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To cite this article: Igor Sotgiu, Alessandra Zagato, Luca Negri & Chiara Mirandola (2026) The memory metaphors held by ordinary people: an exploratory study, *Memory*, 34:9, 1079-1092, DOI: [10.1080/09658211.2026.2714182](https://doi.org/10.1080/09658211.2026.2714182)

To link to this article: <https://doi.org/10.1080/09658211.2026.2714182>



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The memory metaphors held by ordinary people: an exploratory study

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ABSTRACT

Metaphors are widely used by researchers to communicate ideas in cognitive psychology. This is the first study to systematically explore the naïve psychology of human memory metaphors. We attained this goal by surveying a large sample of the adult population resident in Northern and Central Italy ($N = 846$). Participants were administered four self-report questionnaires assessing their favourite memory metaphor, memory beliefs, autobiographical memory experience, and metamemory. Overall, the memory metaphors most endorsed by our sample were store, camera, computer, and map. Personal motives underlying these choices significantly varied across the metaphors. Multinomial logistic regressions showed that the choice of store, camera, and map was significantly influenced by a series of sociodemographic and psychological variables (e.g., age, education, satisfaction with one's memory), which varied depending on the chosen metaphor. We argue that some metaphors, better than others, are able to reflect the characteristics and functions that ordinary people attribute, implicitly or explicitly, to human memory. Study limitations and directions for future research are also discussed.

ARTICLE HISTORY

Received 20 April 2026
Accepted 24 July 2026

KEYWORDS

Autobiographical memory;
memory beliefs; memory
metaphors; metamemory;
naïve psychology

It is a natural impulse, when confronted with a phenomenon that we do not understand, to try to relate it to things that we do understand or at least are more familiar with (Roediger, 1980, p. 231).

If you think of your own memory and how it works, what image or metaphor comes to your mind? You may picture your memory as a house, wandering through the living room or kitchen to find the most immediate details and then stepping into the basement and running into left-over-memories: those dusty events difficult to retrieve! Whatever image comes to your mind, think of how often you share it with others in your daily life.

James (1890), Freud (1925/1961), Neisser (1967), Atkinson and Shiffrin (1968), Baddeley (1992), along with many other researchers who contributed to the foundation and evolution of psychological science, have described the characteristics and functioning of human memory using metaphors.

In a seminal article addressing this topic, Roediger (1980) argued that psychologists, as well as philosophers, typically made use of metaphors which were spatial in nature. Examples include a purse, a bottle, a house, a store, a library, and a map. Remarkably, all these objects were chosen under the twofold assumption (i.e., implicit or explicit)

that memories are entities stored in a space and that mental retrieval consists in a search process within that space. Interestingly, in the same article, Roediger also noted that there are psychologists, although fewer in number, who described memory by means of nonspatial metaphors. Typical examples include a muscle, a tuning fork, and a hologram.

When considering the use of memory metaphors across diverse disciplines and different historical periods, it appears evident that advancement in technology of keeping records played a key role in their choice. As pointed out again by Roediger (1980, p. 244), “we may note a progression from the imprint of seals on wax to the gramophone, tape recorder, switchboard, dictionary, library, keysort cards, and, most recently, the computer and the hologram”. In the years and decades following the publication of Roediger's seminal article, a number of memory scholars emphasised this point (Assmann 1999/2011; Brockmeier, 2015; Draaisma, 1995/2000). The most recent technological metaphor in use is Internet, with its associated digital archives and online environments. Intriguingly, the idea of memory conveyed by this metaphor is that of a *connective memory*, i.e., a mental device that enables the individual to establish and maintain real-

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📎 Supplemental data for this article can be accessed online at <https://doi.org/10.1080/09658211.2026.2714182>.

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time contacts with a great number of people, as well as with the whole socio-cultural and physical environment they live in (on this topic, see Hoskins, 2011).

There seems to be no doubt that memory metaphors have the potential to guide theory and research on memory phenomena. Indeed, each metaphor proposed so far reflects a specific conception of how memory works and how it could be empirically investigated, either in laboratory or real-life settings (Koriat & Goldsmith, 1996). At the same time, memory metaphors can be fruitfully used by scientists with the goals of translating their theories and research into a form which is understandable to a general audience (on this topic, see Sotgiu, 2021). Despite their potential, however, it should be emphasised that there is to date no agreement among researchers on which metaphor is best suited to describe human memory. For this reason, many memory scholars (e.g., Koriat & Goldsmith, 1996; Madan, 2023; Magnussen et al., 2007; Nelson, 1996; Schwartz, 1996) have argued in favour of a metaphorical pluralism orientation. As stated by Koriat and Goldsmith (1996, p. 186), “metaphors are neither right or wrong ... it is in fact desirable to entertain a variety of metaphors in order to capture the full richness of memory phenomena: each may contribute to the strength and elegance of the whole”.

Although some researchers (e.g., Roediger, 1980) have rightly recognised that some memory metaphors used for scientific purposes are intertwined with common sense conceptions, there are no studies to date that have explored, in a systematic fashion, the naïve psychology of memory metaphors. By contrast, we were able to find a great number of studies investigating people’s beliefs on how memory works. These studies generally followed a survey approach targeting both the student population (Brewin et al., 2019; Conway et al., 2014; Garry et al., 1994; Merckelbach & Wessel, 1998; Mirandola et al., 2013; Niedźwieńska et al., 2007; Patihis et al., 2014, Study 1; Riesthuis et al., 2022, Study 1) and the general population (Magnussen et al., 2006; Patihis et al., 2014, Study 2; Riesthuis et al., 2022, Study 2; Simons & Chabris, 2011, 2012; Stockner et al., 2024; Wake et al., 2020). Taken together, they provided evidence that large proportions of the surveyed samples held erroneous beliefs about memory. Examples of misconceptions included believing that more detailed and more vivid memories are more likely to be accurate; thinking that all of our personal experiences are stored permanently in the brain, even if we cannot access all of them; trusting in hypnosis as a technique to improve memory; holding that olfactory memory is better or as good as visual and auditory memory.¹

The studies on memory beliefs by Merckelbach and Wessel (1998), Simons and Chabris (2011, 2012), and Brewin et al. (2019, Study 1) are of particular interest for the present article as they obtained data which are also relevant to the naïve psychology of memory metaphors. We now turn to examine some specific findings from these works.

Merckelbach and Wessel (1998) conducted a questionnaire study exploring the memory beliefs of a small sample of Dutch undergraduates (N = 50). Specifically, their questionnaire included one open-ended item asking the participants to provide a metaphor capturing the essential features of memory. Results showed that 54% of respondents reported metaphors reflecting the belief that memories are static and reproductive in nature after storage. Examples included “diary”, “computer”, “mirror”, and “videofilm”. Merckelbach and Wessel did not report the frequency of citation of these metaphors. Moreover, they did not describe at all the metaphors reported by the remaining 46% of their sample, or the metaphors that did not imply a static and reproductive conceptualisation of memory, making it difficult to have the overall picture of the naïve metaphors reported within this sample.

Simons and Chabris investigated the memory beliefs of North Americans in two distinct studies: a telephone survey involving 1838 respondents (Simons & Chabris, 2011) and a Mechanical Turk survey involving 982 respondents (Simons & Chabris, 2012). In both surveys, researchers asked participants to express their agreement with the following statement, which implies a “video recorder” conceptualisation of memory: “Human memory works like a video camera, accurately recording the events we see and hear so that we can review and inspect them later”. When weighting the two sample to conform to US 2010 census demographics, Simons and Chabris (2012, see Table 3) found that the percentage of participants who either strongly or mostly agree with this statement was 52.7% for the telephone survey and 46.7% for the Mechanical Turk survey.

Brewin et al. (2019, Study 1) surveyed 172 university students using the same video camera statement employed by Simons and Chabris (2011, 2012). The proportion of participants endorsing this item was somewhat lower (i.e., 32.6%) than previously reported. Interestingly, in the same study, Brewin et al. also provided the participants with 21 potential memory metaphors asking them to express their agreement with each metaphor on a 7-point Likert scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). The mean endorsement scores computed for the various items ranged from 2.63–5.31. With mean scores above 5, “diary entry”, “video camera” and “library” were the most endorsed metaphors. On the other hand, “aviary”, “compost heap” and “bottle” had mean scores below 3.5, being the least endorsed metaphors.

Compared to Merckelbach and Wessel (1998) and Simons and Chabris (2011, 2012),² Brewin et al. (2019) provided a more articulated picture of how individuals consider the different memory metaphors used in the scientific discourse. Nevertheless, we believe this study could be replicated and further improved with more refined methodologies and procedures. There are two main reasons behind this statement. First, because Brewin et al.’s study was conducted on a relatively small

student sample, its results cannot be generalised to the general public. Second, Brewin et al. did not provide their participants with specific questions designed to investigate in detail why they preferred certain metaphors over others. The present work aims to advance our current understanding of memory metaphors, taking both these issues into account.

The present study aims and hypotheses

We conducted a questionnaire study on the naïve psychology of memory metaphors by surveying a large sample of the adult population resident in Northern and Central Italy. In particular, our study pursued two main objectives. The first one was to identify the memory metaphors held by our participants and the most important reasons underlying their preference. On the other hand, our second goal was to try to understand whether endorsing a specific memory metaphor could be related to both participants' sociodemographic characteristics and their personal orientations towards memory and its functioning. In particular, to attain this goal, we investigated individual differences in our participants' memory beliefs, autobiographical memory experience, and metamemory. To our knowledge, the specific influence of individual differences in memory experience on the formation of metaphors has not been investigated thus far. However, evidence exists showing that autobiographical memory characteristics can be considered as stable personality-trait-like individual differences (Camia et al., 2024; Mirandola et al., 2026; Rubin, 2021). We were thus interested in investigating whether the tendency to represent memory with certain metaphors would reflect how one conceives of one's own memory.

Our study was exploratory in nature. In fact, we refrained from formulating empirically based hypotheses about the most endorsed memory metaphors because the metaphors we decided to investigate in the present study only partially overlap with those considered by Brewin et al. (2019) (see Note 4 of the current article). Moreover, as we have previously noted, our study differs from that of Brewin et al. because we targeted the general population. That said, we tentatively predicted that the act of endorsing a specific memory metaphor would vary, to a certain extent, according to participants' orientations towards memory, which we operationalised as memory beliefs, autobiographical memory experience, and metamemory.

Method

Sampling and procedure

Given the exploratory nature of the study, we did not calculate a power analysis in order to determine an optimal sample size. However, consistent with previous studies investigating memory beliefs in the general population

(e.g., Stockner et al., 2024; Wake et al., 2020), we did our best to reach a large number of participants. The student participants were recruited at the University of Bergamo. The rest of the participants were recruited from multiple cities (based in Lombardy, Veneto, Lazio and Tuscany regions) following a snowball sampling convenience procedure. All participants were informed that the questionnaires were anonymous and that their responses would be used for research purposes only. Those who accepted to participate were then given paper-and-pencil self-report questionnaires and directions for returning them to the authors. Respondents were not paid for their participation. The data collection took place between March and July 2025. Of the 890 packets of questionnaires distributed, 860 were returned. Of these, 14 were excluded because they were largely incomplete. The response rate was thus 95.0%.

Participants

Eight hundred and forty-six adults aged from 18 to 93 (mean age = 40.71 years, $SD = 16.71$) took part in this study.³ The sample included 563 females, 271 males, two participants reporting "other" gender status, and ten participants giving no information on their gender. As regards marital status, 43.3% of participants were single, 10.2% reported living with a significant other, 36.8% were married, 7.3% separated or divorced, and 2.3% widowed. As regards education level, 20.0% of participants had a middle school diploma, 49.5% a high school diploma, 7.6% a bachelor's degree, 18.7% a master's degree, and 4.3% a post master's diploma or doctorate. Noteworthy, 195 participants (23.2%) were attending university or high school at the time of the study. Instead, the remaining part of the sample consisted of employed (64.5%), retired (7.1%), housewives (2.7%) or unemployed (2.4%) participants. Virtually all participants (99.1%) were born in Italy and were Italian mother tongue speakers.

Instruments

We used four self-report questionnaires, which will be described below. Of importance, the second and the third questionnaires were translated from English into Italian by the authors of the present article with the help of a bilingual speaker. A back-translation was then performed by a second bilingual speaker who was blind to the English original versions of the questionnaires. Only minor discrepancies emerged, and these were resolved through collective discussions involving all the translators (for more details on the Italian adaptation of our third questionnaire, the Autobiographical Recollection Test, see Mirandola et al., 2026). We pilot tested both questionnaires with four adult individuals (two females and two males), who were asked to share their impressions and experiences as respondents. For both questionnaires, all

participants reported no difficulties in understanding item content or verbal instructions.

Questionnaire on memory metaphors

This questionnaire was designed specifically for this study. We provided the participants with a list of 13 metaphors (i.e., blackboard, mirror, camera, video camera, computer, Internet, book, map, store, home, attic, labyrinth, muscle) and asked them to choose the one best suited to describe the characteristics and functioning of human memory. Potential metaphors were carefully selected by the authors of the present study, taking into account the key theoretical contributions on this topic mentioned in the Introduction (e.g., Assmann, 1999/2011; Draaisma 1995/2000; Roediger, 1980), but at the same time excluding some metaphors that we felt were poorly attuned to the current era (e.g., an aviary). If participants did not find in the list a metaphor fitting with their opinions, they could opt for the “other” alternative and specify a new one.⁴ Regardless of the selected metaphor, all the respondents were then asked to briefly explain their choice using an open-ended response format.

Questionnaire on memory beliefs

Participants were asked to express their agreement/disagreement with five statements on how memory works. All statements were taken from questionnaires used in previous studies on memory beliefs: specifically, two statements were drawn from the survey by Simons and Chabris (2011), two from Conway et al. (2014), and one from Patihs et al. (2014) (see Appendix). For each statement, participants were asked to indicate one of the following responses: “strongly disagree”, “disagree”, “agree”, “strongly agree”, “don’t know”. As in Simons and Chabris’ (2011) survey, all statements were worded to contradict robust findings from memory research. Accordingly, for each participant, we calculated the number of statements with which either they agreed or strongly agreed. This measure, ranging from 0 to 5, captured the participants’ subjective tendency to hold erroneous beliefs about memory (*false beliefs about memory*).

Autobiographical Recollection Test (ART; Berntsen et al., 2019)

The ART was used as a measure of autobiographical memory experience. This questionnaire examines individual differences in how well people believe they remember personal events by considering seven distinct components of autobiographical memory: i.e., reliving, vividness, visual imagery, scene, narrative coherence, life-story relevance, and rehearsal. *Reliving* and *vividness* are key features of auto-noetic consciousness, both reflecting the ability to place oneself in the past. *Visual imagery* is the ability to recall images in the absence of real visual stimuli. *Scene* pertains to retrieving the spatial layout of a memory. *Narrative coherence* captures the ability to maintain coherence when telling personal events. *Life-story relevance* reflects

the ability to evaluate the significance of personal events to one’s life story. Finally, *rehearsal* refers to the tendency to recall memories both privately and in relational contexts. Each component is reflected by three statements, for a total of 21 items. Example statements include “My memories of past events are clear, not fuzzy or clouded”, “My memories of past events are a reference point for the way I understand myself and the world” and “I often think back to past events in my mind and think or talk about them”. Respondents were asked to reflect how well they remembered past events and rate each statement on 7-point Likert scales ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). Considering the goals pursued by the present study, we decided to exclusively calculate the total score, which was obtained by averaging the responses to all 21 items constituting the ART. The potential range for this score was thus 1–7, with higher scores indicating a greater individual tendency to remember past events well. The internal consistency of the full ART, as measured by Cronbach’s alpha, was .92. This value is consistent with those found in the original validation studies of the ART (Berntsen et al., 2019).

Multifactorial Memory Questionnaire (MMQ; Troyer & Rich, 2002, 2018)

The Italian version of MMQ (Raimo et al., 2016) was used as a measure of metamemory. This questionnaire consists of 57 items, which participants rated on 5-point Likert scales based on their experiences over the previous two weeks. Items constituting the MMQ belong to three distinct scales. The *Satisfaction* scale includes 18 statements regarding satisfaction, concern and overall evaluation of one’s own memory (e.g., “I am generally pleased with my memory ability”, “I worry that others will notice that my memory is not very good”). Participants were asked to express their agreement/disagreement with each statement. The total score for this scale ranges from 0 to 72, with higher scores indicating higher levels of satisfaction with one’s own memory. The *Ability* scale consists of 20 items measuring self-perception of everyday memory ability. Participants were asked to rate how often they made each of 20 common memory mistakes (e.g., “Forget an appointment”, “Misplace something that you put away a few days ago”). The total score ranges from 0 to 80, with higher scores indicating higher levels of self-perception of memory ability. Finally, the *Strategy* scale contains 19 statements about tricks or strategies helping people to remember things in their everyday life. Participants were asked to rate how often they used each of 19 memory strategies (e.g., “Use a timer or alarm to remind you when to do something”, “Use a routine to remember important things, like checking that you have your wallet and keys when you leave home”). The total score ranges from 0 to 76, with higher scores indicating more frequent use of memory strategies. Noteworthy, the three scales need to be scored differently; moreover, since 11 items of the Satisfaction scale are worded in a negative direction,

they were reverse scored before computing the total score for this scale (for more details on the scoring procedure, see Troyer & Rich, 2018). Cronbach's alphas calculated for the Satisfaction, Ability, and Strategy scales were .90, .89, and .87, respectively.

Coding of free responses

We analysed the contents of free responses that participants gave to explain why they had chosen a certain metaphor as their favourite in the Questionnaire on memory metaphors (for some examples, see Supplementary Materials). At an early stage, the first author of the present article read the responses provided by the entire sample. This qualitative analysis revealed that 89.9% of our sample ($n = 752$) provided responses which incorporated a clearly recognisable metaphorical reasoning; by contrast, 6.1% of participants ($n = 52$) provided responses in which this kind of reasoning was absent; finally, 5.0% of participants ($n = 42$) did not provide any response at all. Taking the first group of participants as a reference ($n = 752$), the first author of the present article was able to identify 13 content categories, all of which referred to how the metaphors chosen by the participants adequately accounted for the basic characteristics of human memory. More in detail, the following categories were identified: *phenomenology* (i.e., remembering experience), *accuracy* (i.e., reliability of memory), *storage capacity* (i.e., quantity of information stored in memory), *accessibility* (i.e., ease in retrieving memories), *permanence* (i.e., persistence of memories for an unlimited time), *contents* (i.e., storage of different types of recollections), *processing* (i.e., processing of information concerning the past), *organisation* (i.e., categorising memories and forming connections between them), *functions* (i.e., uses of memory in everyday life), *forgetting* (i.e., memory loss due to natural causes), *repression* (i.e., hiding personal experiences from consciousness), *decay* (i.e., memory loss due to pathologies), *training* (i.e., exercising and improving memory skills). The first and the second author used the categories just described to independently code the 25% of free responses collected for the present study. Each category was scored 1 if it was mentioned by the participant, and 0 if it was absent. Cohen's kappas computed for the various categories were comprised between 0.79 and 1.00, indicating a very good to excellent inter-rater agreement. Disagreements between the two coders were resolved through discussion, and then the first author autonomously completed the coding of the remaining responses.

Statistical analyses

We first conducted descriptive and bivariate analyses on the main study variables. Then, we ran a multinomial logistic regression to evaluate the extent to which sociodemographic and psychological variables predicted the likelihood of choosing specific memory metaphors.

Notably, this analysis focused on five metaphor categories: store, camera, computer, map, and other. The first four categories were selected as they were those most frequently chosen by our sample and collectively accounted for more than 50% of all responses (see Results section); the remaining responses were collapsed into one fifth residual category ("Other"). Our model was fitted with participants' preferred metaphor as a nominal outcome (reference category: "Other"). Accordingly, model coefficients represented contrasts between each retained metaphor and the reference one (Agresti, 2013; Hosmer et al., 2013). Predictors included participants' gender, education level, age, ART, MMQ scales, and false beliefs about memory. Analyses were restricted to participants with complete data on model variables. Both the distribution of outcome categories and the adequacy of cell count across groups were examined; cross-tabulations between outcome and categorical predictors were inspected to identify complete or quasi-complete separation. Multicollinearity among predictors was also assessed using variance inflation factors (VIF). Continuous predictors were standardised prior to model estimation to facilitate interpretation and comparability of effect sizes. As a final step, the assumption of linearity in the logit was assessed by comparing the main-effects multinomial model with an extended model including quadratic terms for all continuous predictors, using likelihood ratio testing and Akaike Information Criterion (AIC) (Harrell, 2015). Bootstrap confidence intervals for the multinomial model were computed from 5,000 resamples stratified by outcome category. To maintain a constant scaling unit across resamples and improve comparability of resulting odds ratios, continuous predictors within each bootstrap resample were standardised using mean and standard deviation estimated from the original sample. Although no formal a priori sample-size calculation was conducted, the adequacy of the available sample was evaluated in relation to both the complexity and empirical stability of the multinomial regression model. Overall sample size, the number of estimated model parameters, and the distribution of participants across outcome categories were considered. The same bootstrap procedure assessed the stability of model estimation and the precision of the estimated odds ratios, following recommendations for bootstrap inference and regression model validation (Carpenter & Bithell, 2000; Harrell, 2015). Multivariate analyses were conducted with R statistical software (version 4.3.3).

Results

Memory metaphors and motives underlying their choice

Our participants' favourite memory metaphors were store (chosen by 21.0% of the sample), camera (14.7%), computer (10.0%), and map (8.5%). On the other hand, muscle and mirror were chosen the least, being mentioned by

less than 2% of participants. Other memory metaphors were reported by between 3.8% and 6.9% of participants (see Figure 1).

We calculated the percentage of participants mentioning the various content categories, which were derived from the qualitative analysis of motives for choosing the memory metaphor freely reported by our sample. Results of this analysis, which only considered participants providing valid answers ($n = 752$), are presented in Figure 2. As it can be seen, the categories most frequently cited were contents (29.8%), organisation (27.4%), accessibility (25.9%), and functions (24.1%). By contrast, those least reported were accuracy (2.7%), training (2.7%), decay (1.3%), and repression (1.1%). On average, each participant referred to 1.65 content categories ($SD = 0.96$).

Table 1 reports the column percentages obtained from the cross-tabulation of all the content categories and memory metaphors investigated in this study. Chi-square tests computed on this table revealed significant associations between the chosen memory metaphors and the following content categories: contents, $\chi^2(13, N = 752) = 63.90, p < .001, \phi = .29$; organisation, $\chi^2(13, N = 752) = 133.61, p < .001, \phi = .42$; accessibility, $\chi^2(13, N = 752) = 63.68, p < .001, \phi = .29$; functions, $\chi^2(13, N = 752) = 52.83, p < .001, \phi = .26$; phenomenology, $\chi^2(13, N = 752) = 190.46, p < .001, \phi = .50$; and storage capacity, $\chi^2(13, N = 752) = 47.29, p < .001, \phi = .25$. In particular, taking the memory metaphors chosen by at least 5% of participants as a reference, we found that store and computer were

more frequently associated with the storage capacity theme than the other metaphors; motives for choosing camera typically referred to phenomenology; map and Internet were frequently associated with organisation; finally, participants' choice of home, attic, and book was frequently associated with the contents theme.

Beliefs about memory

Table 2 reports data on participants' agreement with the five statements included in our questionnaire on memory beliefs. On average, participants expressed their partial or full agreement with 1.45 statements ($SD = 1.30$). Statements obtaining highest support were "The more details a memory has the more accurate it is" and "The more vivid a memory is the more accurate it is". The percentage of participants who either agreed or strongly agreed with them was 41.7% and 43.1%, respectively. Noteworthy, these percentages are much lower than those found by Conway et al. (2014), who originally formulated and administered both items. Concerning the remaining three statements (i.e., "In my opinion, the testimony of one confident eyewitness should be enough evidence to convict a defendant of a crime", "Once you have experienced an event and formed a memory of it, that memory does not change", "With effort, we can remember events back to birth"), rates of agreement expressed by our participants were 16.8%, 28.6%, and 15.2%, respectively. Overall, these results are similar to those found by

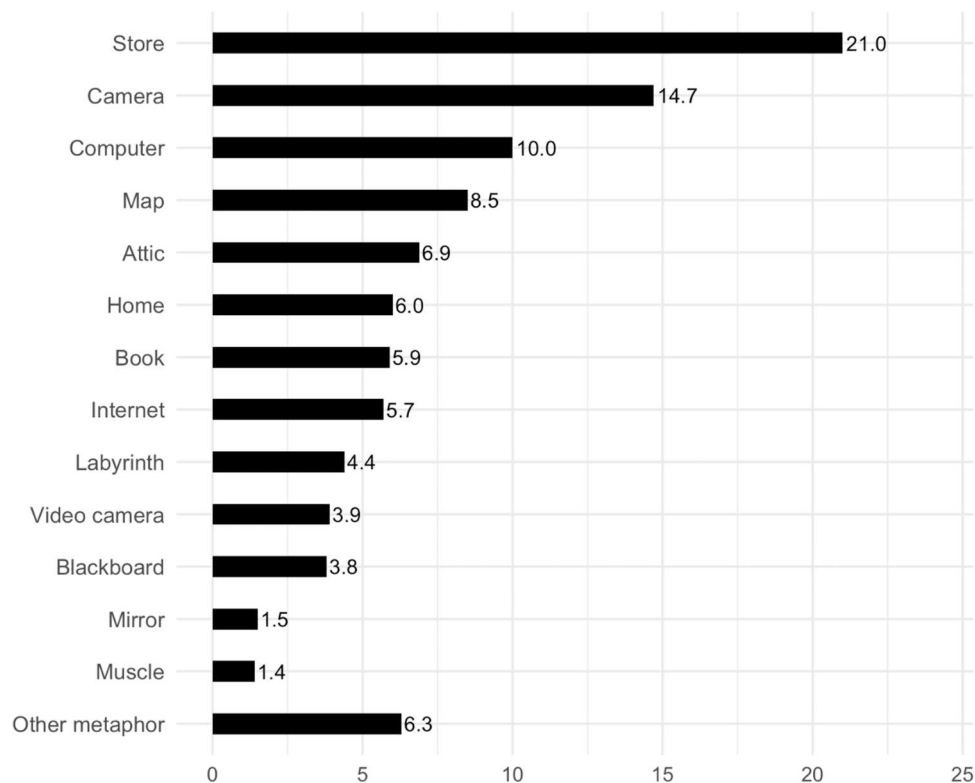


Figure 1 Citation frequency (in percentage) of memory metaphors.

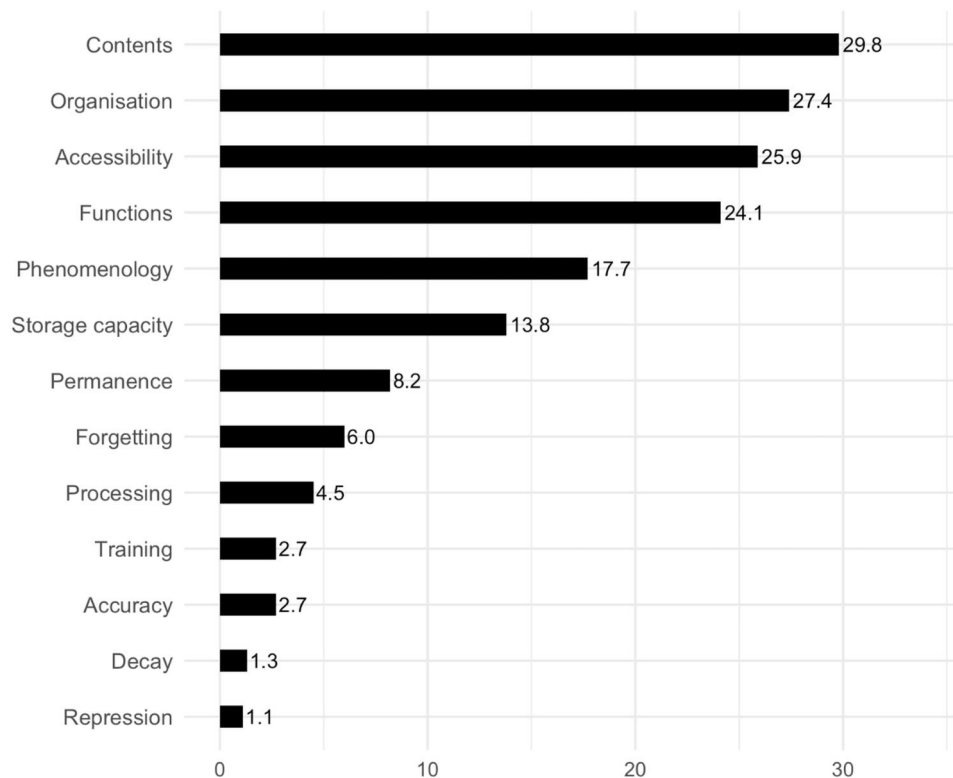


Figure 2. Citation frequency (in percentage) of content categories derived from participants' free responses ($N = 752$).

researchers using the same items (cf. Patihis et al., 2014; Simons & Chabris, 2012). Nevertheless, we would like to emphasise that any comparison between our results and those obtained in previous studies should be done with caution as our items were uniquely assembled for our study purposes.

Autobiographical memory experience and metamemory

The mean and standard deviation calculated for the full ART were $M = 4.61$ ($SD = 0.94$). On the other hand, descriptive statistics for the MMQ were the following: $M = 45.86$ ($SD = 11.52$) for the Satisfaction scale, $M = 52.58$ ($SD = 11.10$) for the Ability scale, and $M = 30.09$ ($SD = 12.17$) for the Strategy scale. We also calculated correlation coefficients (Pearson's r) between the three MMQ scales. The following results were found: Satisfaction–Strategy $r = -.31$; Ability–Satisfaction $r = .59$; and Ability–Strategy $r = -.44$.

Variables predicting the choice of memory metaphors

A multinomial logistic regression was employed to assess whether sociodemographic (age, gender and level of education) and psychological variables (ART, MMQ Strategy and Satisfaction scales, and false beliefs about memory) predicted membership in the four most frequently endorsed memory metaphor (store, camera, computer,

and map) that together accounted for 54.2% of participants' answers. We note that the MMQ Ability scale was excluded from the model as it showed the highest correlations with the other MMQ scales ($r > .44$). Each outcome category was compared with a reference one ("Other") including the remaining metaphors. Level of education was collapsed into two categories and treated as a dichotomous predictor (0 = middle school diploma or high school diploma; 1 = university degree or higher); as for gender, female was the reference category. Dataset screening led to the exclusion of $N = 36$ (4.25%) participants with missing answers on predictors. Two further participants reporting "other" gender status were excluded from the multinomial regression analyses because the resulting additional category was too sparsely represented. A total of $N = 808$ participants were thus included in the multinomial model. The distribution of the outcome categories was inspected to evaluate the adequacy of cell counts for multinomial modelling; no evidence of extreme sparsity or separation was observed. Correlations among the continuous predictors were all low to moderate ($\leq |.32|$); as concerns multicollinearity, VIF values ranged 1.04–1.33, indicating no meaningful collinearity among the model predictors (Midi et al., 2010). The assumption of linearity in the logit for continuous predictors was examined by comparing the main-effects model with an extended model including quadratic terms. This comparison was not statistically significant, $\chi^2(20, N = 808) = 15.11$, $p = .770$, with the quadratic model (AIC =

Table 1. Citation frequency (in percentage) of content categories derived from participants' free responses by memory metaphors (N = 752).

Content category	Store	Camera	Computer	Map	Attic	Home	Book	Internet	Labyrinth	Video camera	Blackboard	Mirror	Muscle	Other	χ^2 , $df = 13$
Contents	36.1	25.7	18.4	11.3	45.3	60.5	38.1	17.4	12.1	32.3	22.7	8.3	8.3	42.9	63.90***
Organisation	39.8	2.9	30.3	59.7	13.2	25.6	11.9	50.0	48.5	–	4.5	–	–	28.6	133.61***
Accessibility	37.3	11.4	26.3	17.7	39.6	14.0	21.4	32.6	51.5	9.7	4.5	–	8.3	34.7	63.68***
Functions	33.7	14.3	19.7	30.6	13.2	39.5	23.8	21.7	12.1	9.7	27.3	75.0	–	20.4	52.83***
Phenomenology	4.2	50.5	6.6	11.3	13.2	4.7	16.7	6.5	6.1	74.2	18.2	25.0	–	20.4	190.46***
Storage capacity	24.1	3.8	23.7	3.2	18.9	9.3	9.5	17.4	12.1	3.2	4.5	–	–	16.3	47.29***
Permanence	3.6	21.0	7.9	3.2	17.0	4.7	7.1	–	6.1	6.5	13.6	–	16.7	6.1	Not calculated ^a
Forgetting	7.2	3.8	3.9	3.2	15.1	–	9.5	–	9.1	–	27.3	–	–	6.1	Not calculated ^a
Processing	3.0	2.9	21.1	3.2	–	–	–	8.7	–	3.2	9.1	–	–	2.0	Not calculated ^a
Accuracy	1.2	1.0	3.9	1.6	–	–	–	4.3	–	–	9.1	66.7	–	2.0	Not calculated ^a
Training	1.2	1.9	1.3	1.6	–	–	4.8	2.2	6.1	–	–	–	75.0	–	Not calculated ^a
Decay	1.8	1.0	1.3	1.6	–	–	–	2.2	–	–	–	–	16.7	2.0	Not calculated ^a
Repression	0.6	1.0	–	–	1.9	2.3	–	–	3.0	3.2	–	–	8.3	2.0	Not calculated ^a

^aChi-square test was not calculated for this category because more than 20% of cells had expected values below 5.* $p < .05$, ** $p < .01$, *** $p < .001$.

Table 2. Memory Belief Statements and Percentage of Participants Giving Each Response

Statement	Don't know	Strongly disagree	Disagree	Agree	Strongly agree
In my opinion, the testimony of one confident eyewitness should be enough evidence to convict a defendant of a crime.	13.3	19.5	50.5	15.2	1.6
Once you have experienced an event and formed a memory of it, that memory does not change.	9.4	18.2	43.7	25.3	3.3
The more details a memory has the more accurate it is.	18.6	6.9	32.7	36.6	5.1
The more vivid a memory is the more accurate it is.	21.1	4.7	31.1	37.6	5.5
With effort, we can remember events back to birth.	23.8	29.1	31.9	11.0	4.2

2307.37) showing poorer fit than the linear one (AIC = 2282.48). Taken together, these results suggest no major assumption violations for the multinomial logistic regression model. The multinomial logistic regression model provided a significantly better fit than the intercept-only model (likelihood-ratio $\chi^2(28, N = 808) = 56.04$, $p = .001$), with pseudo- R^2 indices indicating modest explanatory power (McFadden $R^2 = .025$, Cox and Snell $R^2 = .067$, Nagelkerke $R^2 = .071$). The model estimated 32 regression coefficients, seven predictor coefficients plus an intercept for each of the four non-reference outcome contrasts.

Table 3 shows multinomial logistic regression coefficients, odds ratios, Wald test coefficients, and 95% bootstrap confidence intervals for each contrast with the reference category. Bootstrap diagnostics based on 5,000 resamples showed no model-fitting failures or missing coefficient estimates. Moreover, the precision of the

bootstrap confidence intervals for predictor effects was comparable across outcome categories, with the smallest outcome category ($N = 68$) showing a median upper-to-lower confidence limit ratio of 1.81, similar to those observed for the remaining outcome categories (range: 1.54–1.74). Overall, findings supported stable estimation of the fitted multinomial model in the present sample.

Results show that each one-standard-deviation increase in age was associated with 21.3% lower odds of choosing the store metaphor as compared with the “Other” category ($OR = 0.79$, 95% CI [0.64; 0.97], $p = .023$). On the other hand, higher levels of education were associated with 42.7% lower odds of choosing the camera metaphor ($OR = 0.57$, 95% CI [0.32; 0.93], $p = .035$), whereas each one-standard-deviation increase in false-belief scores was associated with 49% higher odds of choosing this metaphor ($OR = 1.49$, 95% CI [1.20; 1.89], $p < .001$). Moreover, each one-

Table 3. Multinomial Logistic Regression Predicting Preferred Metaphor ($N = 808$)

Contrast ^a	Predictor	B	SE	z^c	p^c	OR	95% OR CI ^d
Store	Age ^b	-.239	.105	-2.268	.023	0.787	0.641; 0.967
	Education ^e	-.087	.208	-0.420	.675	0.916	0.600; 1.384
	Gender ^f	.122	.203	0.598	.550	1.129	0.747; 1.684
	ART ^b	-.165	.099	-1.662	.096	0.848	0.686; 1.040
	MMQ Satisfaction ^b	.125	.103	1.212	.226	1.133	0.913; 1.413
	MMQ Strategy ^b	-.015	.108	-0.135	.893	0.986	0.792; 1.219
Camera	False beliefs ^b	-.061	.103	-0.594	.553	0.941	0.765; 1.141
	Age ^b	-.063	.115	-0.549	.583	0.939	0.744; 1.187
	Education ^e	-.556	.264	-2.106	.035	0.573	0.323; 0.926
	Gender ^f	-.375	.246	-1.524	.128	0.687	0.411; 1.089
	ART ^b	-.162	.112	-1.444	.149	0.850	0.679; 1.066
	MMQ Satisfaction ^b	-.046	.118	-0.390	.696	0.955	0.760; 1.214
Computer	MMQ Strategy ^b	-.093	.125	-0.745	.456	0.911	0.708; 1.164
	False beliefs ^b	.400	.112	3.557	<.001	1.491	1.197; 1.885
	Age ^b	-.078	.137	-0.566	.572	0.925	0.697; 1.205
	Education ^e	.355	.257	1.383	.167	1.426	0.857; 2.410
	Gender ^f	.365	.257	1.423	.155	1.441	0.851; 2.408
	ART ^b	-.077	.129	-0.597	.551	0.926	0.722; 1.190
Map	MMQ Satisfaction ^b	-.052	.129	-0.403	.687	0.949	0.742; 1.219
	MMQ Strategy ^b	-.052	.140	-0.371	.711	0.949	0.712; 1.242
	False beliefs ^b	-.015	.131	-0.113	.910	0.985	0.735; 1.293
	Age ^b	.024	.148	0.159	.874	1.024	0.765; 1.357
	Education ^e	.253	.281	0.898	.369	1.287	0.724; 2.241
	Gender ^f	.202	.284	0.711	.477	1.224	0.671; 2.118
	ART ^b	-.321	.138	-2.327	.020	0.725	0.566; 0.918
	MMQ Satisfaction ^b	.318	.152	2.099	.036	1.375	1.043; 1.884
	MMQ Strategy ^b	.144	.155	0.932	.352	1.155	0.854; 1.548
	False beliefs ^b	.007	.145	0.049	.961	1.007	0.750; 1.321

^aContrast Reference category = “Other”

^bStandardised predictors

^cWald test for individual coefficients

^dConfidence intervals based on 5,000 stratified resamples

^e0 = Middle school diploma or high school diploma; 1 = University degree or higher

^f0 = Female, 1 = Male; B = logit coefficient; SE = standard error; OR = odds ratio

standard-deviation increase in the ART score was associated with 27.5% lower odds of choosing the map metaphor (OR = 0.73, 95% CI [0.57; 0.92], $p = .020$), whereas each one-standard-deviation increase in MMQ Satisfaction was associated with 38% higher odds of choosing it (OR = 1.38, 95% CI [1.04; 1.88], $p = .036$). Finally, no significant associations emerged for the computer metaphor when compared to the “Other” category.

Discussion

The current study exploratively investigated the memory metaphors held by ordinary people within a comprehensive and wide sample including adult populations of Northern and Central Italy. We first attempted to identify the metaphors that best described the participants’ idea of memory. To this end, we proposed a questionnaire allowing participants to select only one option among 13 alternatives of typical metaphors derived from the literature, but at the same time giving them the possibility to select “other” – when they thought none of the available metaphors would fit their personal idea.

Considering the overall sample, the most frequently selected metaphor was the store (21.0%). Other highly selected metaphors were the camera (14.7%), the computer (10.0%) and the map (8.5%). Interestingly and a bit surprisingly, the Internet – which is the most technologically advanced metaphor used in the present study – was selected by a relatively small portion of our sample (5.7%). The remaining metaphors (blackboard, mirror, video camera, book, home, attic, labyrinth, muscle) were reported by a percentage of participants between 1.4 and 6.9%. Notably, the most frequently chosen metaphors by our participants do not correspond with those mostly selected by Brewin and colleagues’ sample (2019) – i.e., diary entry, video camera, and library.⁵ However, a direct comparison between ours and Brewin et al.’s findings is not possible for at least three reasons. First, our study reached the general population, while Brewin et al.’s study targeted a student population. Second, metaphors used in the two studies were only partially overlapping: only six of our metaphors (i.e., video camera, computer, map, store, home, muscle) reflected those used by Brewin et al.; as a result, some of the most frequently endorsed metaphors by the participants in Brewin et al.’s study (i.e., diary entry and library) did not emerge in our investigation. Third, participants in our study could select only one preferred metaphor among those provided, whereas Brewin et al.’s participants could express their degree of endorsement for all of the listed metaphors (i.e., 21 metaphors).

Turning now to the most selected memory metaphors in our sample – store, camera, computer and map (chosen by at least 8.5% of the participants) – we note that all four of them can be categorised into “spatial metaphors”, highly popular within cognitive psychology and philosophical traditions (Roediger, 1980). Indeed, these

metaphors refer to objects or places where to save events and pieces of information from people’s past in order to make them available for current needs or actions. Nonetheless, apart from this, they also represent objects and tools with very different functions, characteristics and daily use. Our participants seem aware of the differences among these metaphors in defining the multiple characteristics and functions of human memory. From the analysis of the motivations that drove the metaphors’ choice, it seems that the preferred orientation towards store and computer may depend on the “storage capacity” of both these objects: indeed, although through diverse mechanisms, they both allow for maintaining past events in great detail. Turning to camera, its ability to reproduce single and accurate details of personal past events is taken as a good example of a memory metaphor by our participants. Finally, map is described as a favourable tool to organise in a logical and intuitive way those pieces of information that the individual might need to retrieve for current needs. Interestingly, these motivations are generally consistent with the arguments and empirical evidence provided by the scholars who highlighted store, camera, computer and map as proper metaphors useful to describe human memory’s characteristics and functions.⁶ Nonetheless, some interpretive difficulties arise when we examine the store metaphor in great detail. In fact, data reported in Table 1 show that participants endorsing this metaphor often associated it with a series of characteristics defining the core aspects of memory functioning: i.e., contents, organisation, and accessibility, beyond storage capacity. Importantly, these features may be similarly related to other spatial metaphors, such as “archive” and “library”, which unfortunately were not included in our questionnaire but are used interchangeably with store in common language. Future studies should compare ordinary people’s subjective representations of these potentially overlapping memory metaphors. It would be, in fact, desirable to better understand whether, among these metaphors, some are used more frequently than others in everyday conversations, and whether and how the concepts they refer to effectively differ in terms of abstraction and semantic organisation (cf. Rosch, 2011).

The second objective of our study was to deepen the role of sociodemographic characteristics and personal orientation towards memory and its functioning in defining the participants’ metaphor selection. Results of the multivariate analysis – focused on the four most frequently cited by our sample and an “Other” residual metaphor category – showed that the variables able to predict the metaphor choice varied depending on the metaphor itself. When compared to the “Other” category, participants’ age negatively predicted the choice of store. On the other hand, the selection of camera was associated with a low educational level and to the tendency to have erroneous beliefs about memory. The choice of map was positively associated with satisfaction for one’s own

memory functioning, measured through MMQ (Troyer & Rich, 2002), and negatively associated with autobiographical memory experience, measured through ART (Berntsen et al., 2019). Finally, the preference for computer was not statistically associated with any of the variables considered in our model.

The interpretation of these results is not easy; nonetheless, we argue that the youngest participants may have preferably selected store against other metaphors because there might be a higher probability that they encountered contemporary psychology theories (for example through university studies or mass/social media), which indeed indicate store as one of the most suitable metaphors to describe memory functioning and characteristics (Atkinson & Shiffrin, 1968).

Concerning the camera, as previously stated, the current findings suggest that this metaphor was selected the most by participants with less scientific knowledge on memory and with a lower educational level. These results seem consistent with studies on the “photographic” nature of memory. In particular, evidence on flashbulb memories contrasts with this belief, somewhat popular among ordinary people, that memory works as a camera (see, for example, Neisser & Harsch, 1992; Schmolck et al., 2000; Talarico & Rubin, 2003; Weaver III & Krug, 2004). The choice of the map was the only one influenced by metacognitive variables and autobiographical memory experience. On the one hand, we found a positive effect of satisfaction with one’s own memory; we could argue that believing to have good memory abilities may reflect in the ability to move throughout the space within everyday activities, and thus to have good sense of orientation and spatial representation, which are nicely represented by the map. However, this interpretation must be cautiously considered given that none of the items of the MMQ Satisfaction scale specifically address spatial memory. The negative association between the map and the ART total score (i.e., autobiographical memory experience) is somewhat surprising. It must be noted that the ART includes seven distinct components of memory. Among these, only one (i.e., scene) may directly refer to spatial representation; however, it deals with the idea of remembering the general layout of an event memory, more than orientation or navigation throughout an environment (i.e., the typical properties of visuospatial memory). Examples of items tapping ART-scene are the following: *“In my memories of past events, I remember where the actions, objects, and people are located in the events”*; *“In my memories of past events, I remember the layout of the broader setting in which the events are located”*. The remaining six components (i.e., reliving, vividness, visual imagery, narrative coherence, life-story relevance, rehearsal) refer to several properties of memory difficult to be included into the metaphoric idea of a map; thus, it may be that individual differences in self-reported memory experience had a negative impact on the selection of the metaphor map. It is a bit surprising that the ART did not predict any of the other most selected memory

metaphors, but it may be that it did not help capture the motivation to select a metaphor against another, and as we partially found, such motivation lies within more metacognitively oriented questionnaires or sociodemographic characteristics.

Limitations and future research directions

The current study has three major limitations, discussed in turn below. First, our participants were forced to select one option among the alternative metaphors. Future studies should include multiple-choice responses to overcome this issue. However, we suggest that future research should also pay close attention to the motivations that drive people’s choices – this aspect was indeed unexplored in Brewin et al.’s study (2019), which followed a multiple-choice alternatives procedure. We would like to highlight the fact that many participants in our study – when asked to motivate their metaphor choice – spontaneously compared their choice against the other options within the questionnaire, suggesting a personal orientation towards a single preference against multiple-choice options. To support our claim, we report the response of a participant in favour of their choice (Internet): *“I compare human memory to the Internet because, in my opinion, it’s a huge warehouse/database containing every thought, perception, and piece of knowledge etc ... of an individual. I compare it to the Internet rather than to a store because of the idea of order I associate with it (in my mind, the idea of the Internet appears more organised) and for its readiness of response. The Internet combines the functions of several tools mentioned above”*.

The second limitation has to do with the variables that we selected as potential predictors of the participants’ metaphor choice. Even if we included several personal and psychological factors (i.e., main sociodemographic characteristics and the participants’ beliefs and subjective experience of memory), we may have neglected potentially relevant variables such as personality traits, emotional affective states, and social attitudes. Future studies are strongly needed to clarify the contribution of these variables and their potential interaction with the other indicators we assessed in the present study.

Finally, we must notice that some participants did not provide any motivation for their metaphor choice. It is a small percentage of the overall sample (6.1%), nonetheless we believe it should be addressed in future research – for example, investigating cognitive competencies that underlie metaphorical reasoning, specifically referring to memory or other psychological constructs (on this topic, see the classical work by Lakoff & Johnson, 1980).

Conclusions

Having reached this point, we would like to stress that some metaphors – better than others – are able to depict the characteristics and functions that ordinary

people, implicitly or explicitly, allocate to human memory. As our exploratory study found, store is the preferred one – which is indeed the metaphor that guided cognitive psychologists Atkinson and Shiffrin (1968) in formulating the “modal” model of human memory (see Baddeley et al., 2025). At the same time, we should not forget that descriptions of (sensory, short-term, and long-term) memory stores put forward by Atkinson and Shiffrin and other cognitive researchers consider very complex mechanisms of information coding and processing that are hard to find in ordinary people’s representations of memory. Thus, there is still a gap that is not entirely negligible between naïve and scientific psychology of human memory.

As a final remark, we would like to point out that it remains difficult for memory scholars to comprehend the specific determinants – psychological, sociodemographic and cultural – that might drive ordinary people in their selection of memory metaphors. We believe that showing with our findings how age, education, tendency to hold erroneous beliefs about memory, satisfaction with one’s own memory and autobiographical memory experience have oriented people’s choices about metaphors is the first contribution in this field.

Notes

1. We would like to note that, over the last two decades, anything but negligible number of studies on memory beliefs also targeted potential memory experts, including experimental psychologists, clinical psychologists, and psychotherapists. For some examples, see Magnussen and Melinder (2012), Mirandola et al. (2013), Patihis et al. (2014, Study 2, 2021), and Zappalà et al. (2024).
2. For the sake of completeness, we note that one of the questions included in the Magnussen et al.’s survey (2006) of memory beliefs among the Norwegian population implicitly referred to the muscle memory metaphor. In fact, the participants were asked “Physical exercise makes the body stronger. Do you think it is possible to train memory in an analogous fashion?”. Whilst the exact term *muscle* did not appear in the wording of this question, it is interesting to note that 94% of participants answered “yes”.
3. Only 56 participants were over 65 years and, of these, only seven were over 80. While we did not carry out a screening of our sample using clinical tests of cognitive functions, we compared participants aged over 65 (age 66–93, $N = 56$) with the remaining participants for whom age data were available (age 18–65, $N = 776$) on a set of cognitive variables which we assessed by means of the Autobiographical Recollection Test (ART; Berntsen et al., 2019) and the Multifactorial Memory Questionnaire (MMQ; Troyer & Rich, 2002) (see the Instruments section for a description of both questionnaires). Given the numerical imbalance between age groups, the Welch’s unequal variances t -test was used. Results are reported in Table S1 of Supplementary Materials. Participants aged over 65 scored lower on the MMQ Strategy scale than younger participants; however, no group differences emerged for the other MMQ scales, as well as for ART scores. These results may be differently interpreted: on the one hand, it is possible that older people do indeed use memory strategies less frequently than younger individuals, as the latter lead more complex lives requiring constant use of such strategies; on the other hand, older people may use memory strategies to

a similar extent as younger people but be less aware of that, as these strategies are part of their daily routines. We would like to remark that our results should be considered with caution, as sample size of the older group was disproportionately smaller than that of the comparison group.

4. Six out of 13 metaphors of our list (i.e., video camera, computer, map, store, home, muscle) were identical (or almost identical) to those used in the Brewin et al.’s study (2019). However, the latter did not give their participants the option to provide a freely chosen metaphor, as we did.
5. We note that store, computer and map correspond to the fifth, sixth and seventeenth position, respectively, obtained in Brewin et al.’s sample (2019). Camera was not included in their study; thus, we do not have information on this metaphor.
6. In particular, see Atkinson and Shiffrin (1968), and Waugh and Norman (1965) for store; see Brown and Kulik (1977) for camera; Loftus (1980), Foster (2009), Feldman (2021), and Meyers (2025) for computer; Collins and Quillian (1970) for map; finally, for critical and comprehensive reviews, see also Roediger (1980), Draaisma (1995/2000), Koriart and Goldsmith (1996), and Magnussen et al. (2007).

Acknowledgments

We would like to thank Lorenzo Bassi, Barbara Cardaci, Marta Colombo, Cristina Cuvillo, Martina D’Elia, Alessio Migliorini, Francesca Petrolini and Francesca Zecchini for their precious help in recruiting participants, collecting and entering data.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

The author(s) reported that there is no funding associated with the work featured in this article.

Data availability statement

The data that support the findings of this study are freely available from the Open Science Framework at <https://osf.io/rmn76/overview>.

Ethics approval

The protocol used for the present study was approved by the Ethics Committee of the University of Bergamo on February 20, 2025 (minute no. 02/2025).

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Appendix

Statements Used to Assess Memory Beliefs

Item	Source
In my opinion, the testimony of one confident eyewitness should be enough evidence to convict a defendant of a crime.	Simons and Chabris (2011)
Once you have experienced an event and formed a memory of it, that memory does not change.	Simons and Chabris (2011)
The more details a memory has the more accurate it is.	Conway et al. (2014)
The more vivid a memory is the more accurate it is.	Conway et al. (2014)
With effort, we can remember events back to birth.	Patihis et al. (2014)