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Toward new memory sciences: The Programme 13-Novembre

Francis Eustache, Denis Peschanski

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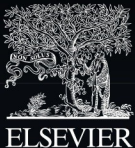
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PROGRESS IN BRAIN RESEARCH

Collective Memory

274



Edited by
Shane O'Mara

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Volume 274

Collective Memory

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Collective Memory

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Toward new memory sciences: The *Programme* 13-Novembre

8

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Abstract

Studies devoted to individual and collective memory have evolved in a compartmentalized way for more than a century. We recall the most emblematic historical works of two distinct visions of memory: those of the experimental psychologist Hermann Ebbinghaus who measured memory, on himself, from lists of meaningless syllables, and those of the sociologist Maurice Halbwachs for whom any act of memory is a social act. Since the beginning of the years 2000, the social turn in life sciences and, more rarely, the opening up of sociologists and historians to the life sciences have tended to bring these hitherto compartmentalized currents together. The *Programme 13-Novembre* has seized upon a diversity of research tools on memory by applying them to a traumatic event in French society: the attacks of 13 November 2015 in Paris and its immediate suburbs. The main objective of this program is to better understand the links between individual and collective memory in the construction of these memories related to this traumatic event. This research is fundamentally transdisciplinary—i.e., developed by researchers from different disciplines—and longitudinal over 12 years to understand the evolution of memories over time. Our studies focus on people who were closest to the traumatic event—and likely to develop posttraumatic stress disorder—and on those who were further away but who are more representative of the general population. We present some of the results, derived from data collected in studies of the program that feed our advocacy for new memory sciences.

Keywords

Memory sciences, Individual memory, Collective memory, Flashbulb memory, Post-traumatic stress disorder, 2015 November 13, Public health, Sociology, History, Neuroscience

CREDOC	Centre de recherche pour l'étude et l'Observation des Conditions de Vie
ESPA	Enquête de Santé publique Post-Attentats
MRI	magnetic resonance imaging
PTSD	post-traumatic stress disorder

1 Inconsistent and compartmentalized premises (mid-19th century—first world war)

Scientific research on human memory began in the second half of the 19th century. The German psychologist Hermann Ebbinghaus was the first to “measure memory,” at a time when experimental psychology was still steeped in psychophysics and measured perceptual thresholds and other low-level indices. It took boldness to tackle a function as complex as memory and to measure different manifestations of it in experimental situations as varied as free recall, recognition, or even “relearning economy,” i.e., relearning the same material once time and forgetting have made access to the acquired material more illusory. To seek is to give up, to take the path of a sometimes-extreme reductionism. Thus, in order to measure memory, Ebbinghaus will learn (he is the only subject of his experiment) lists of syllables without meaning, without affect, totally decontextualized... “Memory” as object of study becomes the processes of encoding, storage, restitution, but the content must be reduced to its simplest form so as not to pollute the analytical study of memory mechanisms. Ebbinghaus, and many authors of this “golden age” of the memory studies, are perfectly aware that it is an eminently complex function which cannot be reduced to the conscious recollection of material devoid of meaning and affect, but it is necessary to go through this to apprehend it with a scientific method which very quickly leads to the mastery of various methods of measurement, to the description of the curve of forgetting, to the positive role of sleep in the consolidation of learning...

The turn of the 19th century and the 20th century was a particularly fertile time. In Moscow, Sergei Korsakoff described the amnesia syndrome, which later bore his name, in heavy vodka drinkers who seemed to forget everything, but who nevertheless retained the ability to form traces. Thus, an encounter with a situation, for example, the doctor's visit to the patient's room, modifies the latter's behavior, who does not consciously “remember” having seen him, but who leaves “traces” in his behavior of having already met him: not shaking his hand, for example, since he had done so a few minutes earlier. Korsakoff published his founding article in the *Revue philosophique de la France et de l'Etranger*, founded and directed by the French psychologist Théodule Ribot, to whom we owe the monograph *Les Maladies de la mémoire (Memory diseases)*, which presents this function in the form of different strata ranging from the simplest to the most complex, the fruit of phylogenetic and ontogenetic evolution. The most complex manifestations are also those that are most susceptible to pathological processes. In general, conscious processes seem to be more affected by memory diseases than non-conscious processes. Ribot and many other authors of the time explored this path. One of the most elegant demonstrations was made by the Genevan psychologist Edouard Claparède, who, using techniques

inherited from Ebbinghaus, showed an “economy of learning” in a patient suffering from Korsakoff’s syndrome. Experimental psychology was thus invited into the exploration of memory diseases.

To continue to set the scene for this golden age, we must mention Alois Alzheimer’s and the description of neurodegenerative diseases, including their neuropathological lesions, the works of philosophers like Henri Bergson and *Matière et mémoire* (*Matter and Memory*), Edmund Husserl and *Phenomenology for an Intimate Consciousness of Time*, the birth of psychoanalysis by Sigmund Freud, who himself had a neurological background, literature and Marcel Proust’s monumental and avant-garde work *À la recherche du temps perdu*, which brings to the forefront, in this fertile medical and scientific landscape, the power of “involuntary memories.”

All the conditions therefore seemed to be in place for a methodical and conceptual memory science to take root throughout the 20th century. However, history was written differently and the Great War contributed to slowing down the brilliant discoveries made on both sides of the Rhine and well beyond. Behaviorism, the dominant trend in psychology in the first half of the 20th century, also distanced researchers from the study of memory mechanisms. However, the pathological method initiated by Ribot and masterfully illustrated by his monograph “*Les maladies de la mémoire*,” did not really cease.

2 The “collective memory” revolution and the time of missed opportunities (1918–1945)

During all these years, and until recently, the concept of collective memory has not been integrated into psychological or neuroscientific work on memory. However, in 1925, in a pioneering book—*Les cadres sociaux de la mémoire*—the French philosopher and sociologist Maurice Halbwachs wrote that every act of memory is a social act. Thus, when I encode a memory, I encode it within a certain social framework, and when I recall a memory, I recall it within a certain social framework. Even if I am alone, I am never alone, I am always in representation. Halbwachs thus anticipates the work of social psychology carried out at the beginning of the 21st century, which emphasizes the communicative and reconstructive dimension of memory, which is constantly constructed and modified in exchanges between individuals, under the guidance of a form of collective memory, sometimes called shared memory.

Although Maurice Halbwachs initiated a real epistemological revolution by promoting the concept of collective memory in a sense that was to remain unchanged thereafter, he insisted less on the possibilities of dialog with the life sciences than on stressing that memory is first and foremost a social act: “It is insofar as our individual thought is placed in these frameworks and participates in this memory that it is capable of remembering” (Halbwachs, 1925).

The proposal seems to leave little room for dialog with life sciences. However, bridges were possible and emerged in the inter-war period, although they were not really used. Psychologists even wished to engage the dialog, such as Jean Delay in his work published in occupied Paris in 1942 under the title *Les Maladies de la mémoire* (*Diseases of memory*), using Ribot’s title in passing (Delay, 1942). At the same time,

we can mention Lucien Febvre. In 1941, one of the two founders of the *Annales d'histoire sociale* (12-1182) proposed a major article on the possible articulation between history and psychology, much influenced as he was at the time by his friend, the psychologist Henry Wallon, whose reference article appeared in the *Encyclopédie française*. He wrote, like a call to research: “And so here a beautiful subject. So many people are leaving, and they feel sorry for themselves at every step: there is nothing left to discover, it seems, in seas that are too well-traveled. Let them plunge into the darkness of psychology in the grip of history: they will regain a taste for exploration.” Quite a program in a way! But this appeal will be just a bottle in the sea.

However, a few authors anticipated Wallon’s approach. It is the psychopathologist Pierre Janet, whose name has not been sufficiently remembered in the maelstrom caused by Freud’s thoughts and writings. Although he had already produced a great deal at the beginning of the twentieth century, his lectures at the *Collège de France* in 1927 and 1928 under the title *L’évolution de la mémoire et la notion du temps* (Janet, 2006) should be read. For its part, Jean Piaget introduced the notion of “schemas” in an article on “Language and thought in children” (Piaget, 1948). The connection is there with the theory of schemas proposed by Frederic Bartlett in 1932. In his book entitled *Remembering* (Bartlett, 1932), he set out, on the basis of an experimental psychology experiment, to understand the transformation of memory with time. “Schemas are abstract cognitive structures, they are formed by various confrontations with the environment, they organize information according to specific modes and groupings.” He is talking about an interaction between the environment and the subject. The “schemas” he refers to are therefore essential for understanding how memory works, and the concept is taken up in a number of current neuroscience studies.

It is striking that psychologists interested in collective memory generally turned to Bartlett, while sociologists and historians were only familiar with Halbwachs (1925, 1950). It was not until the years 2000 that things started to move. In the meantime, the bridges had been broken or simply not built.

3 The time of disciplinary closure (1970s–2000s)

As an intermediate step, cognitive psychologists, from the 1970s/1980s onwards, put a lot of emphasis on contextual memory: the spatial context, the temporal context, which contribute to qualifying the subjective impression of memory, but they had not integrated the social dimension into their analyses and their modeling.

Since the years 2000, the study of social cognition has seen major advances in psychology and neuroscience. For example, the theory of mind has become an essential concept for understanding various neurodevelopmental or neuropsychiatric disorders. However, the strong development of cognitive sciences appeared to be marked by the desire to seek the keys to understanding memory mechanisms in neuroscience, and not in a dialectic between neuroscience and social science. In fact, it was not from the cognitive scientists that the multidisciplinary opening came.

Nor did it come from the human and social sciences. What we will call the second epistemological revolution in work on memory was particularly fruitful, but it

resulted in a disciplinary seal. This was in the 1970s, 1980s, and 1990s. Pierre Nora and his multi-year seminar on “*Les lieux de mémoire*” (Nora, 1984–1992) were the first to produce his major work and, as a relay, work throughout the world on this new theme of “*lieux de mémoire*.” In the following decade, Lavabre (1994) and Rousso (1987) set out to decipher the memory of major historical upheavals, communism in the case of the former, Vichy and the French state in the case of the latter. The phenomenon is general in the world, most often by declining the themes of places and moments according to the countries, their cultures and their histories. But Lavabre and Rousso proposed also an in-depth conceptual framework for approaching collective memory (Lavabre, 2011; Rousso, 2012).

We can also mention the sociologist Jeffrey Olick who, since the 1980s, has been working on the theoretical foundations of collective memory while at the same time working on the memory of the Holocaust in post-war Germany. By distinguishing between “collective” and “collected” memory, he points out the constant aporia in this disciplinary field: we talk about collective memory, but at the same time we also try to work on individual testimonies that participate in the construction of the collective (Olick and Levy, 1997).

More generally, a great German historian, Jan Assmann, was to leave his mark on the whole new generation of historians and sociologists with his work on “cultural memory” (Assmann, 1995). Informed by his work as an Egyptologist, he recomposed the concepts to enrich, rather than to distance himself from Halbwachs’ conceptual toolbox and was also greatly influenced by the art historian Aby Warburg, proposing to distinguish between “cultural memory” and “communicational memory.” In these and other authors, we see a distinction between a shared memory that allows exchanges between individuals and a cultural or social memory that transcends them, a distinction that we have taken up on a theoretical level and in the very conception of the *Programme 13-Novembre* (see below). These different forms of memory change over time and constrain the memories of individuals.

The 1960s thus saw the emergence of a new current in experimental psychology: cognitive psychology, whose objective is to describe the mechanisms of thought, including of course memory; Neuropsychology, whose subject of study is the patient suffering from a brain lesion, followed suit with brio. The descriptions of amnesic patients by Brenda Milner, Endel Tulving and others brought a new dynamic to studies on human memory, soon supported by the discoveries of cerebral imaging, both in healthy subjects—it was indeed possible, from the 1990s onwards, to visualize the brain in action—and in patients suffering from a memory pathology. This new golden age of memory studies is committed to describing “without complex” the conscious and non-conscious mechanisms of memory, including its subjective dimensions, in the links that unite consciousness and memory: what is the level of consciousness attached to this or that expression of memory? Even more surprising and innovative, experimental methodologies are being developed—such as the Remember-Know or Actor-Observer paradigms—to apprehend the subjective impression of memory retrieval. The study of memory is no longer restricted to the mechanisms of the memory instrument (encoding, storage, retrieval) but also and increasingly to the contents of memory and their changing evolution. The beginning

of the 2000s saw the arrival on the scene of autobiographical memory, memory specific to an individual which is constructed and updated throughout his life. In a little over a century, the study of human memory has been enriched; it has moved closer to the mental life of the individual in order to gain access to his or her intimacy, but this evolution—autobiographical memory is emblematic in this respect—has reinforced the individual dimension of memory.

However, it must be noted that all these major works were built within a disciplinary framework. They do not ask the question that seems to be crucial and that feeds the memory sciences that we promote: is it possible to fully understand collective memory if we do not consider the cerebral dynamics of memory? Is it possible to fully understand these cerebral dynamics if we do not consider the impact of the social?

4 The time of rapprochement (the turn of the millennium)

Despite all the years marked by compartmentalized developments in psychology-neuroscience and social science research, we are witnessing the emergence of a new research field combining the latest advances in cognitive neuroscience and the understanding of collective memory mechanisms.

This had already been happening for several decades with the cognitive revolution of the 1960s and, above all, the work on “autobiographical memory,” a concept that was so present among neuropsychologists from the 1980s. What has been called a “social turn” in psychology and neuroscience is becoming increasingly apparent.

In neuropsychology, autobiographical memory refers to personally relevant events situated in space and extended over time that enable a sense of identity and continuity over time. Although interactions between individual memory and collective memory have been stressed, its assessment is still focused on a personal dimension. In psychology and in neuroscience, since the end of the 20th century, the “social turning point” gradually led to the recognition of the social aspect of memory as it is now accepted that autobiographical memories lie at the interface of personal identity and collective conceptions.

Closest to the theories of Halbwachs and Bartlett, the work carried out by [Coman et al. \(2009\)](#) is the most representative. They show that, during an exchange between several individuals, on the one hand the arguments evoked are enhanced—they will be more easily shared between the individuals and accessible in memory later on, and on the other hand the arguments not evoked are degraded, i.e., they become less available than before the initial exchange between the individuals. In addition to highlighting their dynamic and changing nature, this work shows that memories are constructed in exchanges between individuals.

Several models of autobiographical memory organization have been proposed. According to Conway’s model ([Conway, 2001](#)), which is one of the most widely used in neuropsychology, memory reconstruction involves access to different autobiographical elements that can be classified into four levels of increasing specificity. These contain general semantic knowledge associated with life history (e.g., my professional career), with periods of life (e.g., when I was a student in psychology or history), with general events (e.g., my clinical activity at the hospital or my lectures

at the University of Humanities and Social Sciences), and finally with the specific details of an event (e.g., a consultation that was particularly striking or that posed a particular problem or a somewhat heated discussion at a symposium on the Second World War). In this last level, the spatiotemporal context and the perceptions, thoughts and emotions present at the time of encoding are accessible to our consciousness. The episodic nature of the memory depends on access to this level of detail from more general knowledge. Most often, this access involves the executive functions and the subject's identity model, also known as the "Self." In recent years, numerous studies have highlighted the specific alterations of autobiographical memory in various pathologies related to various cognitive disorders.

According to current conceptions largely derived from the theses of [Tulving \(2001\)](#) and Conway, autobiographical memory is nourished by our personal experiences and its evaluation has emphasized the subjective dimension during retrieval: precision of details, impression of reliving, which is sometimes called the phenomenology of memory ([Eustache and Desgranges, 2020](#)). On the other hand, in the context of this work, the importance of the relationship with the other and with our social and cultural environment has been largely underestimated until recently.

Another avenue is rich in new connections. Within the collaboration/confrontation between neuroscience and cognitive science, the question of social issues has been asked. The impressive work edited by [Cacioppo and Bernston \(2002\)](#), entitled *Foundations in Social Neuroscience*, makes this clear. In the early 1990s, these two authors had already expressed the extent of the challenge:

"Social science addresses fundamental questions about the mind and its dynamic interactions with the biological systems of the brain and the social world in which it resides."

In their seminal book published in 2002, they suggest numerous and fascinating lines of thought which go far beyond their own disciplines.

The conceptions defended by the psychologist William Hirst fit well into this framework. For this author, it is necessary to integrate the psychological dynamics of individual recollection into the definition of collective memory ([Hirst and Manier, 2008](#); [Hirst and Echterhof, 2012](#)). His objective is clear: he seeks to understand the role for psychology in the voluminous social science discussion on collective memory. The bottom-up approach is concerned with the individual cognitive factors that modulate the formation of collective memory, and how these individual mechanisms are modulated by interactions within the group (communicative memory). The top-down approach focuses on the general principles that govern the influence of collective memory on individual memories.

5 Setting up a search

The reference to William Hirst, professor at the New School (NY), is not a simple coincidence of intellectual convergences. He was associated early on with the first work we launched between Paris and New York on individual and collective

memory. This began at the end of the 2000s and was based on the postulate that it was necessary to work between the human and social sciences and the life sciences to understand memory issues. At that time, we were working on two major moments in recent history: the Second World War and 9/11 terror attacks.

It is from the neurosciences that we have seen the development of reflections on the inference of collective memory in the brain. What pathway does it follow? What mechanisms are at work? Maurice Halbwachs emphasized that individual memories are constrained by the social frameworks in which they are inserted. According to this perspective, the functioning of the memory in individuals cannot be understood without also looking at their membership to a group, and the social frameworks linked to collective memory. Within the framework of our programs carried out thanks to the *Matrice* equipment of excellence and the Cyceron medical imaging platform, the study of Gagnepain et al. (2020) tested for the first time this theoretical proposal and highlighted the link between collective memory and personal memories in the brain of individuals using brain imaging.

Collective memory is made up of symbols, stories, narratives, and images that contribute to the construction of a community's identity. To better understand this notion, the researchers first analyzed the media coverage of the Second World War in order to identify the common collective representations associated with this period. They used the content of 30 years of reports and documentaries on the war, broadcasted between 1980 and 2010 on French television, and transcribed in texts from the audio-visual material. Using an algorithm and textometric analysis, they identified groups of words regularly used to talk about major themes associated with our collective memory of the Second World War, such as the landing of the Allies in Normandy.

The researchers then recruited volunteers to visit the World War II Memorial in Caen and invited them to observe photos from that period, accompanied by their captions. Based on the words contained in these captions, the team was able to determine the proximity between each of the images: when two photos were associated with the same themes, they were considered "close" in the collective memory. The researchers then sought to find out whether the same degree of proximity between the photos was found in individual memories by offering the volunteers an MRI scan, while they recalled the images seen the previous day at the Memorial.

This innovative approach allowed an indirect comparison between collective and individual memory. The results show that collective memory, which exists outside and beyond individuals, organizes and shapes individual memory. This study is thus the first to show how collective memory enters an individual's brain. Beyond that, this work proposes a model of inference of collective memory on individual memory and is in line with the more general objective of the *Programme 13-Novembre* which is to propose various models of inference from different disciplines.

The study by Dégeilh et al. (2021) focuses on the data collected by William Hirst and his colleagues during their 10-year program about 9/11 memory and, more specifically, on the key issue of flashbulb memory and its evolution. The memory of the conditions in which an event is learned—definition of flashbulb memory, versus the memory of the event itself (event memory)—has long been a key issue in the work of

psychologists and had been explored by Hirst on his corpus of questionnaires collected four times in 10 years between 2001 and 2011. In the same vein, it is interesting to read the remarkable study carried out in six countries by Antonietta Curci and Olivier Luminet on the flashbulb memory/event memory pair, still on the subject of the memory of 9/11 (Curci and Luminet, 2006). However, in our article, Dègeilh et al. aimed to focus on the 204 people who had answered four times and to use the resources of textometry to understand how flashbulb memory of the terrorist attacks of 9/11 evolved, by borrowing the tools developed in *Matrice*, while favoring a transdisciplinary approach. In particular, this allowed us to see how references to time, on the one hand, and to space and emotions, on the other, evolved differently, the former gradually fading away while the latter seemed more resistant. Yet, what we wish to show here is above all that a transdisciplinary approach to memory is taking a concrete form.

These two articles are already the tangible result of a research program that we had initiated. They are already based on the choice of transdisciplinarity and the bet of the dialectic between individual and collective memory. The terror attacks of 13 November 2015 were to upset the political agenda but also our scientific agenda. Fig. 1 broadly proposes a modeling of the links between individual memory and collective memory.

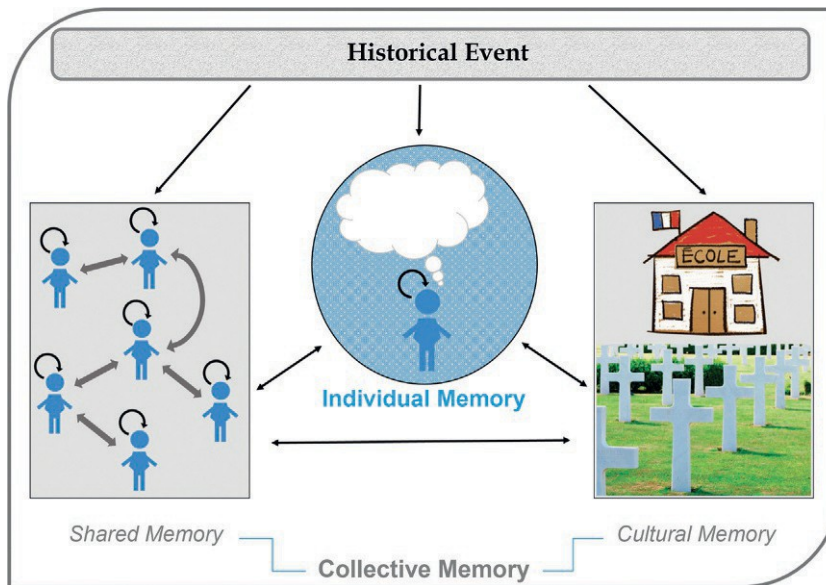


FIG. 1

Individual memory and collective memory of an historical event.

6 The *Programme 13-Novembre*

With the *Programme 13-Novembre* on the memory of the terror attacks of 13 November 2015 in Paris and Saint-Denis, the aim has been to respond to a challenge—to analyze the memory of a traumatic event—by proposing a transdisciplinary approach which, in our opinion, is the only way to answer all the questions that arise (Fig. 2). It is also a question of changing scale. Finally, it is a question of responding to horror with a civic commitment: Francis Eustache and Denis Peschanski, as scientific leaders of the program, and the dozens of people involved in the adventure, wanted to respond to the terrorists with our weapons, the weapons of research and knowledge. If our unusual program was chosen, it was to respond to this urgency, but also because those in charge of this program had in a way proved themselves by developing, in *Matrice*, tools to respond to the major question that arose: to articulate individual memory and collective memory of a traumatic event, since it was not a question of working on the event itself, but on the memory of the event (Eustache and Peschanski, 2017, 2021).

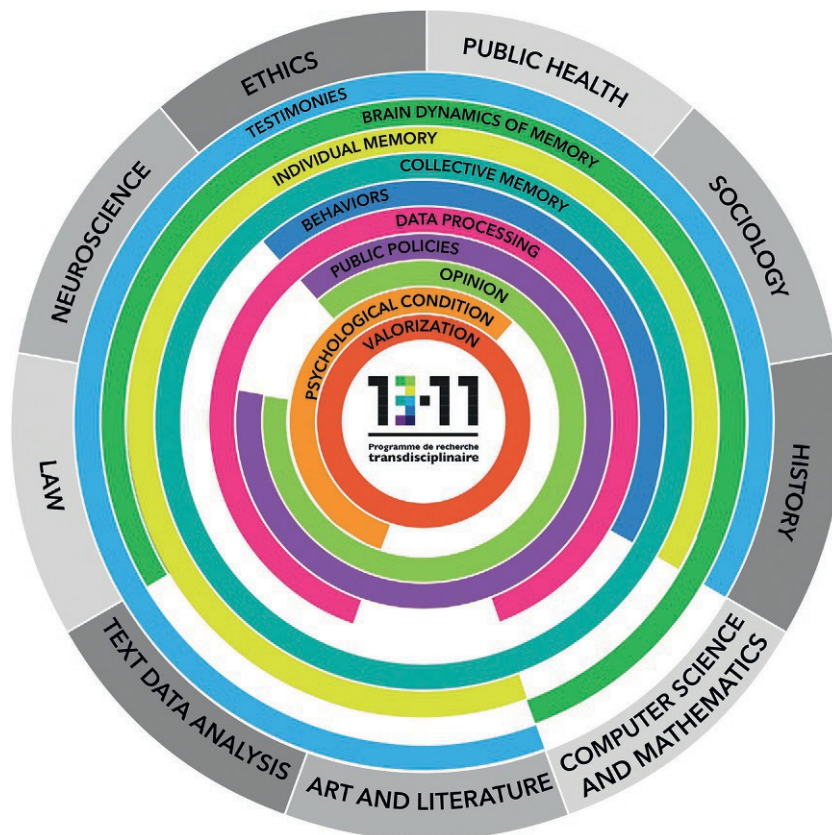


FIG. 2

The *Programme 13-Novembre*. A transdisciplinary approach.

The *Programme 13-Novembre*, which is to run from 2016 to 2028, currently comprises ten or so components. It is mainly based on two main research protocols: the “*étude 1000*” (forged in the human and social sciences, but opening up to psychology and now Artificial Intelligence) and its ancillary study in neuroscience, REMEMBER, of which we will report some results in this article and for which several questions can only be answered by mobilizing the analyses of the human and social sciences.

Cohort follow-up means that we are trying to collect the audio-visual testimonies four times in 10 years of some 1000 people, hence the name “*étude 1000*,” an objective launched without any guarantee at the very beginning when the project was written. It was then a question of finding them 2 years later, 5 years later and 10 years later. We can already report that the first three phases have been completed, in 2016, 2018, and 2021. We will come back to this.

For the biomedical part, travel and attendance time meant that there was a time lag. Two phases have already taken place. A third, more complex, phase will begin in the autumn of 2022.

This longitudinal program raises both technical and epistemological issues: developing protocols at the crossroads of disciplines, with the latest specialized tools. It requires a rigorous and innovative research support team. In the research units and at all the partners’ sites, dozens of staff work to make the results possible, to perpetuate them and to promote them. No less than 20 PhDs, most of them in progress, are attached to the program, in neuroscience as well as in political science and sociology, in law as well as in psychology, in epidemiology and in Artificial Intelligence.

6.1 “*Etude 1000*”

The “*étude 1000*” is the cornerstone of the program and aims to collect the testimonies of the same thousand people during four filmed interview campaigns in 2016, 2018, 2021, and 2026. The same protocol, designed in a transdisciplinary way in 2016, is applied to each phase. The duration of the interviews varies and mobilizes the volunteers for up to half a day at the filming location. The recordings are made by the *Institut national de l’audiovisuel* (INA) and the *Établissement de Communication et de Production Audiovisuelle de la Défense* (ECPAD). (Fig. 3).

Those who are familiar with the work of William Hirst will rightly think of the extensive work he carried out over 10 years on 9/11 memory by sending out a written questionnaire four times in 10 years. The results have been fascinating (Hirst et al., 2015), especially about flashbulb memory and episodic memory. Whether it is this study or, epistemologically, his thoughts on the psychology of collective memory, it is clear that his influence on our work has been important.

However—and no doubt on the basis of his experience—we have taken a slightly different approach.

- We have decided to organize four campaigns of 1000 interviews over 10 years, but, as much as possible, with the same people

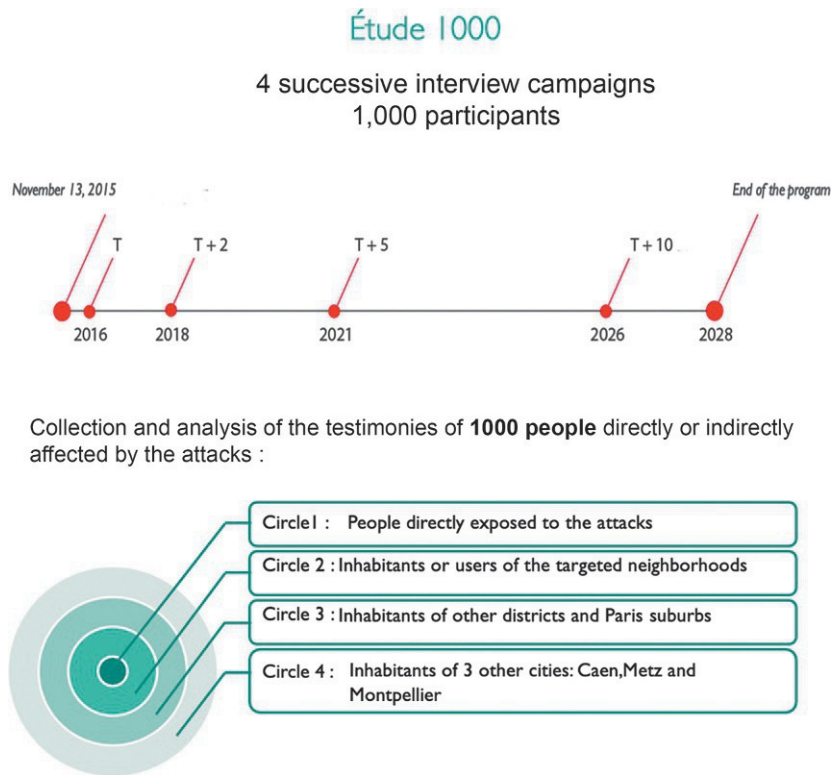


FIG. 3

Etude 1000.

- We set ourselves the goal of obtaining the testimony of 1000 people, from the closest to the furthest away from the event, direct or indirect witnesses of the attacks
- Thanks to the INA and the ECPAD, all recordings are audio-visual. The same questions are asked all four times. An interview guide contains the questions, the reminders (*relances*) and also the instructions. Two examples: 1. Apart from a few exceptions, a new question is only asked when the participant stops; 2. We never correct a participant because we are looking for the truth of the witness, including errors.

The study does not aim for a representative sample, but it is sufficiently diverse to draw up a map of testimonies that is as complete and varied as possible. The volunteers were distributed according to their proximity to the events or places of the attacks, i.e., four circles, from the closest to the furthest. Once filmed, the interviews were recorded and transcribed using speech-to-text software (*#Vocapia*), which automatically transforms oral discourse into text. In order to make the interviews available to the researchers, the teams of the “*Étude 1000*” corrected these transcriptions, which

they accompany with a document containing a summary of about 30 lines and key words that made it possible to identify the salient elements of the content of the interviews. These actions are essential to the study, in that they transform the interviews into databases.

We are now almost at the end of phase 3, i.e., more than 5 years after the first phase (see Fig. 3). In phase 1: 9341 participants, of which almost 40% were from circle 1 (i.e., exposed people); that is 1431 audio-visual hours.

In phase 2, with 839 participants, we had more than a hundred new participants (still many from circle 1) and 720 volunteers from phase 1 who accepted to come back (77%) which, according to epidemiologists, is an exceptional result. We are therefore talking about an attrition rate of 23%.

For phase 3, in the autumn of 2021, the challenge was all the more complicated because it was more than 5 years after phase 1. To date (we still have 10 or 15 interviews to do), there are 968 interviews, more than in phase 2 and even more than in phase 1. We wanted to record close to 300 new ones with the idea of measuring, by comparison, the possible impact of the lack of knowledge of the protocol on the proposed narrative. Yet, what is striking here again is the rate of return and therefore, complementarily, the attrition rate. Compared to the results of phase 2, 3 years earlier, nearly 80% of participants returned. If we add the three phases, we have 570 people for whom we have testimonies in 2016, 2018, and 2021. You can see the interest of such a corpus for those who wish to analyze the evolution of memories over time. Let us remember that, of course, the same questions are asked at each phase.

As these are audio-visual interviews, the transcription process is very long. For the emotional and event-based questionnaires, it is much quicker as they are yes/no, a little/a lot etc. responses. The results are already in a database. Yet, for the non-directive interview, the first and longest part, there is first a speech-to-text transcription by the computer. Then we have to correct it, e.g., the corrected transcripts from phase 1 represent a corpus of 80 million bytes, the equivalent of a printed book of ... 40,000 pages (just for phase 1).

These testimonies are studied by scientific methods, but they also constitute a form of heritage of memory of the attacks of 13 November 2015.

It calls for a lot of work on these data. Let's take two examples:

- ⇒ The book *13 Novembre. Des témoignages, un récit* (Nattiez et al., 2020) is a reconstruction of the story based on the verbatim accounts of the 320 testimonies of exposed people (circle 1) from phase 1 and, above all, for the chronology of the events, the judicial documents, such as the final indictment (“*Requisitoire définitif*”). From an epistemological point of view, it is very interesting, because, by crossing the sources over these 3 h of terror attacks that we are recounting here, we move from the truth of the witness to the truth of the event.
- ⇒ Christian Chevandier's book (Chevandier, 2022) is about the police officers of 13 November. The approach is different even if he devotes part of the book to the role of the police that night. However, an important part of the book is a sociological and even more anthropological approach, which is quite fascinating.

6.2 REMEMBER

The REMEMBER study is a biomedical research protocol, conducted in Caen, which focuses on the cerebral (studied via MRI), cognitive and psychopathological impact of the attacks. Its 200 volunteers are mainly from the “*Étude 1000*” cohort. REMEMBER is working to evaluate the consequences of a traumatic event and the resulting stress on the evolution of mental, psychological and cerebral functions, and in the long term to improve their management. One of the major originalities of this program is that the participants are divided into three groups: in 2016, the control group was made up of 80 unexposed subjects, to which were added 120 subjects exposed to the attacks. The latter formed two subgroups of equal size, those exposed with post-traumatic stress disorder (PTSD) and those with none.

One of the symptoms of PTSD, the most frequent pathology in this context, is the untimely occurrence of intrusions (intrusive images). To measure this and to visualize the processes at work in the brain, particularly between the prefrontal cortex, the hippocampus and other brain structures, REMEMBER confronts the participant with “experimental” intrusions, forbidding him or her from seeing any potentially traumatic image or word. The participant learns a series of unrelated word-picture pairs prior to the MRI scan, allowing observation of brain function while performing a task in which they generate and attempt to inhibit an intrusion. Patients’ attempts to suppress these intrusions have long been considered an ineffective mechanism. The brain imaging study challenges some of these ideas, and hypothesizes that the resurgence of intrusive images and thoughts is related to a dysfunction of the brain networks involved in memory control (Mary et al., 2020).

PTSD is further associated with structural abnormalities of the hippocampus, whose small volume may be associated with the development and persistence of symptoms. This region is composed of several subfields, each with different histological characteristics and functions. In this study, we show that the reduction in volume of the CA1 subfield is related to the presence of traumatic intrusions. These changes do not necessarily precede the trauma, but are probably related to the stress and anxiety caused by the intrusions. It is therefore possible to envisage with hope that the modifications observed in the hippocampus are reversible as soon as the intrusive symptoms diminish (Postel et al., 2021).

One of the axes of the study is the search for psychological determinants of the onset of PTSD and the predictive factors of resilience in subjects exposed to the attacks. The first results confirm the importance of the nature of the traumatic exposure, the immediate physical reactions, the identity narrativity and the social support in the appearance and evolution of psychological disorders. The predictive value of certain physical reactions is highlighted by the study, which tends to link these bodily reactions to high-level cognitive organizations. These results should make it possible to answer a major question: how is it that two exposed people, participating at our biomedical protocol 1 year after the event, one has presented undeniable PTSD and the other no symptom, even though they have experienced the same scene? The answer will require transdisciplinary work involving computational neuroscience (Leone et al., 2022), cognitive psychology (Coll et al., 2022), data sciences and human and social sciences.

6.3 A multiscale project

The study carried out by *Santé Publique France*, named ESPA, is an epidemiological study which interviews volunteers, victims, relatives, interveners and witnesses of the attacks of 13 November 2015, by means of web-questionnaires. Conducted in 2016, the study aimed to estimate the psycho-traumatic impact of the attacks and to better understand the use of the proposed care mechanisms. The prevalence of PTSD among survivors, but also among bereaved relatives (more than 50% of the volunteers), is one of the major conclusions of the study concerning “civilians.” Not only is the prevalence comparable and high, but anxiety and depression have been even more sensitive among the bereaved (Pirard et al., 2020). While the results are lower among “controls,” it has been noted that this category seeks far less support from psychologists or psychiatrists than others, as if they did not feel legitimate. If we turn to the responders (police, health services, firefighters etc.), we find that, unsurprisingly, the rates of probable PTSD are significantly lower than those observed among “civilians,” but also that the rate of probable PTSD is significantly higher among police officers (Motreff et al., 2022). All these data from the ESPA 13-November survey are interesting in themselves, but they are also a source of advice for the ministries in charge of public health.

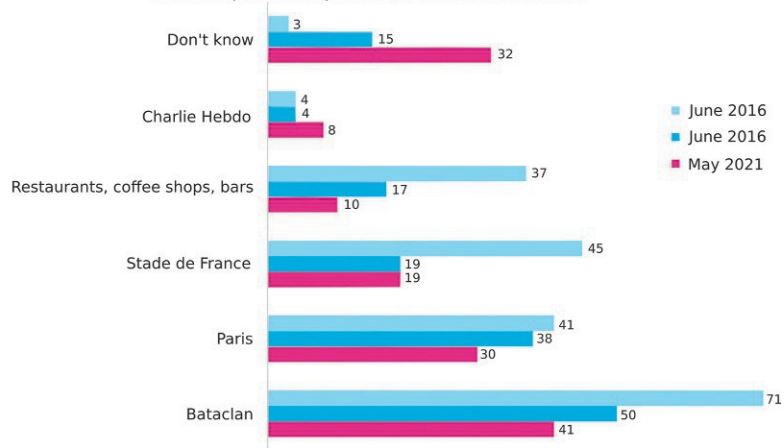
All these programs, even if they concern large cohorts, are primarily concerned with individual memory. What about collective memory? If we wish to understand how they interact with each other, it is imperative to approach collective memory as closely as possible. This is what CREDOC allows us to do, as it has been conducting a survey on “Living Conditions and Aspirations” every 6 months for over 40 years. What is crucial for us, of course, is that CREDOC interviews a representative sample of the French population. A representative sample of the French population on a large scale of topics (1 h-long survey): opinion, values, ways of life... The representativeness of the sample is guaranteed by using the quota method (area, category of city, sex, age, profession) (Hoibian et al., 2020, online).

We have carried out several surveys with CREDOC since the start of the Program. The idea is simple: in “étude 1000,” our sample of volunteers is obviously not representative of the French population. If we want to understand the collective memory of the Islamist attacks of 13 November 2015, nothing beats a survey. We asked 11 questions at the time of each phase (2016, 2018, and 2021). In January, we also asked a few questions to complete the picture on three occasions (2017, 2019, 2021) (Fig. 4).

The main conclusions are the following:

- ⇒ We note a first memory condensation. To the question: which terrorist attacks have had the greatest impact on you since 2000, the answer shows that, increasingly, the attacks of November 13 are the primary reference in relation to 9/11, the attacks of January 2015 in France targeting journalists at *Charlie Hebdo*, Jews at the hypermarket at *Porte de Vincennes* and police officers, and the terrorist attack of 14 July 2016 in Nice. But we see a specificity of January 2015 attacks: the evolution presents a more sinusoidal profile, the memory being reactivated each January, recalled by commemoration and media coverage, before practically disappearing from the collective memory, at least as a major terrorist attack.

Could you please name some of the places where the terrorist attacks of 13th November 2015 took place?
 Recoded open ended question (in % of answers in total)



Could you please name the terrorist attack that has had the greatest impact on you personally since 2000?
 Recoded open ended question - three answers possible - Only answer that total more than 3% are represented in the chart

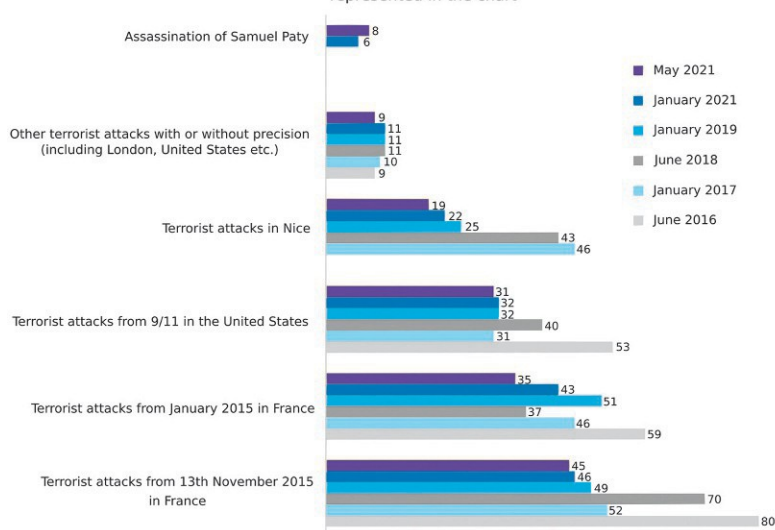


FIG. 4

Collective memory of terror attacks (CREDOC and *Programme 13-Novembre*).

⇒ Another question allows us to note a second memory condensation: when we ask the question of the places of November 13, a spectacular condensation takes place on an imprecise place—Paris, and above all on a precise place—the Bataclan.

⇒ Two additional remarks are in order: (1) the number of non-responses has increased significantly over the last few years, particularly in the lower classes; (2) we have not yet measured the impact of the trial that began in September 2021, a historic trial that is due to end in June 2022! Are we moving toward the construction of a great shared narrative that will influence all individual memories and modify the collective memory of 13 November? This is a crucial question, especially as for the survivors and bereaved parents of the *Stade de France* or the terraces, for the moment, it is a double punishment: they have suffered terribly and they have the feeling that they have been forgotten.

In view of the results accumulated over more than 5 years, the scientific dimension, as well as the scope of the work involved in the longitudinal follow-up of cohorts, will be noted. It is also a heritage construction, that of the memory of the terrorist attacks of 13 November 2015. The work of protecting and smoothing the data, making it available, and developing research avenues are all elements that go beyond the temporality of the phases. It is on the condition that the continuous and intertwined nature of the program is constantly taken into account that we will be able to approach human memory in all its dimensions.

7 September 2021—June 2022: The historical trial of the attacks of 13 November 2015. Renewed memorial issues

We are writing this article at a particular moment in the aftermath of the 13 November attacks, as the trial—which is due to last 8 to 9 months—is underway. The hearings and debates are public. This trial is highly mediatized and, as such, constitutes a meeting point between the individual memories of the various parties who are expressing themselves—in particular the civil parties—and the collective memory, shaped by the media, which retransmits these statements and various comments and analyses. In terms of the writing of collective memory, the trial makes it possible to approach the truth of the facts in their entirety, to revisit the various sites of the terrorist acts and the people who were confronted with them during these tragic moments—the area around the *Stade de France*, the terraces of cafés and restaurants, the Bataclan theater—without forgetting them selectively and so that all the individual memories take their place in the collective memory that is being written. The future will tell us whether a great shared narrative is being constructed. It is an understatement to say that the very fact that the trial was held shows the extent to which the attacks of 13 November 2015 have become part of the collective memory of the French. It should also be noted that the memorial system that was imposed at the time was structured by the figure of the victim and not by that of the hero. Yet, there were many heroes, from the police to the medical staff, from the neighbors who opened their flats or came to help the injured to the survivors themselves, who showed exceptional solidarity even in the horror of the Bataclan. This is understandable if we widen the

focus: since the mid-1980s, the figure of the victim has become a structuring factor in the various memorial systems that have been imposed in France, as in the memory of the Second World War, where the Jewish victim has supplanted the Resistance hero, who was hegemonic in the representations of the 1960s (Peschanski, 2020).

What does this historic trial represent in many respects, since it began in mid-September 2021 and is due to end in June 2022? The coverage of the trial is exceptional and the many reports of the hearings and the documentaries that accompany them are very convergent and in fact provide the same grand narrative. It is also clear that this grand narrative, with the help of the media, is becoming a grand narrative shared by the French people, the basis, as it were, of a collective memory, and is partly shaping the individual memory of each French citizen. We can already see how the collective and the individual are closely intertwined. Yet, this becomes even more complex when we know that the journalists' accounts are fed, of course, by the evidence of the investigation, but, for the most part, by the words of witnesses summoned to recount what they experienced. The great shared narrative, and soon the collective memory, is thus constructed from the testimonies collected and therefore from the individual memories of the main actors of the event. It is an illustration of this dialectic between individual and collective memory.

We also note in the news of the trial a phenomenon that we had come across and that we come across in our interviews. The vagaries of collective memory have major consequences on the psychological state of those exposed. If the survivors of certain crime scenes, such as the *Stade de France* or the terraces, or the mourners become aware that these places have been forgotten in the collective memory, it is a double punishment: in addition to the horror of the crime, there is the horror of finding that they have somehow been forgotten in the collective memory. And this can have pathological consequences: we note that these people are more numerous and longer subject to the psychological disorders of PTSD, anxiety and depression. Others felt that they had simply been forgotten. In the testimonies we collected, as well as in the testimonies during the trial, we were able to see how much the emotional charge was amplified by this singular situation.

These few examples, close to the people and their reactions, also allow us to validate a form of epistemological wager. It was obviously essential to cross disciplinary approaches if we really wanted to understand the memories of a traumatic event. Obviously, the transdisciplinary gamble, the one that requires us not only to cross approaches but also to jointly construct the research object, is a condition for the success of the undertaking.

With this program, as with the technological tools that we are proposing to the scientific community, we are calling for the construction of new memory sciences based on classical concepts of memory (Fig. 5) and including the modeling of the links between individual memory and collective memory (see Fig. 1).

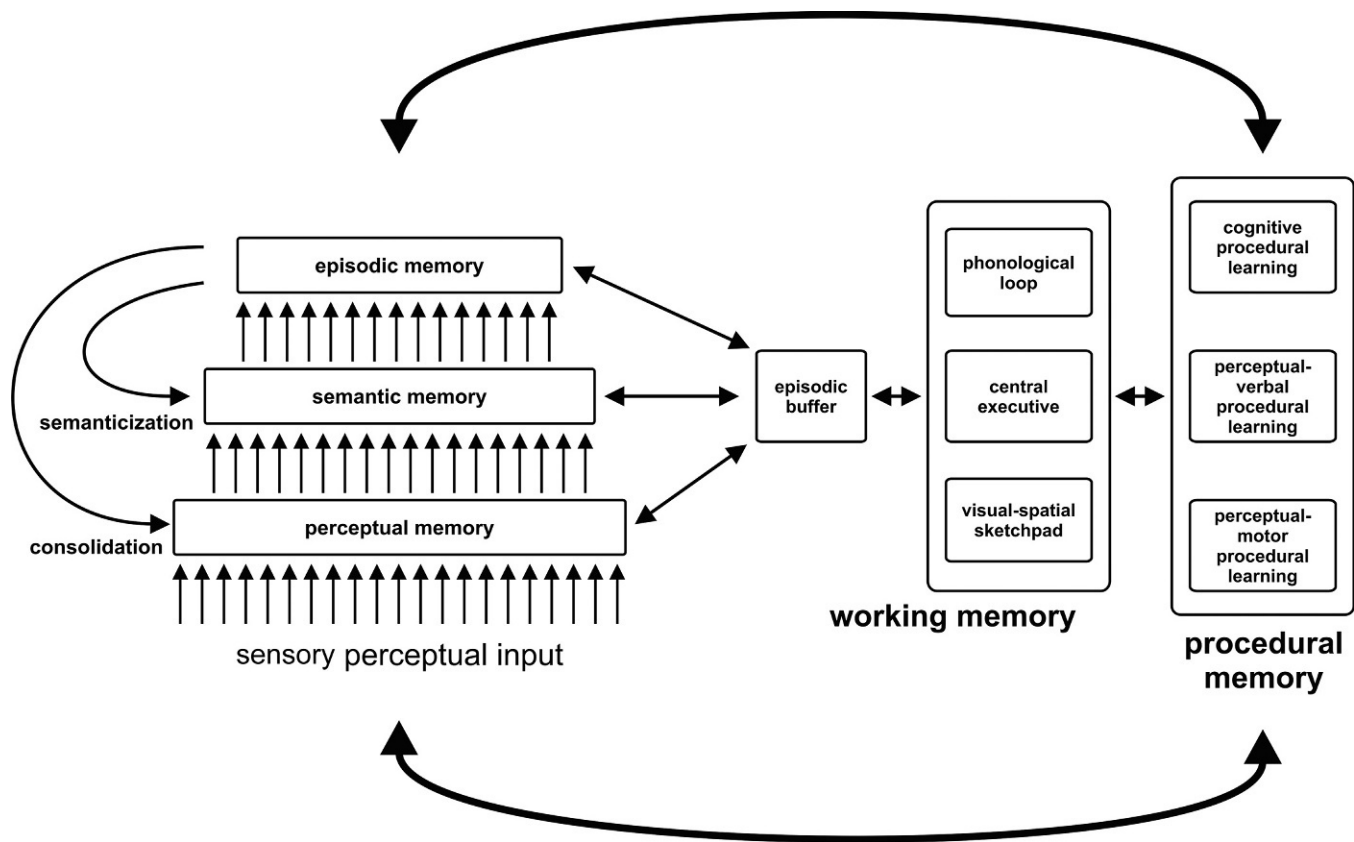


FIG. 5

Mnesia scheme showing main concepts of individual memory and their relationship (Eustache et al., 2016).

8 From memory studies to memory sciences

The situation is ripe, so to speak, for thinking together, in transdisciplinarity, about memory sciences. We can already define the four pillars of these new sciences:

- Dialectic—for it is necessary to understand the articulation between individual and collective memory
- Transdisciplinarity—it is imperative to cross disciplines and to build together the research object and the questioning to take it together in its entirety
- Mathematical modeling—it is about dealing with such databases
- Complexity, a term dear to [Morin \(1990\)](#), the understanding of a whole cannot be resolved by juxtaposing the understandings of each of its components.

On the side of collective memory, we propose to take up some conceptual tools and to propose new ones.

- Collective memory as a selective representation of the past that participates in the identity of a society or a segment of this society.
- Conditions of narrativization: conditions for a given event to be retained by the collective memory.
- Memory regimes: A dominant representation of the past, structured around one or more figures (positive or negative) and imposing itself as such for a certain duration.
- Strong memory/Weak memory: we have to consider evolutions and not fix and drastic positions. Radical oppositions between oblivion and global hegemony does not work.

If we consider psychologists and neuroscientists approaches, we have to stress on the three moments of memory where the hippocampus plays a central role: encoding; storage; retrieval. Another issue can be crucial, the dichotomy between episodic memory and semantic memory. Perhaps more crucial, we have emphasized autobiographical memory: “Autobiographical memory contains the personal memories of an individual, which have accumulated over the course of his or her life and which are at the origin of his or her sense of identity and continuity” ([Eustache, 2019](#); [Eustache and Desgranges, 2020](#); [Piolino et al., 2009](#); [Viard et al., 2007](#)). This property is a particular feature of episodic memory, which is responsible for the encoding, storage and retrieval of personally experienced events situated in their spatiotemporal context of acquisition ([Tulving, 2001](#)). Tulving’s works on episodic memory are well known. However, autobiographical memory also contains a semantic component, made up of general knowledge about oneself and memories of general events from various encoding sources without access to their learning context. This semantic component would be partly related to the process of “semantization” of repeated similar events. We refer to the various models of autobiographical memory organization, such as that of [Conway \(2001\)](#), [Conway et al. \(2004\)](#). The comprehension of the coherence

and of the discordance between individual memory and collective memory in this context of the construction and evolution of the contents of memories is a crucial challenge for memory sciences.

The programs we have developed together are both the result of this theoretical reflection and have fed it as we have progressed and, even more so, in discussions with colleagues from different disciplines. As a transition to this case study, the simple diagram of the disciplines involved illustrates both the reality of these contacts and the ambition of our program (see Fig. 2) (Eustache et al., 2016, Eustache and Peschanski, 2017, 2021).

In clinical terms, the exploration of the coherence between individual and collective memory, for a singular individual, is particularly relevant in PTSD by allowing a better understanding of the risk and resilience factors. The memory distortions at the heart of this disorder have a very particular profile, since they combine hypermnnesia of certain emotional and perceptive aspects linked to the traumatic event with more or less marked amnesia of contextual aspects. The autobiographical memory of these patients is impaired, as evidenced by their difficulty in distancing themselves from the traumatic event and in making it lose its immediacy. The patients tend to consider their trauma as a major autobiographical event, characterizing them in the first place, but poorly integrated into their entire life course. Furthermore, the alteration of the self-image, dominated by negative perceptions, guides the nature of the recalled memories. An emotional memory disorder is at the heart of PTSD, and therapies aim to reduce the emotional burden of the traumatic memory to make it “acceptable.” The existence of a reassuring context around the patient is also a protective factor.

This context involves the family and the workplace, but must extend to the social setting. In this respect, we hypothesize that the collective memory attached to a traumatic event, especially if it is a large-scale event, will have a major impact on the individual’s memory. If this collective memory is in phase with the individual’s memory, it will act as a catalyst in consolidating his or her memories by allowing them to become acceptable. Beyond that, it will encourage the implementation of resilience mechanisms, with the social framework supporting the reconstruction mechanisms. If, on the other hand, these two forms of memory are developed in a disordered, or even antagonistic, manner, they will both be weakened with harmful effects. It will thus be necessary to dig into the sharing of hypotheses on the good management of a traumatic or simply dramatic past: the solution is not in forgetting, but in accepting this past without it invading the present. Acceptance is then worth the pain that this reminder may cause, but a controlled pain.

History provides several examples of discrepancies between individual and collective memories, which led to a failure, at least temporary, of these memories, such as those of the exodus of May–June 1940 or the Allied bombing of Normandy in 1944. Insofar as collective memory is a selective representation of the past that aims to construct the group’s identity, the event must have a meaning, a social utility, which was not the case in these two examples. This lack of explicitness does not mean complete and definitive oblivion, because collective memory evolves over

time and the conditions for the creation of a memorial narrative can be met long or very long after the event and its first recollection. The individuals who experienced these tragic events most closely thus find themselves at odds with the writing of the grand collective narrative, which can be detrimental to their reconstruction.

This reading of the joint construction, discordant or not, of different strata of individual and collective memories, could find applications in various situations that place the individual in an existential rupture. These memory disorders can be understood, in part, as resulting from a psychosociological upheaval linked to a change in status leading to a discordance between individual memory and collective memory (Halbwachs' social frameworks): a person inserted in active social life becomes a sick person, with other constraints, other concerns, another perception by others. This theoretical framework also opens up avenues of reflection for the care of patients, in particular on the way in which the entourage—carers, assistants, but also the wider social framework—must adapt to the existential trajectory, which is certainly modified but constantly under construction, of a singular patient.

This approach can also find relevant developments in patients with a memory pathology (such as Alzheimer's disease or amnesic syndrome). The memory disorders are severe with retrograde amnesia that goes back a long way in their past. Patients may or may not experience a discrepancy between their daily experience (e.g., living in a hospital or nursing home) and the memory of their previous environment to which they remain attached, which may last for several decades. Here again, the distortions in autobiographical memory between day-to-day memory and the "social framework" are a means of understanding memory disorders and, more broadly, cognitive and behavioral disorders, and a potential guide to patient management.

The memory studied by psychologists and the memory studied by historians and sociologists do not correspond to two distinct concepts. The analogies described in both cases do not refer to metaphors, but underline the need for a transdisciplinary approach, which has yet to be largely invented, but whose theoretical importance and multiple applications can be measured, notably in mental health and in the policy of memorialization of a country.

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