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Evolution of mediated memory in the digital age: tracing its path from the 1950s to 2010s

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In the digital age, the relationship between human memory and media is intimate and impossible to separate. This understanding serves as the foundation for this study of mediated memory, which includes an investigation into how memory is stored, represented, and communicated via different forms of media. Despite its significance, there has yet to be a comprehensive review leading to a complete understanding of mediated memory research, particularly from the 1950s to the 2010s. This paper aims to address this knowledge gap through an extensive literature review. It examines research spanning multiple decades, focusing on the methods and paradigms used in previous mediated memory studies. The review uncovers a dual-sided representation of memory. Neurological-cognitive science research suggests that memory is represented through technology, particularly in neuroimaging techniques. Conversely, humanities and social science research highlight memory's cultural representation through digital media, such as television, computers, smartphones, the internet, and social media. The review reveals a dichotomy in mediated memory research, with a risk of oversimplification due to the distinct paradigms. However, since the late 2000s, an interdisciplinary approach has gained momentum, leading to a more integrated perspective on mediated memory. This paper offers a comprehensive review of mediated memory studies from the 1950s to the 2010s, providing historical context, key theories, methodologies, and debates. It also identifies three distinct trajectories in these studies and highlights the gaps and issues that exist in the current research. These findings carry profound implications for future mediated memory research, advocating for a comprehensive, interdisciplinary approach to advance our understanding of how memory is shaped and represented in the digital age.

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Introduction

This paper seeks to provide an exhaustive literature review of the studies pertaining to “mediated memory” within the digital era, which commenced in the 1950s. There is a profound connection between human memory and media. We invariably employ a plethora of mediums to generate and record memories, ranging from pen and paper to cinema, television, and the internet. The evolution of memory modalities and the development of media technologies are closely intertwined. Indeed, it has been postulated that “all memories are mediated and that memory itself is a medium” (Williams 2009, p. 47). Mediated memory studies constitute a pivotal realm within memory research. I borrow the term “mediated memory” from José Van Dijck. In her perspective, mediated memory refers to both how media influences our understanding of memory and how our understanding of physiological memory is influenced by media (Van Dijck 2007). Consequently, we opt to utilize the term “mediated memory studies” (as opposed to “media memory studies”) to designate a field of study that offers a more holistic insight into the nexus between media and memory. The “mediated memory” we refer to encompasses not only the relationship between mass media and collective memory but also the wider implications of memory mediation. In this way, our research simultaneously encompasses both the physiological underpinnings of individual memory and the sociocultural research of so-called “collective memory”, thus revealing the evolutionary process of a distinct field.

The advent of computational techniques—humanity’s most potent media technology to date—in the 1950s instigated a profound transformation in mediated memory studies, ushering in the digital era of mediated memory. A salient characteristic of the digital era is the rise of multimedia technologies (Negroponte 1995; Toffler 1981). Multimedia technologies refer to the confluence of media technology and computation, enabling the conversion of a vast amount of information (including human memories) into digitally accessible data (Manovich 2001). This hallmark of the digital age has led to the emergence of three distinct research trajectories in mediated memory, each of which corresponds to a different period.

The first trajectory involves an investigation into the physiological mechanisms of memory, which, when transmuted into information data through medical imaging technology, is positioned within the fields of psychology, neuroscience, and cognitive science. This trend corresponds with the evolution of experimental psychology in the 1950s, which later became known as cognitive science. With the intervention of computer technology in the development of medical techniques, memory could be visualized using medical imaging technology. Medical imaging, in numerous aspects, operates much like digital media—capturing and disseminating visual information, functioning as a record and a diagnostic instrument, and so forth. In this stage, scholars were no longer restricted to reliance on the outwards behavior of humans but could examine the physiological basis of memory through the memory data presented by digital media. Within this context, “mediated memory,” as a term, first emerged in the 1970s and was defined as the cognitive ability to evoke memory through external objects (Flavell 1970; Vygotsky and Cole 1978). The research on mediated memory during this period primarily concentrated on individual memory.

The second trajectory focuses on the interactive relationship between memory and digital mass media, social media, etc., centralizing in the fields of sociology, communication studies, and cultural research. This trend aligns with the “memory boom” of the 1980s, a time when academic interest in the study of mediated memory primarily centered on its complex interplay with mass media. Throughout the 1970s and 1980s, the connotation of

media as a “collective subject” gained extensive acceptance (Boyer 2007). Thus, the initial exploration into mediated memory revolved around collective memory as depicted via mass media (press and television) (Clark 1986; Debouzy 1986), a form of mediated memory intrinsically linked with external sociocultural structures (Grainge 2002; Huyssen 2003).

Although both research paths take memory as their object of study, their paradigms of inquiry are distinctly divergent. Prior to the 2000s, most scholars considered the former as “scientific studies regarding memory,” and the latter as “humanities-social studies regarding memory.” Rarely did anyone view these two research pathways as different branches within the same study theme.

The third trajectory, which surfaced in the 2000s, pertains to the burgeoning concept of “paradigm fusion”. José Van Dijck, a luminary in the realm of mediated memory studies, argued that mediated memory is not confined to the physiological area of the brain or the material culture stratum, nor should we view the relationship between external media and internal memory through a simplistic binary lens (Van Dijck 2004). She reasoned, “Recollection is also a form of reconnection, as mental and cultural processes are involved in the digital restructuring of personal memory” (Van Dijck 2007, p. 180). Van Dijck’s philosophies unveiled the interdisciplinary character of mediated memory studies in the 2000s. On the one hand, researchers in the field of technological media discovered that digital media encompass distributed features of human memory (Kelly 1994; Star and Bowker 2000), suggesting that the study of mediated memory is inextricably linked to the physiological basis of memory. On the other hand, memory researcher Jeffrey Olick suggests that the true effective paradigm for memory research can only be found when we “[move] beyond the apparent mutual irrelevance of neurological and psychological studies of memory on the one hand and sociological and cultural approaches on the other” (Olick 1999, p. 340). Therefore, since the 2000s, the third trajectory symbolizes the amalgamation of the research paths, combining the physiological foundation of mediated memory production with its cultural framework—an interdisciplinary research trend that reflects the current state of mediated memory studies.

Consequently, this paper, a comprehensive review of mediated memory from the 1950s to the 2010s, employs the chronology of the three emerging trends as a delineating standard. The first phase commenced in the 1950s with the exploration and comprehension of memory’s physiological mechanism through media technologies that scrutinize individual memory (such as computers and neuroimaging technologies). The second phase, which arose in the 1980s, examines how digital media (including digital television, news media, internet, social media, etc.) shape cultural memory. The third phase, originating in the late 2000s, encapsulated the interdisciplinary research that integrates the “scientific” and “humanities-social” facets of mediated memory. Notably, these three research trajectories temporally intersect, and it is not the case that each phase accommodates only one path. This paper focuses on one research path per phase to lucidly illustrate the evolution of mediated memory studies from a subordinate field within various disciplines to its own independent interdisciplinary domain, thereby analyzing the catalysts for the paradigm shift in mediated memory studies over the past seven decades.

Neurocognitive science research on mediated memory

The mediation of memory first gained significance in the scientific domain of the 1950s, given that the burgeoning field of

cognitive science had a direct impact on memory research during this era. In the 1950s, human memory and mental experience research underwent a significant cognitive revolution, which subsequently gave rise to cognitive science (Miller 2003, p. 141). This interdisciplinary field encompasses psychology, linguistics, and computer science, with a shared research paradigm that views the internal mental states of humans as abstract representational levels of logical or computational processes. As cognitive psychologist Henry Roediger aptly summarized, memory, for a long time, was understood as being metaphorically likened to some form of technical media; hence, the advancement of memory research relied on the progression of technical media (Roediger 1980, p. 244). At the onset of the cognitive revolution, the metaphor of the computer influenced scholars' understanding of the concept of mediated memory. Memory researchers of the 1950s to 1970s era were inclined to employ the functions of storage, access, search, and calculation in computers to represent memory models. For instance, they drew parallels between the process of memory reconsolidation and the recollection of events to the information processing system that inputs, stores, and manipulates information (Baddeley and Hitch 1974; Miller 1956). They believed that the operations of storing, re-encoding, and hierarchically processing information in computers provided useful models for understanding human memory (Atkinson and Shiffrin 1968; Oldfield 1954).

American philosopher Jerry Alan Fodor proposed five major assumptions of representational theory: 1. Propositional attitude states (such as beliefs and desires) are relevant. 2. Psychological representations exist within relationships. 3. Psychological representations are symbolic, possessing both formal and semantic attributes. 4. Psychological representations exert causal effects due to their formal properties. 5. Propositional attitudes inherit semantic properties from their object's psychological representations (Fodor 1983, p. 26). Influenced by computer technology, memory researchers during this period perceived memory as a "coded, representational memory" (Rosenblatt 1958, p. 386)—a computer information system that stores and represents data and re-encodes and outputs data. This perspective conformed to the theory of mental representationalism from the first transformation of cognitive science, which forms an analogy between the mind and a computer and perceives mental cognitive processes as akin to the representation and computational processes of a computer.

However, in other research, the representational theory of cognition encountered a fundamental predicament: the extensive human cognitive abilities could not be entirely characterized by computational processes. Philosopher of mind John Searle revealed, through the renowned Chinese Room thought experiment, that representationalism introduced an information "black box" converting symbols and meanings within the nervous system. This left researchers unable to illustrate how our experiences are represented as semantic symbols within the brain (Searle 1980, pp. 417–424).

The predicament of mental representationalism prompted the second revolution in cognitive science, transitioning from a focus on the representationalism of mental abilities to the study of embodied cognition. Cognitive linguist George Lakoff noted that one of the significant contemporary cognitive science discoveries concerning human cognitive abilities is that "thought is mostly unconscious" (Lakoff and Johnson 1999, p. 3). We cannot directly explore the mechanisms of thought and language consciously, as the human stream of consciousness flows too swiftly and deeply for us to observe them in a straightforward manner. The unconscious nature of thought has impelled cognitive science to investigate human mental abilities in new ways. Francisco Varela, a cognitive scientist from Chile, wrote that human cognition is

not an independent understanding of the external world by the brain; rather, it "emerges" only within specific environments through concrete actions (Varela et al. 1991, p. 8). Later, cognitive scientists further emphasized the embodied features of cognition and advocated that human cognition should be described based on agent-environment dynamics as opposed to computation and representation.

Mediated memory research also shifted direction with the second transformation of cognitive science. Researchers began by questioning the "recording of the past" (storage of content) function of memory. For example, ample empirical research has established that a substantial portion of memory is non-representational or contentless. John Sutton proposed that memory should be understood as a contentless embodied cognitive ability based on the latest findings in cognitive science (Sutton 1998). This suggests that the conception of memory as a record of the past is flawed. Such a research shift owes to the advent of neuroimaging technology. Neuroimaging technology, broadly speaking, refers to techniques capable of directly or indirectly imaging the functional and structural characteristics of the brain's neural system, such as positron emission tomography (PET) or functional magnetic resonance imaging (fMRI). In the research of cognitive scientists on memory, neuroimaging technologies targeting physiological factors have been employed. These detection and statistical methods can reproduce bodily and brain activity during memory experiments as numerical data or images, allowing researchers to analyse nonrepresentable memories. These studies, supported by neuroimaging technology, give visibility to cerebral activity and investigate how memory's encoding and storage processes are represented in terms of neural activation and connectivity. This technology assists in forming memory representations that we cannot "see" with our consciousness or eyes alone (Rugg et al. 2002; Skinner and Fernandes 2007). Increasingly, studies are revealing significant discrepancies between human memory activity and past understandings under the observation of neuroimaging technology.

For example, research using technological mediums such as PET, fMRI, and transcranial magnetic stimulation has observed varying roles of different brain regions in the process of memory encoding and retrieval (Anderson 2005; Fletcher and Henson 2001; Lepage et al. 1998). Some studies have found that the brain produces different memory representations when retrieving and encoding the same item (Rugg et al., 2008), and others have found that forgetfulness results from the brain's inability to transform initial events and experiences into lasting memory representations (Levy et al. 2010). These investigations suggest that compared to "memory storage theory," "memory constructivism" offers a more apt elucidation of the operational principles of memory. In other words, our brains do not have a specific region for "storing" concrete memory content; "remembering" is simply the reactivation of the neural network (Kandel 2001).

As some of the earliest cognitive psychologists to study the reconstructive nature of memory, Elizabeth F. Loftus and her collaborators concluded after observing the neural activity of memory through event-related potentials and fMRI: "all memory is false to some degree. Memory is inherently a reconstructive process, whereby we piece together the past to form a coherent narrative that becomes our autobiography" (Bernstein and Loftus 2009, p. 373). This implies that memory is altered and reconstructed during the ongoing processes of consolidation and transcription. Simultaneously, related research has discovered a close connection between changes in neural system stimulation and the construction of memory. Based on observations of mouse brains through electrophysiology and deep brain stimulation, researchers at the French National Center for Scientific Research discovered that technology can alter biological memory on a

neural basis. They conducted the experiment repeatedly on five slumbering mice. Having previously discovered place cells while exploring their surroundings, the researchers allowed the animals to rest briefly and then paired the firing of selected place cells with stimulation of the medial forebrain bundle. The results indicated that the animals exhibited a strong preference for the designated locations, spending significantly more time there than elsewhere upon awakening (De Lavilléon et al. 2015, pp. 493–495). In other words, memory is not merely an objective reflection of the past but can be stimulated and altered by stimulating the nervous system.

Research on the construction of memory has also inspired studies on the fictitious nature of memory. Some studies have discovered that memory permits us to flexibly reassemble different components of encoded traces, representing past events that may or may not have happened, as mental simulations to construct futures. Thus, “remembering facts” may not be the most critical physiological function of memory; rather, assisting cognition of the present situation is (De Brigard, 2014). This research demonstrates that memory not only helps us consider what has happened but also supports the perception of potentially advantageous situations that have not occurred. The experimental conclusions emphasize the creativity and flexibility of memory and its significance in cognitive processes. In other words, “it is a mistake to think of memory as system that is uniquely or even primarily dedicated to reproducing the contents of previous experiences” (De Brigard 2014, p. 177). Furthermore, by analyzing the outcomes of numerous cognitive and memory experiments, Daniel Hutto discovered that the function of memory is not to accurately reflect the past; rather, memory is a constructive cognitive ability situated in human-environment interactions (Hutto and Peeters 2018, p. 113). The constructive cognitive ability of mediated memory gradually supersedes its record-keeping ability, becoming a focal point for researchers.

Influenced by cognitive science, another significant area of study for mediated memory pertains to distributed memory. As early as 1993, Gavriel Salomon introduced the concept of “distributed cognition” in his book. Distributed cognition posits that human cognitive abilities are dispersed among others, the environment, and media (Salomon 1993, pp. 1–46). This significant discovery in the field of cognitive science profoundly altered our understanding of human cognitive capacities. As one of the most crucial human cognitive abilities, memory naturally exhibits distributed characteristics. In 1998, John Sutton conducted an in-depth study of the distributed memory model by British empiricist philosopher David Hartley and contended that human memory is not stored entirely within the brain, as its retrieval is largely reliant on the body, environment, and other media (Sutton 1998, pp. 248–259).

The introduction of “distributed cognition” has revolutionized the previous research paradigm that involved the understanding of memory operation from the operation of computers, data storage mediums, or information processing systems. Conversely, media researchers use the characteristics of the brain’s distributed cognition and memory to understand the principles of technological mediums, believing that storage medium systems, akin to the human brain, are distributed in a complex manner. They do not merely serve as passive data repositories but actively shape and are shaped by the information they process, the practices they support, and the technologies associated with them (Kelly 1994; Star and Bowker 2000). The homogeneity between memory and digital media has become more conspicuous with the prevalence of the internet.

Andrew Hoskins, combining distributed characteristics similar to memory and the internet, discovered that memory, with the support of network connections, more vividly embodies the

characteristics of distribution and extension. Therefore, based on John Sutton’s “distributed memory model,” he summarized the characteristics of mediated memory, believing it to be “pervasive, accessible, disposable, distributed, promiscuous” (Hoskins 2011, p. 19). An increasing number of studies indicate that memory is not merely stored in a closed brain; it is produced and represented with the continuous assistance of external mediums (Allen 2018; Michaelian 2016). Or, as Daniel D. Hutto and Anco Peeters summed it up, memory is a widely distributed, transactional, and extra-personal process, implying that successful memory behavior requires extensive scaffolding provided by the environment or other individuals (Hutto and Peeters 2018).

Tracing the shift within cognitive science in memory research, this paper discerns that the 1990s heralded a turning point in the study of mediated memory. Influenced by the second revolution in cognitive science, the scientific research on mediated memory shifted towards the study of its constructiveness and distribution. On one hand, the vigorous development of computer technology during this phase allowed for the digitization and visualization of human memory activity. Researchers could utilize neuroimaging technology to study the neural activity process of human memory. On the other hand, the proposition of distributed cognition led neurobiologists and cognitive scientists to recognize the importance of the external environment for memory research. The development of media technology meant that memory could no longer be discussed outside the framework of external socio-cultural contexts. For this reason, in the early 1990s, some researchers classified memory into external and internal memory, defining internal memory as that which is stored in biological memory of the brain while viewing external memory as memory stored and disseminated through external mediums (Donald 1991). For external memory, a scholar pointed out that media provide a warehouse for memory, externalizing memory outside the brain. Memory only appears when connected with the medium as a container (Zelizer and Steiner 1995). Although a scholar of neurocognitive science, Merlin Donald pointed out that it was external memory, not internal biological memory, that constituted a significant factor in human intellectual activity and contributed to our cultural achievements (Donald 1991, p. 309). This viewpoint highlights the deficiency in cognitive science’s study of memory’s external media. In conjunction with the mediated memory research in cognitive science, this chapter summarizes that the constructiveness and distributive characteristics of memory have prompted a shift in mediated memory studies from internal to external and from cognitive science to the humanities and social sciences.

Humanities and social sciences research on mediated memory

During the period from the 1950s to the 1990s, scientific research into mediated memory revolved around the physiological mechanisms of individual memory. This paradigm was significantly influenced by the evolution of cognitive science. However, the advent of the “memory boom” in the 1980s symbolized the commencement of a “collective transformation” in the study of mediated memory, provoking animated discourse in the humanities and social sciences (Garde-Hansen et al. 2009). The “memory boom” shared an intimate correlation with the rise and evolution of nascent media, such as television, the internet, and social media (Garde-Hansen et al. 2009). Although televisions, radio stations, and telephones existed prior to the digital age, digital technology markedly expedited the proliferation of mass media. Furthermore, the advent of the internet in the 1990s significantly amplified our interactions with the external world (Feldman 1997, p. 17). As Jan Assmann elucidated, new electronic

media, serving as innovative external storage and artificial memory, have ushered in a cultural revolution (Assmann 2011). The digitalization of technological media has not only enhanced the amount of available information and the use of media in society (Wessels 2016, p. 1) but also broadened and deepened the practice of mediating memory. The convergence of digital technology and mass media was a primary catalyst for the gradual transition of mediated memory in the 1980s from individual cognitive mechanisms towards cultural structures of the masses and from technical representations of brain memory towards cultural representations of external memory.

Within the domain of communication studies, the delineation between “new” and “old” media by researchers has stirred debates among mediated memory researchers on whether corresponding methodological innovations should be implemented. Numerous scholars have differentiated between digital media (new media) and analog media (old media) in their studies on mediated memory (Arnold-De-Simine 2013; Feldman 1997; Manovich 2001; Merrill et al. 2020; Pickering and Keightley 2016). Some propose that these two forms of media display distinct characteristics of mediated memory and should be studied separately (Arnold-De-Simine 2013; Merrill et al. 2020). However, others assert that the shift from analog to digital media does not necessitate entirely different research methods. Instead, employing the same method across different media can highlight the continuity and change in memory practices associated with these media (Pickering and Keightley 2016).

The concept of remediation, posited by Jay David Bolter and Richard Grusin, stood as a significant intellectual contribution to this debate, attempting to reconcile the paradox between the continuity and change of research paradigms. Remediation referred to the integration or manifestation of one medium within another. It demonstrated how new media inherit the technologies, forms, and conventions of old media, redeploying them for new purposes (Bolter and Grusin 2000). In other words, the relationship between media is not a linear process of substitution; instead, the media of a particular culture enter a relational structure comprising cooperation and competition among various media (Bolter 2008). Especially when new media evolve, old media also evolve to keep pace with the constantly changing situation. For instance, monuments and museums, with the aid of technological media, offer more possibilities for the negotiation of various memories (Huyssen 1995, p. 255). In the digital age, the so-called binary opposition between “new” and “old” media is becoming blurred, with various media participating increasingly in mediated memory practices through media convergence (Jenkins 2006). This reveals that the focus of mediated memory research should not focus only on the boundaries between different media but rather the ways in which media are used, interpreted, and incorporated into other social practices (Couldry 2004).

The sociological study of mediated memory is indissolubly linked to the 1980 publication of the English translation of Maurice Halbwachs’ *On Collective Memory* (Hoskins 2014). Halbwachs’ proposed collective memory concept serves as a mutual acknowledgement of historical events (Halbwachs 1992). The implications of collective memory are strikingly similar to the characteristics of memory propagation facilitated by digitized mass media (Zelizer 1998). This likeness has compelled a multitude of scholars to employ Halbwach’s concept of collective memory as a framework for discussing the media’s role in memory mediation. In this context, some have posited that perpetual collective memory undergoes transformation through the machinations of mass media (Dawis 2009; Novick 1999), while others categorically define mediated memory as collective memory disseminated via media channels (Clark 1986; Huyssen 2003;

Zelizer 1998). One perspective on this phase of mediated memory research posited that the mass media’s practice of mediating collective memory is a form of memory reconstruction, a sort of “selective amnesia” (Wilson 2008), whereby media narratives provide us with an official understanding of the past and history (Hume 2014; Ricoeur 2004), indoctrinating the masses with specific ideological perspectives (Grainge 2002; Sontag 2003), and forcing memory to serve the creation and consolidation of collective identity (McEachern 2002). In this context, mediated memory was considered a highly politicized form of collective memory.

In contrast, another viewpoint asserted that mediated memory inherently possesses significant resilience, thereby rendering it resistant to fixation by any political force. For instance, some scholars have proposed that even within oral traditions, collective memory is consistently reconstructed and unreliable (Fara and Patterson 1998). This is because memory itself possesses performative characteristics. In other words, memory is not merely a passive process of recollection but an active process involving participation and performance (Connerton 1989). Therefore, whether memory is communicated orally, performed ceremonially, or disseminated through mass media, all practices are reenactments of the past, endowing memory with new meanings against the backdrop of contemporary culture (Connerton 1989; Kuhn 2010). Mass media, through different forms of integration and acceleration in the societal shift towards performativity (Abercrombie and Longhurst 1998), positions the audience as both passive recipients of media content and as active participants in the creation and interpretation of media content (Abercrombie and Longhurst 1998, p. 18). They contribute to media content through their performances, using media as a resource for these performances, and their participation and interpretation of media content (Abercrombie and Longhurst 1998, p. 113). For example, the dialogic mode of heritage, as a form of cultural memory, enhances the role of individuals making daily decisions towards actively shaping our past (Harrison 2013). Some scholars conclude that although political forces attempt to influence people’s collective memory of certain events through digitized media, overall, memory possesses resilience (Kligler-Vilenchik et al. 2014). Finally, collective identities shaped by mediated memory are not immutable; for instance, the concept of “identity work” enables us to recognize that people actively interpret memory and reevaluate the past based on current sociocultural needs, thereby continuously recreating and renegotiating identities (Smith 2006).

In research involving the internet, especially social media, new developments have emerged in the controversy over the control and resistance of mediated memory. This time, the focal point for researchers has shifted from the manipulation of political narratives to the manipulation of algorithms. As we store and publish more information in digital media, our perception of events and the world is founded upon the mining and retrieval of data, with different data molding distinct memories. This molding of data is strongly associated with recommendation algorithms (Yu et al. 2016), which are the product of traditional human needs combined with digital commercial services. To increase click-throughs, readership, and views, media adopt strategies of customizing and precisely targeting information for readers and viewers. Bolstered by information technology, this individualization of information needs can now be realized through independent delivery without mingling with unrelated information. Personalized delivery mechanisms based on user preferences have become an essential tool for attracting users on major online media platforms. While such strategies aid in catering to the individual needs of consumers, readers, and spectators, it has been posited that Facebook’s algorithmic information filtration and selection is merely for purposes of entertainment or

promoting advertisements that are relevant to specific audiences, rather than for the precise conveyance of factual occurrences (Vaidhyanathan 2018). When the delivery mechanism automatically filters out information that does not align with our past reading interests, our understanding of events becomes further restricted by the algorithm recommendation, which lacks diverse sources of information to enrich our comprehension.

In reference to the potent algorithmic capabilities of social media platforms, certain scholars have postulated that such platforms determine what aspects of the past are worthy of remembrance, dictating what should or should not be retained in memory (Jacobsen 2022). From this perspective, media determinism appears to have dominated, neglecting the inherent autonomy of the subject of memory. Indeed, different individuals harbor varying attitudes towards algorithmic recommendations. A societal survey discovered that although some users believe that algorithms curtail their autonomy, a larger proportion adopts a positive or neutral stance, considering that algorithms assist them in locating information of interest more efficiently or believing that the ultimate decision regarding which information to use is their own (Dogruel et al. 2022). For researchers subscribing to the autonomy of the memory subject, the way algorithms process information differs from humans—they handle data, not meaning, devoid of human capacity for memory or forgetting. They merely employ the intellect, memory, and sense of significance of human actors to calculate and generate pivotal results (Esposito 2017). In other words, the perusal of content is a voluntary decision by the user, while algorithms treat their choices only as data for processing, being unable to fathom their intrinsic meaning. Thus, the memory of users is a consequence of autonomous selection, not algorithmic manipulation. Accordingly, the notion that the restructuring of memory by the media equates to unilateral manipulation of collective memory by political or technological forces has not gained widespread acceptance.

In particular, numerous scholars have noted that in the memory practises of mass media in the digital age, the boundaries between public and private domains, collective memory and individual memory are becoming increasingly blurred (Elsaesser 2008; Hoskins 2001; Landsberg 2004), leading to challenges in formulating Halbwachs' concept of collective memory. As Wulf Kansteiner observed, "one faces a veritable paradox: the more 'collective' the medium (that is, the larger its potential or actual audience), the less likely it is that its representation will reflect the collective memory of that audience" (Kansteiner 2002, p. 193). This led some scholars to adopt an optimistic attitude towards the potential of mediated memory to resist. For instance, it is argued that mediated memory can resist a singular, authoritative historical truth and narrative (Morris-Suzuki 2005) or that mediated memory can serve as a supplement to mainstream media and official narratives (Bartoletti 2011; Sorensen 2009). New media often presents narratives about the same event from angles that are distinct from mainstream and official media, with new media revolving around individual experiences that offer disparate narratives. This not only allows memory to circulate among diverse groups, exhibiting vitality and multiple meanings (Erl 2011a), but also transforms the medium for memory transmission from the past's "one-to-one" or "one-to-many" to today's "many-to-many" (Garde-Hansen 2011). The practise of memory mediation has evolved from purely "retrieving" from the past to a "selection and combination" method (Coudry 2012).

Concurrently, the continual flow of information grants greater autonomy to individuals in their choices, gradually diminishing the emergence of collective significance as subjective experiences and perceptions take precedence. When people create, share, and consume information through self-media, they are referred to as

prosumers (Jenkins 2006). One scholar noted, "The digital era has seen the expansion of personally produced content, an empowerment of individual creation that represents an epochal transformation of the structures of media communication. All professional content now exists in a competitive relationship with the individual's own content and peer-produced information" (Merrin 2014, p. 52). The diverse array of digital media offers various channels through which people receive information, potentially leading to differing recollections of a single event. The coexistence of official media narratives and new media narratives forms a new memory ecology, where diverse voices coexist and everyone has the right to express memory, an evolution some scholars refer to as the democratization of memory (Assmann and Conrad 2010; Garde-Hansen 2011).

One manifestation of this democratization of mediated memory is the recognition that archives, museums, and other official institutions are no longer the sole repositories of memory (Garde-Hansen 2011). The internet has decentralized memory, dispersing it across the world and transforming media companies, public institutions, private enterprises, and ordinary citizens into custodians of memory. Consequently, scholars have noted, "Digital tools and the internet have made the past is now more present in the present than ever before. Nonstate actors, including private citizens, have greater latitude to create publicly accessible sites of memory" (Zucker and Simon 2020, p. 2). "Rogue memories", constructed by nonprofessionals such as fans, hackers, volunteers, pirates, hobbyists, and minority groups, exemplify this shift: "The rogues of digital archiving have effectuated cultural memory's escape from the state; memory will never again be wholly, or even mostly, under the control of the state or state-approved capitalists. Having fallen under the sway of rogues, cultural memory has become more democratic" (De Kosnik 2021, p. 3). Subcultures (such as fan cultures) and minority group narratives are integral components of "rogue" memory and embody the potential for the democratization of cultural memory. In such a context, memory no longer remains entirely under the control of official or mainstream media but rather is dispersed among digital nomads.

However, numerous academics dispute the notion that the decentralization and democratization of mediated memory necessarily dilute its capacity to bind a community. Landsberg propounds the concept of "prosthetic memory," emphasizing the connective potential of mediated memory across diverse groups. This so-called "prosthetic memory" indicates that digital media can enable individuals to experience an event or a historical period without personal exposure, thereby cultivating an alternative collective memory (Landsberg 2004). Some scholars refer to such media-derived memory without firsthand experience as "post-memory," lauding its potential to transmit critical historical events across generations (Hirsch 2008), thereby fostering inter-generational connections through mediated memory practices. One theory posits that this medium-facilitated experience of remote events and memories transforms individuals from mere spectators into participants, witnesses, and survivors, contributing significantly to our cultural memory (Elsaesser 2008). This suggests that mediated memory can play a pivotal role in the formation of communities. However, these are not communities based on the erstwhile notions of nationhood but are far more globalized entities. In this regard, mediated memory demonstrates the ability to enhance interaction and dialog across broader populations and between individuals and groups.

For instance, many scholars believe that with the advancement of global internet connectivity and transnational communication technologies, the spread of mediated memory content has extended to all corners of the globe (Merrill et al. 2020), thereby engendering a form of "global memory" (Assmann and Conrad 2010; Erl 2011a; Reading 2011). In Reading's words, "the

combination of digitization and globalization within the global memory field means that memory is an assemblage of discursive formations and material practices not limited or bounded by one medium” (Reading 2011, p. 248). This implies that the traditional concept of collective memory is insufficient to encompass mediated memory in the digital age. To this end, Michael Rothberg’s concept of “multidirectional memory” has been proposed to better understand “collective memory” in digital media. He asserts, “Against the framework that understands collective memory as competitive memory—as a zero-sum struggle over scarce resources—I suggest that we consider memory as multidirectional: as subject to ongoing negotiation, cross-referencing, and borrowing, as productive and not privative” (Rothberg 2009, p. 3). As the memory sociologist Jeffrey Olick predicted in 1999, in the digital age, “collective memory” would gradually be supplanted by “collected memories,” referring to “the aggregated individual memories of members of a group” (Olick 1999, p. 338).

Astri Erill further expounded the concept of “collected memories” from the perspective of mediated memory, contending, “Collected memory must be understood as fundamentally a ‘mediated memory’” (Erill 2011b, p. 128). This is because the term “collected” aptly conveys the process of individuals utilizing cultural elements from their social environment via the medium. Astri Erill emphasizes, “‘collected memory’ as the socially and culturally formed individual memory. We remember with the aid of culturally specific schemata” (Erill 2011b, p. 97). Mediated memory, as an amalgamation of individual memories into collective memory, is derived from culturally specific schemata and serves as cultural representation. This definition aligned with José Van Dijck’s earlier definition of mediated memory, which posited that it is both personal and collective. This is because the mediation of memory can be viewed as a cultural selection process, and mediated memory entails the definition of individual memory within a larger cultural framework. Therefore, mediated memory not only enables the cultural representation of collective memory on a larger scale but also turns individual memory into a cultural phenomenon (Van Dijck 2004).

Finally, with the affordability and ubiquity of personal electronic devices (smartphones, notebooks, portable storage), scholars have started to examine the enhancement of human memory capacity that is facilitated by digital media. As digital storage and electronic devices become ever more integrated into daily life, people’s actions and life details are transformed into data streams. The digitization of life has profoundly influenced our memory of events, rendering memories of daily occurrences increasingly lucid and traceable, particularly with the assistance of digital media. Some scholars term this phenomenon the “end of forgetting” (Mayer-Schönberger 2011), positing that humans, with the aid of technological media, now possess the ability to “recall everything” (Bell and Gemmill 2009). Technological media enable humans to preserve memories of events and access information more readily about past occurrences. Leveraging the classification, retrieval, and rapid access capabilities of digital devices, digitized information not only verifies the authenticity of memory but also reconstructs scenes without omission. In other words, the comprehensiveness and precision of data enhance the veracity of memory, compensating for the imperfections and unverifiability of human recollection (Assmann 2008; Garde-Hansen et al. 2009). However, the condition of remembering everything with the aid of media has led many scholars to worry about “memory overload,” subsequently emphasizing the importance of the right to be forgotten and the autonomy of information (Ghezzi et al. 2014; Mayer-Schönberger 2011).

By retracing the research on mediated memory in the humanities and social sciences, this chapter synthesizes three pivotal aspects. First, the contemplation of the sociocultural framework

of mediated memory should not overlook the flexibility of individual memory cognition. The study of “external” frameworks needs to be grounded in the insights of individual memory cognition research. Second, it has become more challenging to distinguish between individual and collective memories within mediated memory. Especially in the era of social media, the memory uploader is not only a witness to individual memories but also a global memory producer and a consumer of mediated memory. From this perspective, once a memory is presented in digital media, it acquires social attributes. Consequently, individual memories serve as one source of collective memories. A scholar concluded that even our most private memories captured in media forms are related to others; therefore, they are public, and media contains memories. All interactions with media become part of our experiences and memories (Mihelj 2017). Last, the development of digital media itself has an increasingly significant impact on mediated memory research, suggesting that “digitization” for mediated memory is not merely a discussion context but is gradually embedding itself in the ontology of mediated memory. These three key points have catalyzed a paradigm shift in mediated memory research.

Interdisciplinary research on mediated memory

With the onset of the 21st century, an increasing number of researchers have discerned that the dichotomy between the physiological and cultural dimensions of mediated memory research has detrimentally impacted our comprehensive understanding of the subject. Consequently, mediated memory investigations have witnessed an uptick in interdisciplinary endeavors, particularly those that merge cognitive science, computer science, and humanities-social science. As José Van Dijck elucidates, “mediated memories means our memories are embodied by individual brains and minds, enabled by the technologies and material objects that render them manifest, and embedded in social practices and cultural forms” (Van Dijck 2007, p. 174). This perspective has subsequently garnered widespread acceptance among mediated memory researchers (Bondebjerg 2014; Erill 2011b; Garde-Hansen 2011; Heersmink 2018).

Despite recognition by cognitive psychologists that there is an intimate interconnection between memory’s physiological foundations and its external environment (Donald 1991), only a handful have succeeded in incorporating this consideration into their research (Hoskins 2011). Merely acknowledging the existence of another research paradigm in one’s study does not constitute interdisciplinary research. As such, Hoskins posited an interdisciplinary criterion for mediated memory research that requires engagement with literature, theories, and methodologies across various disciplines (Hoskins 2011, p. 21). However, in specific mediated memory studies, the engagement with literature is subsumed under the exploration of theories and methods. Hence, the triad of interdisciplinary standards proposed by Hoskins can be condensed into two aspects: theory and methodology. Many researchers approach the multidisciplinary investigation of mediated memory from these two aspects.

In the 21st century, the interdisciplinary characteristics of mediated memory research manifested in a shift in theoretical foundations. The theory of distributed memory in cognitive science gradually became the theoretical premise for mediated research in numerous ways, intertwined with discussions about the environment and cultural background. Hoskins coined this interdisciplinary research based on distributed memory as the ecological study of memory. The ecological study of memory investigates the dynamic relationship between individual memory and cultural memory. As Hoskins states, “So, rather than having ‘memory’ off into distinct and separate zones or even

‘containers’—the body, the brain, the social, the cultural etcetera—an ecological approach is interested in how these together work or don’t work in producing memory” (Hoskins 2011, p. 24).

Additionally, other scholars have navigated towards an inclusive understanding of mediated memory, treating physiological elements and sociocultural aspects as part of a unified, dynamic memory system. The concept of “embedded cognition”, proposed by Hayles, provides an understanding of memory attributes, suggesting that humans utilize environmental objects to support and enhance memory (Hayles 2012). This perspective on the distribution of memory and embedding it in technological mediums has drawn scholars’ attention to object memory. For instance, Giaccardi and Plate, through the workings of the Internet of Things, observed that as humans delegate a greater number of tasks to objects and use them to assist their memory, the memory of these objects reciprocally shapes human memory, challenging the anthropocentric interpretation of memory (Giaccardi and Plate 2016). Meanwhile, Allen noted the direct interfacing of media technology and biological systems, which are capable of surpassing human memory, necessitates our acknowledgement of the roles played by digital spaces and non-human entities (such as cells and biomaterials) in the memory process (Allen 2018). Another study considers the smartphone to be an externalizing tool for memory that has taken over numerous cognitive functions previously managed by the brain, becoming a major nonbiological source to enhance biological memory (Stone and Wang 2019). Clowes argues that ubiquitous electronic devices are wearable extended memory technologies for humans. He further underscores the importance of establishing theoretical hypotheses regarding the role of electronic memory (E-memory) within distributed memory in empirical research methodologies (Clowes 2017).

Indeed, some scholars have explored the influence of physiological and environmental factors on mediated memory by simultaneously harnessing distributed memory theory and empirical research methods. For instance, Sparrow and colleagues unearthed, through four cognitive experiments, the influence of “external memory” in the “digital age” on human physiological memory: people tend to remember the location in the network where the memory is stored rather than specific information on the internet. This indicates that we are cohabiting with our computer tools, evolving into interconnected systems. Humans no longer memorize information by understanding the content but by knowing where to find it (Sparrow et al. 2011). Another experiment employing fMRI to explore the brain mechanisms of collective memory formation discovered that collective memory exists both outside and within individuals, organizing individual memories and constructing a shared psychological model linking people’s memories across time and space (Gagnepain et al. 2020). These studies underscore that media factors, bolstered by digital enablement, play an increasingly significant role in memory construction.

Within the paradigm of humanities and social sciences research on mediated memory, scholars primarily substantiate the influence of media on memory by incorporating sociocultural theories, while in the interdisciplinary research of mediated memory, researchers chiefly validate the impact of digital media on shaping memory through cognitive experiments. On the one hand, scholars highlight the enhancing function of digital media (particularly social media) on human memory. For instance, some researchers tested the memorability of Facebook posts (or tweets) compared with other forms of information (such as sentences in books or faces). They found that the memory of Facebook posts markedly surpassed that of other types of information (Mickes et al. 2013). Another scholar explored the relationship between Facebook and memory through the lens of the stage theory of memory and the level-of-processing mode,

discovering that employing Facebook for academic purposes, such as submitting homework, could potentially amplify memory retention and learning efficacy (Acar 2014). Another study discovered that selectively sharing personal information on social media (Facebook, Twitter) may enhance the memory of the posted information. Merely retrieving an event from memory helps ensure subsequent recollection of the same event when done against a backdrop of social sharing, and the effect becomes more pronounced. Participants recalled more memories posted online than those that were not (Wang et al. 2016).

Conversely, there is abundant research pointing out the potential misguidance of memory due to media factors. A study found that presentation media (Twitter versus nonsocial media) and language style (informal versus formal) affected false memories. The control group (nonsocial media) showed more false memories than the Twitter group, suggesting that the type of media presentation influences false memory formation (Fenn et al. 2014). In an experiment on the impact of post-sharing on social media on memory, researchers found that some shared information was more prone to memory errors than information that was not, indicating that selectively sharing public information could lead to memory consequences similar to consuming public information, resulting in reduced recall abilities (Jiang et al. 2016). Another study suggested that using media to preserve moments could prevent individuals from fully experiencing them from the outset, thus affecting their memory of the events (Tamir et al. 2018).

As researchers deepen their understanding of mediated memory through empirical experiments, distributed memory theory, initially premised on physiological factors as the primary and external factors as secondary in cognitive science, has gradually shifted to a “dual-centered” or “multicentred” research hypothesis. This shift has led some scholars to focus on memory-in-the-body, located between external and internal memory, inspired by cognitive science’s embodiment of theories in interdisciplinary studies on mediated memory. Lagerkvist, for instance, proposed the concept of the device body, arguing that digital memory technologies are intimately connected with our bodies and that our memories are formed through the interaction of the body with digital media. Both our embodied self and traces of memory are embedded within our technologized daily lives that are a part of our connected culture (Lagerkvist 2016). Another study used body-worn virtual reality technology as a tool for memory research and found that, due to its immersive interactive experience, using a virtual environment could enhance memory performance (Peeters and Segundo-Ortin 2019). The body has been consistently viewed as a bridge between the brain and the world, and the embodied study of mediated memory lays the groundwork for a clearer understanding of the relationship between intracranial memory and sociocultural memory. It also points out the significance of embodied technology (such as virtual reality and augmented reality) in constructing memory for the future.

Through a comprehensive review of interdisciplinary research on mediated memory since the 2000s, this chapter illuminates the critical role of cognitive sciences and humanities, along with social science research, in establishing a solid foundation for this emergent field. This confluence has not only endowed mediated memory research with greater autonomy and independence but has also allowed researchers, unhindered by disciplinary boundaries, to embrace diverse theories and methodologies to systematically decode the intricacies of memory mediation.

Conclusion

Mediated memory research history has transitioned from a mere subdiscipline of cognitive science, cultural studies, and sociological studies to an autonomous field of research. The journey

demonstrates that memory is inherently mediated. Recent research now views memory as a continuum, blending individual biological attributes and societal influences. Therefore, this paper posits that an interdisciplinary approach is indispensable for comprehensively understanding the nature and mechanisms of memory construction. The current stage of interdisciplinary research is focused on integrating paradigms across various disciplines. The forthcoming challenge lies in leveraging this integration to develop unique theories and research methodologies specifically suited for mediated memory research. Through the understanding that memory is a dynamic and mediated construct, we open new avenues for exploration and comprehension in the digital age.

Data availability

Data sharing is not applicable to this research as no data were generated or analyzed.

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Author contributions

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Competing interests

The author declares no competing interests.

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