust. Generative AI is the colloquial name of models capable of synthesising data in different formats (e.g. image, text, or sound; Epstein *et al.* 2023). The ability to produce new content instead of retrieving already existing content is a major distinction between earlier forms of non-generative AI primarily used in the field of information retrieval (Boughanem *et al.* 2020). However, memory communication is also happening between robotic agents themselves without the immediate supervision of humans. In the example above, such communication would happen in the backend of the Bing Chat, where the text generation model has to make a request to the Bing search engine to acquire recommended information sources.

The importance of robotic agents in memory communication is attributed to the fundamental changes in individual and collective remembrance caused by digital technologies. One major consequence of this digital (Liebermann 2021) or connective (Hoskins 2011b) memory turn is the unprecedented increase in the volume of memory-related content that prompts the need for robotic agents to help human users navigate and organise this content. Distinguished by their ability to process large volumes of data quickly and to customise their services for specific individuals based on their preferences, robotic agents become memory gatekeepers who decide what information about the past is available and accessible for the platform users.

In recent years, however, the role of robotic agents has gone beyond (re)distribution and (re)activation of memories in response to explicit and implicit signals from human users (Makhortykh 2021b; Prey and Smit 2018). In addition to curating and organising memories through communicating with human users, robotic agents increasingly exchange information about past states of human and non-human entities with each other. Considering that the transmission of such information can be viewed as a form of remembrance on its own, it enables new forms of memory communication. These forms are distinguished by the decreasing presence of humans in the memory communication loop with such communication not being initiated exclusively by humans anymore and occurring not under human supervision. In a way, this lack of human supervision in memory communication is similar to the human-out-of-the-loop military systems as discussed by Citron and Pasquale (2014).

https://doi.org/10.1017/mem.2024.2 Published online by Cambridge University Press

To account for these complexities, the article proposes a conceptual framework composed of three models of memory communication: (1) human-to-human; (2) human-to-robot; and (3) robot-to-robot. The framework is based on the agency of communication actors and aims to advance critical perspectives on (digital) memory communication research by bridging it with theoretical insights from science and technology studies (e.g. van House and Churchill 2008) and algorithm/AI studies (e.g. Esposito 2017). The framework also takes into consideration recent empirical inquiries into the performance of robotic agents in the context of memory communication (e.g. Makhortykh *et al.* 2021; Zavadski and Toepfl 2019). To introduce the framework, the article discusses communication practices enabled by each of the three models together with their implications for memory transmission and concludes with outlining directions for the memory communication research agenda.

Human-to-human memory communication

Human-to-human communication is the default model of human interactions with the past. It incorporates a broad range of communication practices dealing with the transmission of memory on the individual and collective levels (e.g. Hume 2010; Neiger *et al.* 2011). Intergenerational interactions between individuals aiming to preserve family stories (Erll 2011; Jones and Ackerman 2018) and interpersonal exchanges involved in the production and sharing of witness testimonies (Kraft 2006) are examples of such transmission-focused practices. Other examples include institutionalised communication from and within memory institutions, such as archives and museums (Ernst 2015; Gruenewald 2021) or the exposure to narratives about the past via mass media. The latter exposure can happen through a multitude of formats varying from documentaries (Ten Brink and Oppenheimer 2012; Waterson 2007) to fiction movies (Grainge 2003; Kilbourn 2013) to journalistic stories (Zelizer 2008; Zelizer and Tenenboim-Weinblatt 2014).

The rise of digital platforms has dramatically changed human-to-human memory communication (Garde-Hansen *et al.* 2009; Hoskins 2017a). The impressive diversity of communication practices has expanded to accommodate new formats for transmitting individual and collective memories defined by platforms' infrastructural affordances and community practices (see examples below). Despite their diversity, these new formats had one thing in common, namely the relatively low costs of producing and sharing content that made participation in memory-making more accessible. The lowered participation barrier has expanded the range of individual and collective actors involved in memory-making, enabling the 'democratisation' (Blackburn 2013, 431) of remembrance and communication related to it.

The digital turn has been accompanied by a growing variety of human-to-human communication memory practices. These practices are embedded in the architecture of the platforms hosting them and range from collaborative history-writing via online encyclopaedias (Luyt 2015; Pentzold 2009) to spreading history-related Internet memes (González-Aguilar and Makhortykh 2022; Khoruzhenko 2020). Other examples include making (audio)visual tributes to the past in the form of videos (Gibson and Jones 2012) or E-cards (Makhortykh and Sydorova 2022), establishing interactive digital memorials (de Bruyn 2010; Maciel *et al.* 2017), or emotionally engaging with the traumatic past via digital self-representation at atrocity memorials (Bareither 2021).

A particularly interesting example of human-to-human digital memory communication is Wikipedia, which has been referred to as the largest work of digital history (Rosenzweig 2006). Wikipedia covers many historical and recent memory-related subjects, ranging from the large-scale armed conflicts in the 20th century (Makhortykh 2018; Smith and Lee 2022) to biographies of historical personalities (Jatowt *et al.* 2016) to recent

https://doi.org/10.1017/mem.2024.2 Published online by Cambridge University Press

terrorist attacks and revolutions (Ferron and Massa 2011; Pentzold 2009). The broad scope and diverse communicative functionalities of Wikipedia illustrate both the possibilities and risks of the digital forms of human-to-human communication. By letting encyclopaedia's users to rework and update its articles, Wikipedia enables memory prosumerism, where users can both consume information about the past and produce it for the larger public. Introduced by Toffler (1980), the concept of prosumption refers to the merge between the roles of a producer and a consumer. In the context of digital media, it is often exemplified by the rise of user-generated content, where platform-based affordances allow individuals to not only consume but also generate content items (Ritzer *et al.* 2012). The same principle applies to collective memory, where the growing connectivity between memory actors has bridged the gap between the production and consumption of memory-related content (Hoskins 2011b). At the same time, this potential for democratising memory practices is challenged by the power relations which guide the process of memory-making on Wikipedia and are often used by the power editors to silence alternative views on the past (Dounaevsky 2013). The concept of a power editor is used to denote small groups of Wikipedians responsible for the majority of edits within the encyclopaedia that makes the content production on Wikipedia similar to the power law distribution (e.g. Panciera *et al.* 2009).

There are several important implications of the digital turn for human-to-human memory communication. The first of them is the increased connectivity between the different groups involved in the production but also consumption of memory (Hoskins 2011b). This connectivity enabled by platforms accelerates the processes of generating memory-related content, blurs the line between private and public remembrance (Hoskins and Halstead 2021), and intensifies communication about the past. The intensification is attributed to several factors. One of them is the built-in platform affordances, which encourage user engagement such as discussion pages on Wikipedia used to facilitate collaborative history-writing (Makhortykh 2017; Pentzold 2009) or review sections on TripAdvisor allowing users to share their opinions on memorial sites (Moskwa 2021; Wight 2020). Another factor is the general ease of making such content in digital formats that facilitates the process of constructing (counter)narratives and then sharing them with the public in different formats (Brown and Tucker 2017; Makhortykh and Sydorova 2022).

The increased connectivity of memory communication, in theory, makes the process of transmitting memories (especially the ones related to the collective perceptions of the past) less top-down and more accessible for individuals. In practice, many digital communication practices tend to reproduce pre-digital institutional practices with limited possibilities for user participation (e.g. by sticking to the typical "broadcast" model of communication; Walden 2022a, 33) or are disproportionately influenced by a few influential individuals (e.g. as in the case of Wikipedia; Grabowski and Klein 2023; Kaprāns 2016). However, connectivity still enables more possibilities for discussing and challenging established memory narratives that lead to bifurcation between institutional and public memory cultures (Walden and Makhortykh 2023). As a result, intense contestation becomes an important feature of memory communication, as shown by the growing recognition that digital platforms often become the arenas for discursive confrontations about the past (i.e. web wars; Rutten *et al.* 2013).

The second implication of the increased connectivity of memory-related communication relates to the transition towards the 'post-scarcity' (Hoskins 2011a, 269) memory ecosystem. This transition is characterised by the expansion of the range of actors actively involved in memory-making, together with the decreased costs of producing and sharing memory-related content. These decreased production costs result in the unprecedented availability of information about the individual past due to the intense use of technology

https://doi.org/10.1017/mem.2024.2 Published online by Cambridge University Press

to capture specific moments of one's life (e.g. via digital photos or videos; Makhortykh 2021a; Van Dijck 2008) and the extensive number of resulting digital traces (Mayer-Schönberger 2011). Similar processes are ongoing in relation to the collective past, where heritage institutions intensify their effort in digitising collections and producing new digital-born materials, whereas non-institutional actors use new forms of digital content to comment on the narratives promoted by the institutions.

Under the post-scarcity conditions, memory communication is subject to two processes which seem to be orthogonal to each other. On the one hand, the availability of memory-related content and the possibility for its active generation, together with the limited ability to fully remove undesired content after it has appeared online (Mayer-Schönberger 2011), limit possibilities for individual and collective forgetting. On the other hand, the abundance of memory-related content causes the dependency on technology for preserving and retrieving this content, resulting in the shift from conscious and active human remembrance towards robotic agent-driven mechanisms for storing and remembering the past (Hoskins and Halstead 2021). This shift towards mechanical 'grey memory' (Hoskins and Halstead 2021, 676) prompts the shift from human-to-human to human-to-robot memory communication discussed below.

Human-to-robot memory communication

In addition to fundamentally transforming how human-to-human memory communication works, the digital turn also resulted in the rise of human-to-robot communication. Unlike human-to-human communication, where interactions about the past happen between human agents, human-to-robot communication involves both human and non-human agents. In most cases, human agents are responsible for initiating the communication (e.g. by providing input in response to which the robotic agent generates the output). However, under certain conditions, the direction of communication can be reversed, resulting in robot-to-human communication (e.g. where a bot removes the human edit dealing with the Holocaust on Wikipedia).

The reasons behind the growing importance of human-to-robot communication are related to the growing availability of memory-related content due to the digital turn, which shapes the current state of human-to-human memory communication. Under the post-scarcity conditions, where memory prosumers utilise platform affordances to store the unprecedented volume of content, there is a growing need to rely on automated systems to help human users retrieve such content and make sense of it (Hoskins and Halstead 2021; Makhortykh 2021b). With human curation being unfeasible due to the overwhelming amount and diversity of available content, robotic memory agents become integral means of preserving the past both on the individual (Prey and Smit 2018) and the collective levels (Zucker *et al.* 2023).

Possibly, the most common form of human-to-robot memory communication involves individual interactions with AI-driven information systems which retrieve content in response to user queries. Two examples of such systems are web search engines such as Google or Yandex (Urman *et al.* 2023; Zavadski and Toepfl 2019) and recommender systems such as Facebook Memories (Prey and Smit 2018). These systems are increasingly adopted both by commercial (e.g. Prey and Smit 2018, Urman *et al.* 2023) and institutional platforms (e.g. Heard *et al.* 2006) to prevent users from feeling lost due to the abundance of content and help them retrieve information which they are looking for. For this aim, information retrieval systems rank available content items in response to user queries to prioritise sources (e.g. documents, posts or web pages) that the system views as the most relevant for the query. More advanced systems can also personalise content selection by

https://doi.org/10.1017/mem.2024.2 Published online by Cambridge University Press

learning about user information preferences (e.g. via the earlier history of interactions with the system).

Besides established forms of communication which rely on non-anthropomorphised interfaces of information retrieval systems, namely interfaces which do not enable information retrieval via human-like conversational exchanges as, for instance, done by conversational agents, such as chatGPT, the advancements in the field of AI contribute to new forms of human-to-robot communication. These forms are characterised by the higher degree of anthropomorphisation of robotic agents: either in the appearance (e.g. when a robotic agent looks similar to a human as in the case of holograms; Shur-Ofry and Pessach 2019; Walden 2022b) or in functionality (e.g. when a robotic agent has communicative capabilities similar to the ones of a human as in the case of conversational agents powered by generative AI models; Kansteiner 2022; Makhortykh *et al.* 2023).

The first major implication of the rise of human-to-robot memory communication is the growing importance of AI-driven systems as memory actors. By becoming responsible for the organisation and retrieval of information in response to human queries, these systems effectively decide what information sources and what interpretations of the collective past gain more visibility and, thus, shape how this past is remembered (Makhortykh 2023b). Such an impact is particularly pronounced for the general public, members of which often rely on information retrieval systems such as search engines or conversational agents to acquire information about a specific historical event or a personality. Similarly, AI-driven systems increasingly shape individual memory practices by curating personal recollections, for instance, social media photos or posts capturing specific moments from the past. Besides storing these recollections, systems such as Facebook Memories (Prey and Smit 2018) reactivate remembering by retrieving and highlighting recollections to their owners at certain points in time.

The growing importance of robotic agents as curators of human memories raises many conceptual questions related to the ability of robots to remember and forget. An integral part of the ongoing discussion is the debate about whether there is a need to integrate more features of human memory into the functionality of robotic memory in the context of human-to-robot communication. Some examples include the programmed ability to forget (Gurrin *et al.* 2010) or to better contextualise the present and reason about the future using mental time travel (Prescott *et al.* 2019). Similarly debated are the ethical matters related to the robotic remembrance of collective suffering, for instance, the risks of it amplifying 'exploitative, harmful, or disrespectful' (Simon and Zucker 2020) interactions with the past encouraged by the transformation of the environment in which such interactions occur.

A related question concerns the overarching computational logic powering non-human agents involved in memory communication. By default, AI-based systems do not have moral values or ethical preferences but learn them through the data used to train these systems or by having certain principles encoded in the systems' decision logic (van de Poel 2020). Considering the sensitive nature of remembrance and many associated moral obligations, especially in the case of remembering mass atrocities (e.g. respecting victims and treating information about them in a just and fair manner; Makhortykh 2023a), it is integral to embed memory-related values into the design of systems involved in human-to-robot communication. In practice, however, many of these systems (e.g. commercial search engines) are used primarily for profit and not necessarily designed with memory-related communication in mind which complicates their use in this context.

Furthermore, the operationalisation of memory-related ethical principles can be challenging due to the subjective and multiperspective nature of memory that makes it difficult to develop universal narratives about the past, especially considering the different interests that specific memory actors can have. For instance, in the case of mass atrocities

https://doi.org/10.1017/mem.2024.2 Published online by Cambridge University Press

affecting different communities, how shall the robotic agent prioritise content dealing with specific groups of victims? Shall the agent prioritise information about groups which suffered the most and what criteria (e.g. the count of victims) can be used to judge the amount of suffering? Or shall the selection of information which is retrieved or generated be diversified to enable more equal treatment of victims? How to deal with matters of privacy of bystanders or perpetrators who may not be willing to let information about their involvement be disclosed? Is the agent expected to prioritise the right to privacy or the interests of the victims?

There are no universal answers to the above-mentioned questions, but in order to ensure the consistent performance of the robotic agents dealing with the memory-related content, there is a need for consistent guidelines which can be translated into the system design principles based on which the agent can make decisions. Realising this goal regarding an inherently subjective and highly contextual matter of memory is a challenging task, but considering that commercial platforms already integrate robotic agents and these agents already have to deal with information about historical and recent suffering, operationalisation of memory-sensitive design principles for developing robotic agent by the memory stakeholders (e.g. survivors and their descendants, heritage practitioners, and scholars) is a necessity. Without the active involvement of such stakeholders, the decisions of how robotic agents are to treat memory-related subjects will be delegated to commercial companies such as OpenAI or Meta, who do not necessarily have expertise or interest in taking into consideration the intricacies of remembrance. While it is almost inevitable that even with the involvement of memory stakeholders, human-to-robot memory communication will conflict with certain human-to-human communication practices, such an involvement will enable possibilities for reconsidering what is objective or fair representation of historical phenomena that will also be of crucial use for robot-to-robot memory communication discussed later.

The second implication relates to the increasing personalisation of human-to-robot memory communication and the potential for more individualised treatment of human inquiries about the past by robotic agents. Some forms of human-to-human memory communication, in particular the more individual-oriented ones (e.g. related to family stories and witness testimonies), have already been characterised by the lack of uniformity in terms of how specific experiences are expressed and shared. However, many collective-oriented memory practices driven by mass media and institutions tended to be more constant in terms of both the message which is communicated about the past and the format of the message. By contrast, human-to-robot communication opens possibilities for engagements with memory both on the individual and collective level, which can be personalised for particular individuals based on their specific preferences or knowledge gaps. Examples of such personalised engagements include the unique selection of recollections provided by the recommender systems for individual users (Prey and Smit 2018) or the different representation of historical events by generative AI based on the language of the user input (Makhortykh *et al.* 2023). In some cases, personalisation can go even further and include individualised presentations of historical monuments in augmented reality applications (Makhortykh and Menyhert 2023).

At the same time, the implications of such personalisation remain unclear. A few empirical studies (e.g. Makhortykh *et al.* 2021, 2022) show profound differences depending on the language in which human users interact with the robotic agents, but the impact of other personalisation factors, such as user location or time remains understudied. Furthermore, current research on memory-related content personalisation focuses on information retrieval systems, such as search engines, whereas more recent types of robotic agents, such as generative AI systems, might operate differently. The observations from some of these systems (e.g. chatGPT) highlight divergent tendencies. In some cases,

https://doi.org/10.1017/mem.2024.2 Published online by Cambridge University Press

the system performance can vary broadly for individual users both for general (Lai *et al.* 2023) and memory-specific tasks; the example of the latter is the generation of different interpretations of the past by conversational agents depending on the input language (Makhortykh *et al.* 2023). By contrast, Rettberg (2022) suggests that, despite multilingualism, systems like chatGPT tend to be monocultural (e.g. due to these systems being fine-tuned according to the values of a culturally non-diverse group of testers). This monoculturalism can result in similar interactions between the robotic agents and human users independently of possible personalisation of these interactions, so it cannot be excluded that in the long run, human-to-robot communication may enforce more memory homogeneity.

Besides the non-diverse composition of developers and testers, homogeneity in robotic agents' representation of the past can result from several factors, such as the limited diversity of training data, for instance, due to them being constituted by historical information coming from a few prevalent sources, or the ethical guardrails aiming to prevent agents from malfunctioning, for example, by propagating distorted interpretations of the past. While the homogeneity is not necessarily always bad (e.g. robotic agents can homogeneously avoid propagating Holocaust denial), it can also contribute to the simplification of the ways the past is represented and engaged. For instance, when generating content about less known instances of mass suffering, robotic agents can reproduce textual and visual patterns learned from the data about iconic mass atrocities recognised and commemorated in the Global North (e.g. the Holocaust), thus contributing to the standardisation of memory that is often driven by a small set of Western-centric practices (David 2017).

The final implication of human-to-robot communication relates to it further amplifying the production of memory-related content. This feature is particularly relevant for generative AIs capable of not only generating visual and textual content dealing with the individual and collective past but also achieving quality that makes it difficult to distinguish from the content generated by humans. Besides raising multiple questions about whether it may undermine the idea of authenticity in relation to the memory-related content (e.g. what if, at some point, it would be difficult to differentiate authentic historical evidence from content generated by the AI), these capacities of AI result in a self-reinforcing loop of robots producing more content through the human-to-robots communication and increasing the necessity to rely on robotic agents for helping human users to navigate and retrieve such content.

The amplification of the production of memory-related content via human-to-robot communication stresses the importance of findability in the context of memory communication. As Hoskins and Halstead (2021) note, the availability of information about the past in the post-scarcity memory ecosystem increasingly becomes synonymous with its findability – i.e. how well the robots can retrieve content in response to human queries. The exact way robots retrieve information varies between different platforms and systems and can be based on different signals, for instance, the presence of a direct match to the user query in the content or metadata or the high amount of user engagement. Overall, however, the effectiveness of robotic agents in retrieving content (including information which individuals might not want to be retrieved; Mayer-Schönberger 2011) raises questions about whether the robotic ability to find information about the past shall be constrained, for example to protect human privacy as in the case of the right to be forgotten (Esposito 2017).

Robot-to-robot memory communication

The growing deployment of AI-driven systems for communicating with human actors enables possibilities for the last memory communication model. Robot-to-robot

https://doi.org/10.1017/mem.2024.2 Published online by Cambridge University Press

communication occurs when robotic agents exchange memory-related information, which can be understood broadly as information concerning the historical and present states of human individuals and collectives. An example of such an exchange is a conversational agent sending a request for information to a search engine to respond to the human agent's inquiry about a recent event (Wiggers 2023). Besides information about humans, memory-related information can include data about the past states of the robotic system (e.g. when different components of a smart home exchange status updates to identify possible malfunctions; Li *et al.* 2018). The exchange of memory-related information is required to enable robotic agents' functionalities regarding other communication models, such as human-to-robot memory communication, as in the case of the conversational agent example above. Such exchange is also needed for functionalities which are not explicitly focused on remembrance, such as health monitoring where AI-based sensors (e.g. smartwatches) exchange information about the past and present states of their owner with health apps.

Similar to human-to-robot memory communication, the growing prominence of the robot-to-robot model is attributed to the post-scarcity of the current memory ecosystem. The unprecedented volume of memory-related content causes the necessity to rely on robotic agents both to help users navigate available information (i.e. human-to-robot memory communication) and to maintain data structures for storing and updating this information. Due to the volume and the speed of information refreshment, these maintenance tasks are delegated to the robots, with humans being largely removed from the loop. To implement these tasks, robots need to exchange memory-related information with each other, thus giving rise to robot-to-robot communication.

A distinct feature of robot-to-robot communication is the limited presence of the human in the memory communication loop in terms of interaction and supervision. Humans still remain an integral part of robot-to-robot communication due to robotic agents incorporating human knowledge by generating training data and due to humans developing robotic agents (i.e. the common interpretation of the human-in-the-loop concept in the field of machine learning; Wu *et al.* 2022). However, in terms of supervisory oversight (e.g. Citron and Pasquale 2014; Grønsund and Aanestad 2020), the presence of humans in the robot-to-robot communication loop is substantially less pronounced due to robotic agents being able to initiate memory communication and humans not directly supervising these agents' activity.

The lack of human supervision over robot-to-robot communication can explain why normative debates related to the human-to-robot model (for instance, whether forgetting mechanisms should be integrated into the functionality of robotic agents; Gurrin *et al.* 2010) receive meagre attention in the context of robot-to-robot communication. The absence of supervision results in little awareness about the implications of such communication for memory-making. The lack of such awareness contributes to the lesser anthropomorphisation of robots in this context, which is an important motivator behind the integration of human-like memory mechanisms in the human-to-robot communication processes. Instead, the discussion of memory in the context of the robot-to-robot model tends to focus on its functional aspects, such as the engineering solutions to prevent information loss (Prince and Prince 2018) or the optimisation of memory usage by AI systems (Pisarchyk and Lee 2020).

The limited visibility of robot-to-robot communication compared to human-to-human or human-to-robot communication makes it challenging to study. The lack of human involvement complicates the process of tracking communication between robotic agents, which often takes the form of information exchanges between databases in the system backend. Examples of such communication include conversational agents retrieving information from the Web or smart devices sharing information with each other as part of the

https://doi.org/10.1017/mem.2024.2 Published online by Cambridge University Press

Internet of Things (IoT). Despite the increasing use of IoT in different sectors, including heritage (e.g. Maceli 2020; Pujar and Satyanarayana 2015), the current discussion of the IoT impact on memory communication focuses on the possibilities for humans to interact with data generated through robot-to-robot communication, but not necessarily the robotic communication itself.

A rare exception is the memory-related interactions between non-human agents, which take place not in the backend but via the interfaces used by human agents. One particular example is Wikipedia, where non-human agents (i.e. Wikipedia bots) interact with each other while working on the articles, including the ones dealing with the collective and individual past. At times, these agents conflict by reverting changes made by other robotic agents (Tsvetkova *et al.* 2017). Due to such robot-to-robot communication occurring in the same environment as the one used by humans and in a format comprehensible for humans (i.e. removal or addition of human-readable text), it is easier to track. This communication is an integral part of robotic activities on Wikipedia (for an overview, see Zheng *et al.* 2019) that enables its functionality as a global memory place (Pentzold 2009) and results in the production of memory narratives used by humans.

The major implication of the rise of robot-to-robot memory communication relates to the possibility of robotic agents moving beyond facilitating human remembrance (i.e. the main function of human-to-robot communication) and engaging in the processes of remembrance on their own (i.e. independently of human agents). While robotic agents have long been capable of storing information, thus memorising it in a more mechanical sense, their increased autonomy allows them to partake in activities which share similarities with the memory practices of their human creators. A profound shift in this context is due to the ability of robotic agents to initiate the exchange of memory-related information on their own and generate such information. This ability makes robotic agents capable of the spectrum of actions (i.e. encoding, storage, and retrieval of historical information) which constitute the experience of memory in a simplified – or 'received' (Klein 2014, 1) – interpretation and can be viewed as a basis for non-human memory practices.

The rise of robotic memory practices has direct consequences for how individual and collective memories about not only robots but also humans are shaped. It signifies that human agents are not the only memory prosumers anymore. With the decrease of active remembrance among human agents (i.e. as part of the process of greying memory; Hoskins and Halstead 2021), this transformation can make robots key actors in retrieving and producing memories. Such production can take various forms: for instance, robotic agents can communicate with each other in order to construct memories about human individuals (e.g. in the form of personal digital twins; de Kerckhove 2021). The same principle can be applied to historical events, where information retrieval and generative AI agents can collaborate to retrieve information about specific episodes of the past to generate new narratives about it which then can be automatically uploaded and retrieved by robotic agents in the future.

The related implication is the further decrease of transparency of memory communication in the aftermath of the digital turn. While human-to-robot communication is already becoming intransparent due to the obscure functionality of non-human agents involved in it (e.g. Makhortykh 2021b), transparency decreases even more when communication about the past happens without the human in the loop. This lack of transparency is particularly concerning regarding the possibility of conflicts between robotic agents with different computational logic (similar to conflicts between bots on Wikipedia; Tsvetkova *et al.* 2017). For instance, if one non-human agent (e.g. a generative AI) does not have guardrails for preventing the generation of content denying the Holocaust, whereas another similar agent does, then different logics may enter the conflict. Similar conflicts may also occur between robotic agents processing memory-related

https://doi.org/10.1017/mem.2024.2 Published online by Cambridge University Press

information about individuals. An example of this is the situation where two AI systems have to assess their human owner's health using historical information from different smart sensors and interpret the data from these sensors in a different way.

This lack of transparency is particularly concerning due to the epistemic uncertainty about the consequences of robotic agents proactively engaging in memory communication with each other. By exchanging information about past states of specific entities and phenomena, robotic agents will develop certain interpretations of the past, which, in the case of decision-making systems, can affect the decisions these agents will make. Some of these decisions can directly affect the human agents. For instance, robotic agents can exchange information about the past of the individual and then draw conclusions about certain aspects of the individual's life (e.g. the likelihood of developing a disease or committing a criminal offence), which then can influence the outcomes of the automated decision-making process relying on such memory-related information.

The epistemic uncertainty about the consequences of robot-to-robot memory communication is worsened by the multiple evidence of AI systems being prone to bias (e.g. Birhane 2021; Noble 2018). Often inherited from their human creators through the training data or system logic design, such bias impacts many forms of human-to-robot communication and can distort the representation of reality. In the context of memory, it can result in a simplified representation of the nuanced past or even the distortion of facts (see, for instance, Makhortykh *et al.* 2021, 2023). However, bias can also affect robot-to-robot communication and impact how the robotic agents make their decisions. For instance, if an agent gets poisoned with false information (as it happened with the Tay chatbot in relation to Holocaust denial), it can poison other agents engaging with it, in particular regarding more niche memory-related topics, where the amount of information available to the robotic agent is likely to be low and ethical guardrails are not necessarily thoroughly implemented. What makes these scenarios particularly dangerous is that without human supervision, it is difficult to detect the presence of bias and then correct it, which can result in bias affecting the performance of robotic agents for a long time.

Discussion

The present moment is unique due to the ongoing transition beyond human-to-human memory communication enabled by diverse forms of mass media. Instead of being a single model of memory transmission, human-to-human communication is becoming one of several possible models. The distinct characteristic of these new models is that they involve both human and non-human agents capable of proactive engagement in memory communication. This shift signifies the growing importance of robotic agents composed of different types of AI-driven systems which both facilitate human memory transmission (human-to-robot communication) and produce new forms of memory based on different ethical and cognitive principles (robot-to-robot communication). Due to being able to process large volumes of data faster than humans, these robotic agents will play a key role in the post-scarcity digital memory ecosystem that is likely to define memory communication in the upcoming decades. Besides, robotic agents will serve as a crucial factor in shaping the relations of power and inequalities in the context of individual and collective remembrance. The current concerns about AI systems amplifying discrimination and disempowerment of vulnerable communities (e.g. Birhane 2021; Kalluri 2020) stress the importance of considering the risks associated with the impact of robotic agents on memory practices which are profoundly affected by the relations of cultural, political, and economic power.

https://doi.org/10.1017/mem.2024.2 Published online by Cambridge University Press

Despite the importance of communication involving robotic agents, the state of research on them in the field of memory studies currently remains limited. Only a few studies (e.g. Locke 2020; Makhortykh 2023b; Shur-Ofry and Pessach 2019; Walden 2022a; Walden *et al.* 2023; Zavadski and Toepfl 2019) discuss the role of these agents in the context of memory communication. While the recent advancements in the field of generative AI have ignited interest in human-to-robot memory communication (see, for instance, Kansteiner (2022) and initiatives such as the AI4Europeana (Europeana 2022)), there is an urgent need for expanding the memory communication research agenda to assess the role of non-human agents both conceptually and empirically. Such a need is particularly pressing in the case of robot-to-robot communication which remains severely understudied and under-conceptualised at the current point in time.

The expansion of the agenda of memory communication research is essential for addressing conceptual and practical issues related to the ongoing changes in how information about the past is transmitted and engaged by human and non-human agents. One of these issues concerns how the design of AI-driven systems can impact their role in the context of communication involving individual and collective remembrance. As discussed earlier, the computational logic behind AI systems is essential for determining how these robotic agents deal with memory-related information when communicating with humans and other robots. However, it is safe to assume that many systems, in particular the ones used by commercial platforms for a broad range of cross-domain tasks (e.g. search engines such as Google or generative AIs such as chatGPT), are not necessarily designed with the memory communication in mind. Under these circumstances, analysing the implications of different system designs and the possibility of integrating specific values which are important for memory communication (e.g. Makhortykh 2023a; Simon and Zucker 2020) is an important task. Its importance is particularly pronounced when considering the impact of robotic agents on communicating memories about particularly sensitive and traumatic episodes of the past such as genocides.

Another related matter concerns the question of the regulation of human-to-robot and robot-to-robot memory communication. While the discussion of memory-related regulatory mechanisms has intensified in the last decade, it has primarily been focused on the protection of individual privacy in the context of human interactions with AI-driven information retrieval systems (i.e. the right to be forgotten/the right for erasure in relation to search engines; Ausloos 2012; Esposito 2017). By contrast, the discussion of the regulation of human-to-robot communication in relation to collective memories remains lacking. However, such a discussion is highly relevant because collective remembrance is a prominent element of the relations of power and often serves as an important component of mechanisms used to ground inequalities and discrimination in the present (Brown and Au 2014). Considering the frequent presence of bias towards discriminated communities in the AI systems (e.g. Noble 2018), the lack of regulation can contribute to the persistence of inadequate treatment of specific groups as well as their memories.

Another important gap is the limited discussion of how the recent advancements in the field of generative AI can be regulated regarding memory communication, for instance, to prevent the spread of false historical evidence generated by AI or limit the use of sensitive memory-related content for commercial purposes. Similarly pending is the debate on how regulation shall approach robot-to-robot memory communication. Such discussions are essential for answering a number of challenging questions, such as can robotic agents be held responsible for promoting distorted information about the past, and what is their expected behaviour regarding contested memory subjects (e.g. the Ukrainian Holodomor; Makhortykh *et al.* 2022)? Do robotic agents have the right (or even the obligation) to remember and forget? How do human and non-human rights to remember and forget interact, and what can be the mechanisms for protecting these rights?

https://doi.org/10.1017/mem.2024.2 Published online by Cambridge University Press

One more important consideration is that technological infrastructures behind human-to-robot and robot-to-robot memory communication are systems of power. Similar to other communication technologies (Flew and Liu 2016), these infrastructures are strongly connected to other elements of digital capitalism and are often embedded in the systems of colonial relations responsible for 'the maintenance of political, economic, and cultural inequities' (Keightley 2022, 2). Such embedding is conceptually concerning and can result in a number of additional challenges, including, for instance, the promotion of Western-centric bias by robotic agents. An example of such bias can be the prioritisation of specific visual representations or textual interpretations of historical events coming primarily from Western (and often colonial) sources. Another example is the unfair treatment of non-Western actors and alternative memories due to robotic agents downgrading the visibility of non-Western sources in their outputs. Under these circumstances, monitoring the robotic behaviour in the context of memory communication and intensifying the discussion about the possible operationalisation of different forms of robotic bias regarding memory-related information becomes of paramount importance.

Finally, there is a question of whether robot-to-robot communication leads to the formation of memory in the human sense of the word. While the concept of memory has been extensively applied in the field of computer engineering, its anthropomorphisation can be misleading due to the different cognitive principles on which human and machine memory function. This paper does not engage in an in-depth discussion of these differences and instead assumes that any form of communication dealing with the exchange of information about the past states of individual and collective entities can be viewed as part of the larger phenomenon of remembrance (i.e. in a way similar to the concept of media memory which encompasses all mediated forms of narration about the past; Neiger *et al.* 2011). However, it is necessary to acknowledge that this rather broad understanding of memory can lead to oversimplifications (see, for instance, Klein (2014) for criticism of the generalised definitions of memory and calls for more concrete interpretations). A more nuanced conceptual discussion of whether the outcomes of robot-to-robot communication can (or shall) be viewed as a form of remembrance or be treated as a mechanical process subjected to stochastic factors is needed.

The importance of the clear definition of what is meant by memory is particularly relevant due to the distinctions between the memory communication models, in particular between human-to-robot and robot-to-robot memory communication. As shown by the example of Bing Chat discussed in the introduction, sometimes, these two models go side by side, with one model underlying the other. Such symbiotic relationship is true not only for robot-to-robot communication increasingly being required to enable human-related communication but also for humans shaping robot-to-robot communication in ways different from immediate supervision and interaction. While the paper argues that the lack of human supervision for the autonomous memory-related exchanges between robotic agents is sufficient for distinguishing robot-to-robot communication as a separate model, it is essential to acknowledge that human factors still persist in the context of robot-to-robot memory exchanges. Such persistence is particularly pronounced in the case of power relations and potential biases inherited by robotic agents from their human counterparts. It is essential that it is taken into consideration when evaluating the performance of robotic agents and operationalising the notions of accountability and responsibility in relation to it.

It is also important to note several limitations of this article. The first is the highly complex nature of memory communication in the digital age. Under these circumstances, it is hardly possible to offer a comprehensive summary of all possible mechanisms and implications of the different communication models in a single article. Due to this, the

https://doi.org/10.1017/mem.2024.2 Published online by Cambridge University Press

article has focused on a few aspects which are particularly relevant for illustrating the specificities of individual communication models. However, such selection is, by definition, prone to subjective choices and is not comprehensive. The second limitation concerns the rather simplistic operationalisation of memory communication and memory in general adopted in the article. Further research will benefit from problematising these two concepts and contrasting them against the growing body of literature on the cognitive and philosophical aspects of communication about the past.

Data availability statement. No data are available for this conceptual article.

Funding statement. This work was supported by the Alfred Landecker Foundation as part of the project titled "Algorithmic turn in Holocaust memory transmission: Challenges, opportunities, threats". The funder had no role in study design, data collection and analysis, the decision to publish, or manuscript preparation.

Competing interest statement. The author has no competing interests to declare.

References

Assmann A (2011) *Cultural Memory and Early Civilization: Writing, Remembrance, and Political Imagination*. Cambridge: Cambridge University Press.

Ausloos J (2012) The 'right to be forgotten' – worth remembering? *Computer Law & Security Review* **28**(2), 143–152.

Bareither C (2021) Difficult heritage and digital media: 'Selfie culture' and emotional practices at the Memorial to the Murdered Jews of Europe. *International Journal of Heritage Studies* **27**(1), 57–72.

Birhane A (2021) Algorithmic injustice: A relational ethics approach. *Patterns* **2**(2), 1–9.

Blackburn K (2013) The 'democratization' of memories of Singapore's past. *Bijdragen tot de taal-, land-en volkenkunde* **169**(4), 431–456.

Boughanem M, Akermi I, Pasi G and Abdulahhad K (2020) Information retrieval and artificial intelligence. In Marquis P, Papini O and Prade H (eds), *A Guided Tour of Artificial Intelligence Research*. Cham: Springer Link, pp. 147–180.

Brown A and Au W (2014) Race, memory, and master narratives: A critical essay on US curriculum history. *Curriculum Inquiry* **44**(3), 358–389.

Brown M and Tucker K (2017) Unconsented sterilisation, participatory story-telling, and digital countermemory in Peru. *Antipode* **49**(5), 1186–1203.

Citron D and Pasquale F (2014) The scored society: Due process for automated predictions. *Washington Law Review* **89**, 1–35.

David L (2017) Against standardization of memory. *Human Rights Quarterly* **39**, 296–319.

De Bruyn D (2010) World War 2.0: Commemorating war and Holocaust in Poland through Facebook. *Studies in Russian, Eurasian and Central European New Media* **4**, 45–62.

de Kerckhove D (2021) The personal digital twin, ethical considerations. *Philosophical Transactions of the Royal Society A* **379**(2207), 1–12.

Dounaevsky H (2013) *Building Wiki-History. Memory, Conflict and New Media: Web Wars in Post-Socialist States*. London: Routledge.

Epstein Z, Hertzmann A, Investigators of Human Creativity, Akten M, Farid H, Fjeld J, Frank MR, Groh M, Herman L, Leach N and Mahari R (2023) Art and the science of generative AI. *Science* **380**(6650), 1110–1111.

Erll A (2011) Locating family in cultural memory studies. *Journal of Comparative Family Studies* **42**(3), 303–318.

Ernst W (2015) *Stirrings in the Archives: Order from disorder*. Lanham: Rowman & Littlefield.

Esposito E (2017) Algorithmic memory and the right to be forgotten on the web. *Big Data & Society* **4**(1), 1–11.

Europeana (2022) *AI4Europeana – An AI Platform for the Cultural Heritage Data Space*. Europeana, November 14. Available at https://t.ly/2gBWS (accessed 6 May 2023).

Ferron M and Massa P (2011) Studying collective memories in Wikipedia. *Journal of Social Theory* **3**(4), 449–466.

Flew T and Liu B (2016) Media convergence. In Merten K and Kramer L (eds), *Postcolonial Studies Meets Media Studies: A Critical Encounter*. Germany: Transcript Verlag, pp. 25–42.

Garde-Hansen J, Hoskins A and Reading A (2009) *Save as... Digital Memories*. Cham: Springer.

Gibson PL and Jones S (2012) Remediation and remembrance: 'Dancing Auschwitz' collective memory and new media. *Journal for Communication Studies* **5**(2), 107–131.

González-Aguilar JM and Makhortykh M (2022) Laughing to forget or to remember? Anne Frank memes and mediatization of Holocaust memory. *Media, Culture & Society* **44**(7), 1307–1329.

https://doi.org/10.1017/mem.2024.2 Published online by Cambridge University Press

Grabowski J and Klein S (2023) Wikipedia's intentional distortion of the history of the Holocaust. *The Journal of Holocaust Research* **37**(2), 133–190.
Grainge P (2003) *Memory and Popular Film*. Manchester: Manchester University Press.
Grønsund T and Aanestad M (2020) Augmenting the algorithm: Emerging human-in-the-loop work configurations. *The Journal of Strategic Information Systems* **29**(2), 1–16.
Gruenewald T (2021) *Curating America's Painful Past: Memory, Museums, and the National Imagination*. Lawrence: University Press of Kansas.
Gurrin C, Lee H and Hayes J (2010) iForgot: A model of forgetting in robotic memories. In *2010 5th ACM/IEEE International Conference on Human-Robot Interaction*. Piscataway: IEEE, pp. 93–94.
Heard J, Wilberding J, Frieder G, Frieder O, Grossman D and Kane L (2006) On mediated search of the United States Holocaust Memorial Museum data. In *Next Generation Information Technologies and Systems: 6th International Conference*. Berlin: Springer, pp. 38–46.
Hirsch M (2008) The generation of postmemory. *Poetics Today* **29**(1), 103–128.
Hoskins A (2011a) 7/7 and connective memory: Interactional trajectories of remembering in post-scarcity culture. *Memory Studies* **4**(3), 269–280.
Hoskins A (2011b) Media, memory, metaphor: Remembering and the connective turn. *Parallax* **17**(4), 19–31.
Hoskins A (2017a) *Digital Memory Studies: Media Pasts in Transition*. New York: Routledge.
Hoskins A (2017b) Memory of the multitude: The end of collective memory. In Hoskins A (ed.), *Digital Memory Studies*. London: Routledge, pp. 85–109.
Hoskins A and Halstead H (2021) The new grey of memory: Andrew Hoskins in conversation with Huw Halstead. *Memory Studies* **14**(3), 675–685.
Hume J (2010) Memory matters: The evolution of scholarship in collective memory and mass communication. *The Review of Communication* **10**(3), 181–196.
Jatowt A, Kawai D and Tanaka K (2016) Digital history meets Wikipedia: Analyzing historical persons in Wikipedia. In *Proceedings of the 16th ACM/IEEE-CS on Joint Conference on Digital Libraries*. New York: ACM, pp. 17–26.
Jones J and Ackerman MS (2018) Co-constructing family memory: Understanding the intergenerational practices of passing on family stories. In *Proceedings of the 2018 Conference on Human Factors in Computing Systems*. New York: ACM, pp. 1–13.
Kalluri P (2020) Don't ask if artificial intelligence is good or fair, ask how it shifts power. *Nature* **583**(7815), 169–169.
Kansteiner W (2022) Digital doping for historians: Can history, memory, and historical theory be rendered artificially intelligent? *History and Theory* **61**, 119–13.
Kaprāns M (2016) Hegemonic representations of the past and digital agency: Giving meaning to "The Soviet Story" on social networking sites. *Memory Studies* **9**(2), 156–172.
Keightley E (2022) Rethinking technologies of remembering for a postcolonial world. *Memory, Mind & Media* **1**, 1–15.
Khoruzhenko T (2020) Why are Stalin and Google alike? The Russian internet's representation of Stalin. *Humor* **33**(1), 79–103.
Kilbourn RJA (2013) *Cinema, Memory, Modernity*. New York: Routledge.
Klein SB (2014) What memory is. *Wiley Interdisciplinary Reviews: Cognitive Science* **6**(1), 1–38.
Kraft RN (2006) Archival memory: Representations of the Holocaust in oral testimony. *Poetics Today* **27**(2), 311–330.
Lai VD, Ngo NT, Veyseh APB, Man H, Dernoncourt F, Bui T and Nguyen TH (2023) ChatGPT beyond English: Towards a comprehensive evaluation of large language models in multilingual learning. arXiv preprint arXiv:2304.05613.
Landsberg A (2004) *Prosthetic Memory: The Transformation of American Remembrance in the Age of Mass Culture*. New York: Columbia University Press.
Li M, Gu W, Chen W, He Y, Wu Y and Zhang Y (2018) Smart home: Architecture, technologies and systems. *Procedia Computer Science* **131**, 393–400.
Liebermann Y (2021) Born digital: The Black lives matter movement and memory after the digital turn. *Memory Studies* **14**(4), 713–732.
Locke C (2020) Digital memory and the problem of forgetting. In Radstone S (ed.), *Memory and Methodology*. London: Routledge, pp. 25–36.
Luyt B (2015) Debating reliable sources: Writing the history of the Vietnam War on Wikipedia. *Journal of Documentation* **71**(3), 440–455.
Maceli M (2020) Internet of things in the archives: Novel tools for environmental monitoring of archival collections. *Records Management Journal* **30**(2), 201–220.

https://doi.org/10.1017/mem.2024.2 Published online by Cambridge University Press

Maciel C, Pereira VC, Leitão C, Pereira R and Viterbo J (2017). Interacting with digital memorials in a cemetery: Insights from an immersive practice. In *2017 Federated Conference on Computer Science and Information Systems*. Piscataway: IEEE, pp. 1239–1248.

Makhortykh M (2017) Framing the Holocaust online: memory of the Babi Yar massacres on Wikipedia. *Studies in Russian, Eurasian and Central European New Media* **18**, 67–94.

Makhortykh M (2018) Remediating violence: Second World War memory on Wikipedia. *Remembrance and Solidarity* **6**, 123–143.

Makhortykh M (2021a) #givemebackmy90s: Memories of the first post-Soviet decade in Russia on Instagram and TikTok. *Cultures of History Forum*, 28 June. Available at https://t.ly/3FJ4Q (accessed 6 May 2023).

Makhortykh M (2021b) Memoriae ex machina: How algorithms make us remember and forget. *Georgetown Journal of International Affairs* **22**(2), 180–185.

Makhortykh M (2023a) No AI after Auschwitz? Bridging AI and memory ethics in the context of information retrieval of genocide-related information. In Mukherjee A, Kulshrestha J, Chakraborty A and Kumar S (eds), *Ethics in Artificial Intelligence: Bias, Fairness and Beyond*. Singapore: Springer Nature Singapore, pp. 71–83.

Makhortykh M (2023b) The user is dead, long live the platform? Problematising the user-centric focus of (digital) memory studies. *Memory Studies* **16**(6), 1500–1512.

Makhortykh M and Menyhert M (2023) Keeping in the past from freezing: Augmented reality and memories in the public space. In Gensburger S and Wüstenberg J (eds), *De-Commemoration: Removing Statues and Renaming Places*. Berlin: De Gruyter, pp. 355–367.

Makhortykh M and Sydorova M (2022) Animating the subjugated past: Digital greeting cards as a form of counter-memory. *Visual Communication* **21**(1), 28–52.

Makhortykh M, Urman A and Ulloa R (2021) Hey, Google, is it what the Holocaust looked like? *First Monday* **26**(10), 1–24. https://doi.org/10.5210/fm.v26i10.11562

Makhortykh M, Urman A and Ulloa R (2022) Memory, counter-memory, and denialism: How search engines circulate information about the Holodomor-related memory wars. *Memory Studies* **15**(6), 1330–1345.

Makhortykh M, Vziatysheva V and Sydorova M (2023) Generative AI and contestation and instrumentalization of memory about the Holocaust in Ukraine. *Eastern European Holocaust Studies* **1**(2), 349–355.

Mayer-Schönberger V (2011) *Delete: The Virtue of Forgetting in the Digital Age*. Princeton: Princeton University Press.

Moskwa A (2021) The users of Tripadvisor as the public(s) of public history: Case study of the Hiroshima Peace Memorial Museum. In Wojdon J and Wiśniewska D (eds), *Public in Public History*. London: Routledge, pp. 199–213.

Neiger M, Meyers O and Zandberg E (2011) *On Media Memory: Collective Memory in a New Media Age*. Cham: Springer.

Nilsson NJ (1998) *Artificial Intelligence: A New Synthesis*. San Francisco: Morgan Kaufmann.

Noble SU (2018) *Algorithms of Oppression*. New York: NY University Press.

Panciera K, Halfaker A and Terveen L (2009) Wikipedians are born, not made: A study of power editors on Wikipedia. In *Proceedings of the 2009 ACM International Conference on Supporting Group Work*. New York: ACM, pp. 51–60.

Pentzold C (2009) Fixing the floating gap: The online Encyclopaedia Wikipedia as a global memory place. *Memory Studies* **2**(2), 255–272.

Pisarchyk Y and Lee J (2020) Efficient memory management for deep neural net inference. arXiv preprint arXiv:2001.03288.

Prescott TJ, Camilleri D, Martinez-Hernandez U, Damianou A and Lawrence ND (2019) Memory and mental time travel in humans and social robots. *Philosophical Transactions of the Royal Society B* **374**(1771), 20180025.

Prey R and Smit R (2018) From personal to personalized memory: Social media as mnemotechnology. In Papacharissi Z (ed.), *A Networked Self and Birth, Life, Death*. London: Routledge, pp. 209–223.

Prince B and Prince D (2018) *Memories for the Intelligent Internet of Things*. Hoboken: John Wiley & Sons.

Pujar SM and Satyanarayana KV (2015) Internet of things and libraries. *Annals of Library and Information Studies* **62**(3), 186–190.

Rettberg JW (2022) ChatGPT is multilingual but monocultural, and it's learning your values. jull/txt, December 6. Available at https://t.ly/zYVOk (accessed 13 January 2024).

Ritzer G, Dean P and Jurgenson N (2012) The coming of age of the prosumer. *American Behavioral Scientist* **56**(4), 379–398.

Rosenzweig R (2006) Can history be open source? Wikipedia and the future of the past. *The Journal of American History* **93**(1), 117–146.

Rothberg M (2009) *Multidirectional Memory: Remembering the Holocaust in the Age of Decolonization*. Redwood City: Stanford University Press.

https://doi.org/10.1017/mem.2024.2 Published online by Cambridge University Press

Rutten E, Fedor J and Zvereva V (2013) *Memory, Conflict and New Media: Web Wars in Post-Socialist States*. London: Routledge.
Shur-Ofry M and Pessach G (2019) Robotic collective memory. *Washington University Law Review* **97**, 975–1004.
Simon DJ and Zucker EM (2020) Introduction: Mass violence and memory in the digital age – memorialization unmoored. In Zucker EM and Simon DJ (eds), *Mass Violence and Memory in the Digital Age: Memorialization Unmoored*. Cham: Springer Link, pp. 1–18.
Smith A and Lee L (2022) War and pieces: Comparing perspectives about World War I and II across Wikipedia language communities. In *Proceedings of the 6th Joint SIGHUM Workshop on Computational Linguistics for Cultural Heritage, Social Sciences, Humanities and Literature*. Kerrville: ACL, pp. 94–104.
Ten Brink J and Oppenheimer J (2012) *Killer Images: Documentary Film, Memory and the Performance of Violence*. New York: Columbia University Press.
Toffler A (1980) *The Third Wave*. New York: William Morrow.
Tsvetkova M, García-Gavilanes R, Floridi L and Yasseri T (2017) Even good bots fight: The case of Wikipedia. *PLoS ONE* **12**(2), 1–13.
Urman A, Makhortykh M, Ulloa R, Sydorova M and Kulshrestha J (2023) Constants and variables: How does the visual representation of the Holocaust by AI change over time. *Eastern European Holocaust Studies* **1**(2), 365–371.
van de Poel I (2020) Embedding values in artificial intelligence (AI) systems. *Minds and Machines* **30**(3), 385–409.
Van Dijck J (2008) Digital photography: Communication, identity, memory. *Visual Communication* **7**(1), 57–76.
Van House N and Churchill EF (2008) Technologies of memory: Key issues and critical perspectives. *Memory Studies* **1**(3), 295–310.
Walden VG (2022a) The memorial museum in the digital age. In Walden VG (ed.), *The Memorial Museum in the Digital Age*. Sussex: REFRAME, pp. 20–44.
Walden VG (2022b) What is 'virtual Holocaust memory'? *Memory Studies* **15**(4), 621–633.
Walden VG and Makhortykh M (2023) #Hashtag commemoration: A comparison of public engagement with commemoration events for Neuengamme, Srebrenica, and Beau Bassin during Covid-19 lockdowns. In Fridman O and Gensburger S (eds), *The COVID-19 Pandemic and Memory*. Cham: Springer, pp. 245–266.
Walden VG, Makhortykh M, Marrison K, Arnold-de Simine S, Balis A, Clavert F, Cole T, Culp L, Grau R, Groschek I, Perak B, Pucciarelli A, Sagie T, Szonyi A, Torrance S, Verschure P and Wierenga S (2023) *Recommendations for using Artificial Intelligence and Machine Learning for Holocaust Memory and Education*. Sussex: REFRAME.
Waterson R (2007) Trajectories of memory: Documentary film and the transmission of testimony. *History and Anthropology* **18**(1), 51–73.
Wiggers K (2023) OpenAI connects ChatGPT to the internet. *TechCrunch*, March 23. Available at https://techcrunch.com/2023/03/23/openai-connects-chatgpt-to-the-internet/ (accessed 6 May 2023).
Wight AC (2020) Visitor perceptions of European Holocaust Heritage: A social media analysis. *Tourism Management* **81**, 1–12.
Wu X, Xiao L, Sun Y, Zhang J, Ma T and He L (2022) A survey of human-in-the-loop for machine learning. *Future Generation Computer Systems* **135**, 364–381.
Zavadski A and Toepfl F (2019) Querying the Internet as a mnemonic practice: how search engines mediate four types of past events in Russia. *Media, Culture & Society* **41**(1), 21–37.
Zelizer B (2008) Why memory's work on journalism does not reflect journalism's work on memory. *Memory Studies* **1**(1), 79–87.
Zelizer B and Tenenboim-Weinblatt K (2014) *Journalism and Memory*. Cham: Springer.
Zheng L, Albano CM, Vora NM, Mai F and Nickerson JV (2019) The roles bots play in Wikipedia. *Proceedings of the ACM on Human-Computer Interaction* **3**, 1–20.
Zucker EM, Makhortykh M, Ulloa R, Bultmann D and Simon DJ (2023) AI and archives: How can technology help preserve Holocaust heritage under the risk of disappearance? *Eastern European Holocaust Studies* **1**(2), 357–363.

Mykola Makhortykh (University of Bern) is an Alfred Landecker lecturer at the Institute of Communication and Media Studies. His research interests include armed conflict reporting, disinformation and computational propaganda research, cybersecurity and critical security studies, and bias in information retrieval systems.

Cite this article: Makhortykh M (2024). Shall the robots remember? Conceptualising the role of non-human agents in digital memory communication. *Memory, Mind & Media* **3**, e6, 1–17. https://doi.org/10.1017/mem.2024.2