

## What people believe about memory

**Svein Magnussen, Jan Andersson, Cesare Cornoldi, Rossana De Beni, Tor Endestad, Gail S. Goodman, Tore Helstrup, Asher Koriat, Maria Larsson, Annika Melinder, Lars-Göran Nilsson, Jerker Rönnerberg, and Hubert Zimmer**

*Centre for Advanced Study at the Norwegian Academy of Science and Letters, Oslo, Norway*

Two representative samples of adult Norwegians ( $n=2000$ ) were asked a set of general and specific questions regarding their beliefs and opinions about human memory. The results indicate that on many questions, such as time of the earliest memories, inhibiting effects of collaboration, and memory for dramatic versus ordinary events, the views of the general public concurred with current research findings, and people in general had realistic views about their own memory performance. On other questions, such as the reliability of olfactory as compared with visual and auditory memory, the memory of small children in comparison with that of adults, the likelihood of repression of adult traumatic memories, and on more general questions such as the possibility of training memory and the capacity limitations of long-term memory, a large proportion of the participants expressed views that are less supported by scientific evidence. Implications of these findings are briefly discussed.

“Memory is a central part of the brain’s attempt to make sense of experience, and to tell coherent stories about it. These tales are all we have of our past, so they are potent determinants of how we view ourselves and what we do. Yet our stories are built from many ingredients. Snippets of what actually happened, thoughts about what might have happened, and beliefs that guide us as we attempt to remember. Our memories are the powerful but fragile products of what we recall from the past, believe about the present, and imagine about the future.”

This quotation from Daniel Schacter’s exciting journey into memory research (1996, p. 308), published 10 years ago, captures the central role of memory in human life. However, psychology

textbooks frequently treat memory as if it were a circumscribed area of study, a special mental faculty or capacity that coexists with other mental capacities. True, it is recognised that memory is not a single cognitive process or system, but a collective term for a family of neurocognitive systems that differ in the way they store information and make it available to consciousness and behaviour (Schacter, Wagner, & Buckner, 2000), but the tight web that memory forms with perception, attention, language, reasoning, decision making, and human action is rarely highlighted. For example, it is rarely explicitly stated that perception implies memory. To produce a perceptual experience, on-line sensory signals must join stored representations, and this linking is part of the perceptual process itself. If the

---

Address correspondence to: Svein Magnussen, Department of Psychology, University of Oslo, Box 1094 Blindern, 0317 Oslo, Norway. E-mail: svein.magnussen@psykologi.uio.no

Svein Magnussen, University of Oslo, Norway; Jan Andersson, University of Linköping, Sweden; Cesare Cornoldi and Rossana De Beni, University of Padua, Italy; Tor Endestad, University of Oslo, Norway; Gail S. Goodman, University of Oslo, Norway, and University of California, Davis, USA; Tore Helstrup, University of Oslo, Norway; Asher Koriat, University of Haifa, Israel; Maria Larsson, Stockholm University, Sweden; Annika Melinder, University of Oslo, Norway; Lars-Göran Nilsson, Stockholm University, Sweden; Jerker Rönnerberg, University of Linköping, Sweden; Hubert Zimmer, University of Saarland, Germany.

This research is part of a project on everyday memory organised at the Centre of Advanced Study at the Norwegian Academy of Science and Letters during the academic year 2003–2004. We thank the Centre for its generous hospitality and support.

on-line signals are disconnected from stored representations, as in certain cases of bilateral lesions to the temporal lobes, the person becomes agnostic. The person sees but does not perceive—the world is meaningless (Farah, 1990; Goodale & Milner, 2004).

In the psychology of personality, the concept of the self is typically not explicitly related to memory although it is closely tied to episodic memory. Self-involvement is in fact one of the defining characteristics of the episodic memory system (Tulving, 2002). If a person suffers complete retrograde amnesia, it is the self that is lost. A Norwegian newspaper (*Dagbladet, Magasinet*, 27 March, 2004) recently told the story of Dodo, a young man of Asian origin who woke up in January 2003 on the freezing ground in a small village in Switzerland with his well-equipped rucksack nearby, stuffed with expensive clothes and a money belt containing \$5000, but no identity papers or tickets, and with absolutely no personal memory. Dodo wandered around in Europe for several weeks, and somehow managed to travel to Oslo, Norway, for reasons he cannot explain, where he is currently being studied at the University hospital. His memory loss for the time before he woke up in Switzerland is massive: He has no idea who he is, and does not even recognise his own face in the mirror; he has even lost his native language—he speaks heavily accented English but no Asian languages. He has a picture of a young girl, taken in Paris, but he has no idea who she is. Dodo's memory goes roughly a year back—the rest is speculation. "I was nobody," Dodo says, "Now I tell myself I was born one year ago."

A large part of clinical psychologists' work deals with memory; not with people's memory problems, but with normal memories. In psychotherapy, patients talk about their current lives and their personal history. To understand these stories and interpret them, the therapist must be aware of the factors that may shape the clients' stories including factors that may distort memory, what Schacter (2001) recently termed the "seven sins of memory". But courses covering scientific work on memory are rarely included in the required curriculum of clinical training programmes, and it is our impression that some clinical psychologists are almost as naïve as laypeople when it comes to understanding the processes of memory and representation.

The scientific literature on memory is enormous. A search in the *Psychinfo* database gave

close to 90,000 references to the term "memory", with almost 38,000 references to books and papers published in the last 10 years, and 3536 references in 2003 alone. The state of the art is presented in several handbooks (e.g., Tulving & Craik, 2000). To what degree have the results of this research been incorporated into psychological folklore? Do people nurture ideas about memory that agree with or are in conflict with current scientific knowledge? Because topics such as memory and emotion are among the most popular for visitors to neuroscience web sites (Herculano-Houzel, 2003), it might be expected that scientific knowledge about memory is fairly quickly absorbed by society.

Most previous surveys on memory have targeted selected groups of respondents, mostly professionals, and/or probed specific topics. For example, Loftus (1979) asked participants a set of questions that were directly relevant to eyewitness testimony, with questions related to specific experimental findings and phenomena, such as weapon focus and cross-racial identification. A number of surveys have probed the beliefs of professionals of the judicial system regarding the reliability of child-witness memory reports (Brigham & Spier, 1992; Everson, Boat, Sherries, & Robertson, 1996; Melinder, Goodman, Eilertsen, & Magnussen, 2004), and Kassin, Tobb, Hosch, and Memon (2001) included memory questions in their recent survey of eyewitness experts. A number of other surveys have dealt with specific themes such as memories of childhood abuse, false memories in therapeutic practice, and therapists' beliefs about the frequency and signs of such memories (e.g., Gore-Felton, Koopman, Thoresen, Arnow, Bridges, & Spiegel, 2000; Katz, 2001). To our knowledge, no surveys have been published on the general public's beliefs about the more general questions of memory.

The present study reports the results of a large-scale ( $n=2000$ ) telephone survey on a representative sample of the adult Norwegian population. In selecting questions for study, the authors drew on their personal experience as memory researchers; for example, concerning the types of questions they have been asked by news media, the popular media, and individuals in informal settings. Frequently asked questions cover topics such as emotion and memory, memory and ageing, individual differences in memory, and the possibility of improving memory. For some of the questions, current memory science suggests a reasonably good answer, for some of the

questions the answer is tentative, and for other questions the answer is open. When presenting the results, we briefly review relevant research for comparison.

When laypeople talk about memory, they usually refer to episodic and semantic memory; that is, to the recollection of the things they have learned and the experiences they have had. Because the large majority of our respondents were scientifically unsophisticated, in phrasing our questions we made an effort to avoid an explicit reference to the different forms of memory that scientific taxonomies define, but accepted that memory is simply what people believe it is.

## METHOD

The survey was carried out by OPINION, a major Norwegian survey research company, in November 2003 and March 2004. On the first occasion 10 questions were asked. The second survey comprised three follow-up questions and a rephrasing of one of the original questions. All questions probed general aspects of memory, and with one exception, they had fixed response alternatives. "Don't know" or "uncertain" were not included among the response alternatives offered to the respondents, but this category was ticked by the interviewer for occasional respondents who refused to answer a particular question. On each occasion, 1000 participants were tested, with different samples surveyed on the two occasions. The survey was conducted as a telephone interview, and all interviews were completed within a 3-day period. On the first occasion 3256 telephone numbers were drawn. A total of 647 people did not answer after six separate attempts and 1630 did not wish to participate or had no time to participate. The corresponding numbers on the second occasion were 2652, 773, and 879, respectively.

All questions were presented in Norwegian; below we present the English translations of the questions and the response alternatives, and we indicate the sample (1 or 2) associated with the question:

1. Physical exercise makes the body stronger. Do you think it is possible to train memory in an analogous fashion? (Yes – no). Sample 1.
2. Most people are exposed to large amounts of new information each day. Do you think there is a limit to the amount of information the brain is able to store? (Yes – no). Sample 1.
3. Many people report vivid memory for smells. Do you think that sensations of smell are remembered better, as well as, or worse than visual and auditory impressions? (Better – as good as – worse). Sample 2.
4. When small children recount events they have experienced, do you think they remember better, as well as, or worse than adults? (Better – as good as – worse). Sample 1.
5. Many people talk about memories from their early childhood years. How far back in time do you believe people can remember? (From birth on – 1 year – 2 years – 3 years – 4 years – 5 years – 6 years or older). Sample 1.
6. Do you think your own memory has become better or worse during the last five years, or is it unchanged? (Better – no change – worse). Sample 1.
7. It is generally believed that memory gets worse with age. When do you think the decline starts? (At 20 years – 30 – 40 – 50 – 60 – 70 – 80 – never). Sample 2.
8. Do you think your memory is better, as good as, or worse than most people of your own age? (Better – as good as – worse) Sample 1; (much better – somewhat better – as good as – somewhat worse – much worse) Sample 2.
9. We sometimes remember incorrectly. How good are you at judging the reliability of your own memory? (Very good – pretty good – neither good nor bad – pretty bad – very bad). Sample 1.
10. Sometimes people become witnesses to dramatic events. Do you think the memory for such events is worse, as good as, or better compared with the memory for everyday events? (better – as good as – worse). Sample 1.
11. Sometimes people who have experienced frightening and dramatic events claim to have no memory for the event. Do you think they actually do not remember, or do you think they choose not to talk about it? (Do not remember – choose not to talk). Sample 1.
12. Sometimes people who have committed murder claim to have no memory for the

crime. Do you think such memories can be repressed and that the perpetrators are telling the truth, or do you think they are lying? (They tell the truth – they lie). Sample 2.

13. Sometimes two or more persons are witnesses to the same event. A police investigator may interview the witnesses together or separately. When do you think he will obtain the most information? (Joint interview – separate interviews – no differences). Sample 2.

The survey was embedded in a larger survey which, depending on the subscribers of that month, might also probe a number of other topics such as political preferences, holiday habits, opinions on current television programmes, attitudes towards foreigners, and so on. The respondents were selected according to the company's standard sampling procedures and form representative samples of the adult Norwegian population between 18 and 85 years of age. Several background variables were recorded such as gender, age, education, and geographical location. With the exceptions noted in the results section, the findings are presented as estimated population distributions, weighted with respect to gender and age, and have an estimated deviation of  $\pm 1.4$ – $3.3\%$  from the actual population distributions.

## RESULTS AND DISCUSSION

We present the results for each question separately, with graphs depicting the overall response pattern headed by the specific phrasing of that question. For all questions, the data were analysed with respect to age, gender, and educational level. Except where noted, these variables did not turn up as significant factors in the response patterns, and when any of the background factors yielded a non-trivial effect size in the analyses, this will be depicted in the graphs.

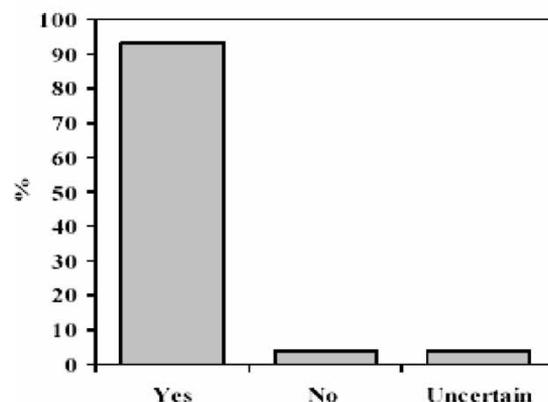
### Can memory be trained?

Weekly magazines publish articles on memory-enhancing techniques, most of which consist of a rephrasing of various mnemonic techniques. However, sometimes the mnemonic techniques are presented as suitable for overall memory

improvement. When phrasing this question (“Physical exercise makes the body stronger. Do you think it is possible to train memory in an analogous fashion?”), we introduced the analogy with body strengthening to probe the idea that specific memory exercises transfer to memory in general. To ascertain that the question was interpreted as such, at least by the majority of the respondents, we showed it to a number of non-experts, and they all provided the “muscle” interpretation of the question.

Since the time of the observations made by William James on himself (1890), research suggests that pure memory exercise does not enhance memory in general. The scientific literature on memory expertise (see reviews by De Beni, Cornoldi, Larsson, Magnussen, & Rönnerberg, in press; Gobet, 1998; Kimball & Holyoak, 2000; Vicente & Wang, 1998) indicates that superior memory of experts in the various fields, such as chess and sports, is confined to domain-relevant information and does not carry over to other fields. Waters, Gobet, and Leyden (2002) recently found zero correlations between chess skill, as measured in terms of international rating, and visuo-spatial memory. Master players did no better than non-master-level players, and the chess players as a group performed at the level of a control group of navy cadets. However, the results of the survey, presented in Figure 1, show that an overwhelming majority of the respon-

**Physical exercise makes the body stronger. Do you think it is possible to train memory in an analogous fashion?**



**Figure 1.** Can memory abilities be trained? Distribution of responses ( $n=1000$ ) to the question quoted above the diagram. “Uncertain” in this and the following diagrams is a category ticked by the interviewer when the respondent refused to choose any of the other categories.

dents, 94%, do believe that memory capacity can be trained; only 2% were sceptical.

### Storage capacity

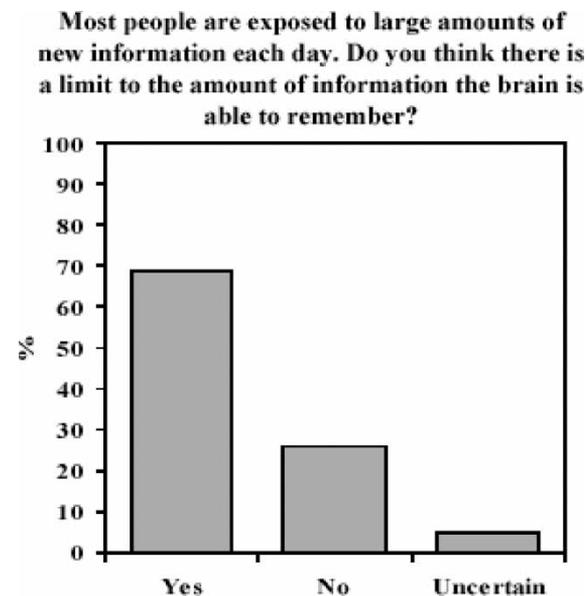
Closely linked with the idea of memory exercise is the question of whether long-term memory has a limited storage capacity or is limitless. This question (“Most people are exposed to large amounts of new information each day. Do you think there is a limit to the amount of information the brain is able to store?”) specifically hinted at the storehouse metaphor of long-term memory (Koriat & Goldsmith, 1996; Koriat, Goldsmith, & Pansky, 2000), rather than at the filtering and consolidation of memory processing, and was indeed interpreted by informants in that way. So far, there is no evidence indicating a limit to the amount of information the brain is able to store and retrieve. Most classical papers on memory for large amounts of information suggest that human long-term memory is virtually limitless (Landauer, 1986; Standing, 1973). Selection mechanisms and short-term memory capacity limitations are effective in filtering the information that enters into long-term storage, and a dive into the *Psychinfo* database indicated that all the papers discussing capacity limitations in human memory referred to short-term memory. What-

ever memory research indicates, the results of the survey, presented in Figure 2, show that a majority of the respondents believed that there is a limit to memory, with a substantial minority disagreeing. The belief in capacity limitations was more pronounced in respondents with lower education than those with higher education. Of the respondents with no education beyond elementary school, 80% believed in a capacity limitation whereas 65% of the respondents who had completed a university degree so believed.

### Olfactory memory

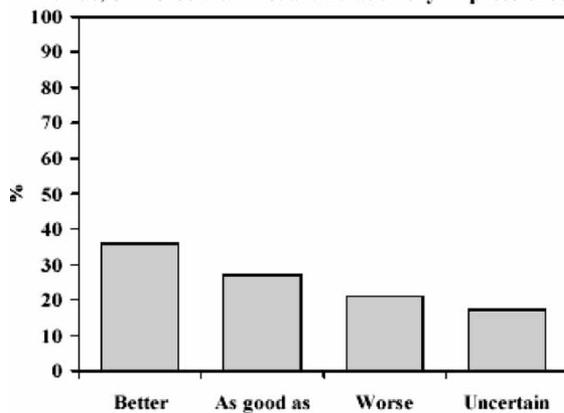
Marcel Proust’s vivid recollection of his childhood experiences triggered by the smell of a madeleine dipped in lime-blossom tea in *A la Recherche du Temps Perdu* is frequently cited in memory textbooks as an example of the cue dependency of retrieval from long-term memory. This experience, referred to as the “Proust phenomenon”, illustrates the potential of odours to act as triggers for evoking odour-associated memories (Chu & Downes, 2002; Willander & Larsson, in press). Odour-evoked memories have been shown to be older, more emotional, and thought of less often than memories elicited by visual or verbal variants of the same items (Chu & Downes, 2002; Herz, 1996; Rubin, Groth, & Goldsmith, 1984; Willander & Larsson, in press). However, a comparison of episodic memory for information presented in different sensory modalities clearly indicates that forgetting for olfactory information is substantially more severe than it is for visually based information (Larsson & Bäckman, 1998; Murphy, Cain, Gilmore, & Skinner, 1991). Thus, the human capacity to efficiently encode, store, and retrieve olfactory information is reliably poorer than the ability to process visual information.

However, when we asked our respondents to decide if olfactory memory was better, equal to, or worse than visual and auditory memory (“Many people report vivid memory for smells. Do you think that sensations of smell are remembered better, as well as, or worse than visual and auditory impressions?” see Figure 3), a majority believed that olfactory memory is better or as good as visual and auditory memory. Only every fifth respondent correctly believed it to be worse, but a substantial minority of the respon-



**Figure 2.** Is long-term memory capacity limited? Distribution of responses ( $n=1000$ ) to the question quoted above the diagram.

Many people report vivid memory for smells. Do you think that sensations of smell are remembered better, as well as, or worse than visual and auditory impressions?



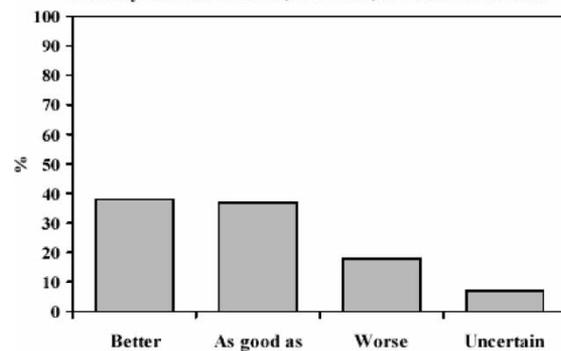
**Figure 3.** How good is olfactory memory? Distributions of responses ( $n=1000$ ) to the question quoted above the diagram.

dents was sufficiently uncertain to be unable to answer the question.

### Children's memory

Four questions dealt with changes in memory across the lifespan. In the first of these questions ("When small children recount events they have experienced, do you think they remember better, as well as, or worse than adults?"), children's memory was compared with adults' memory. The question (see Figure 4) was phrased as a comparison between small children and adults, and by "small children", we had in mind preschoolers and young school children aged 3 to 6 years. A small-sample informal check indicated that people indeed interpreted the question in this manner. The experimental evidence is quite clear: Small children report less information than do adults, and 3- to 4-year-old children recall fewer details and are more suggestible than are 5- to 6-year-olds (Fivush, 2002; Goodman & Reed, 1986; Peterson, 2002). The type of question used when interviewing children about personal events is also a significant predictor of children's reliability and memory. Open-ended questions are known to elicit particularly accurate, although also particularly limited, memory reports compared to direct and suggestive questions (Hutcheson, Baxter, Telfer, & Warden, 1995; Leichtman & Ceci, 1995; Milne & Bull, 1999). However, even when questioned in an open-ended manner,

When small children recount events they have experienced, do you think they remember better, as well as, or worse than adults?



**Figure 4.** Beliefs about the memory performance of small children. Distributions of responses ( $n=1000$ ) to the question quoted above the diagram.

childhood amnesia (as we will discuss later) sets a definite starting point for episodic memory expression.

On this question, the public does not agree with the results of memory research. Figure 4 shows that a large majority believed that small children's memory is at least as good as that of adults, and as many as about 40% of the respondents thought it was better. This is interesting, given parents' daily experience that, when asking their children what they did at kindergarten or school that day, the children's frequent answer is simply "We played." This brief answer may be a consequence not only of difficulty in communicating but also possibly of poor memory of the event, at least when children are required to retrieve the information on their own. Perhaps the belief in children's memory performance is influenced by our selective memory of the episodes where young children display extraordinarily good recollection; it is perhaps the surprising memory performance that we remember. As children's episodic memory has been a theme in connection with sexual abuse cases, our faith in young children's memory may also be governed by a need at times to believe children, but also by an absence of information about the potential fragility of episodic memory in young children and their susceptibility to external influences (Bruck, Ceci & Hembrooke, 2002; Poole & Lindsay, 2002). However, external vulnerability is often reinforced by young children's lack of appropriate metacognitive skills (Ghetti & Alexander, 2004), theory of mind capabilities (Flavell, 1999; Welch-Ross, 2000), and cognitive inhibition functions (Alexander, Goodman,

Schaaf, Edelstein, Quas, & Shaver, 2002), all of which may contribute to the individual's susceptibility, or lack thereof.

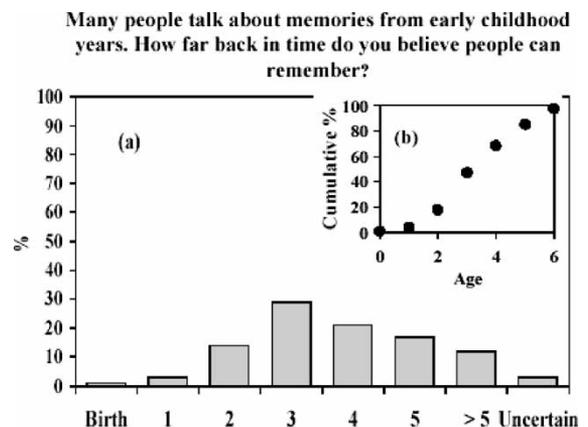
### Memory for early childhood

We also included a question on how well adults remember their early childhood ("Many people talk about memories from their early childhood years. How far back in time do you believe people can remember?"). The concept of childhood amnesia refers to the inability of adults and older children to remember anything from the early years of life, usually before 3 years of age. Recent research indicates that the incidence of childhood amnesia depends on several factors associated with cognitive development, in particular language development (see Nelson, 1993; Pillemer & White, 1989; Reese & Fivush, 1993; Reese, Haden, & Fivush, 1993), and is better viewed as a dynamic process than a barrier (Goodman & Melinder, in press; Howe, 2000; Nelson & Fivush, 2004; Peterson, 2002). A wide range of studies have also shown that brain structures implicated in different forms of memory mature during the first and into the second decade of life (see Cycowicz, 2000, for review), which likely results in several shortcomings when younger children report their memories, and also later when they attempt to recall early memories as adults. Each of us may possess a grey zone of memory glimpses and vague images before an explicit or conscious form of memory associated with deliberate remembering emerges, and the time window of the transition may differ between individuals. Experiments have shown that some children have long-term memories of events that happened when they were 2 years of age, if they possessed linguistic capabilities at that time, but children who could not talk at the time of the event had little, if any, explicit memories of the incidents (Peterson, 2002; Quas, Goodman, Bidrose, Craw, & Ablin, 1999; Simcock & Hayne, 2002). Other salient events occurring in children's lives when they were as young as 2 years (i.e., the birth of a younger sibling) can sometimes be recalled in adulthood (Eacott & Crawley, 1998). Furthermore, studies have shown that 18-month-old children can remember actions over a period of 12 months when shown the context again (Bauer & Wewerka, 1995), but the memory is typically behavioural and non-declarative rather than

expressed in words. Thus, as a rule, pre-linguistic experiences from infancy seem rarely accessible to episodic memory, even if there are interesting cases reported in the clinical literature (Gaensbauer, 1995; Terr, 1988).

Studies of early autobiographical memory support the idea of a movable time window of episodic memory. Rubin (2000) published a meta-analysis of these studies and plotted an average growth curve of early autobiographical memory, in terms of the proportion of memories that could be dated. This analysis showed that a small proportion of memories could be dated back to the second year of life, and that there is a steady growth in the proportion of memories from that time on. This curve is independent of the age of the adult respondent, a fact that, together with the deviations of autobiographical memory from a general Ebbinghaus curve (Robinson, 1992), indicates that it is not solely the time in storage—the age of the memory—that determines the fate of early memories.

It is, however, unlikely that the public belief about early memories would be shaped by memory research. More likely, it is influenced by the respondent's own childhood memories, in which case the public belief could well agree with science. However, the public belief might also be influenced by ideas communicated by the popular press, on age regression and the hypnotic and therapeutic techniques of psychologically bringing people back to birth (and even to earlier lives) advocated by "new age" believers and even some professional psychologists. If so, we might expect



**Figure 5.** Beliefs about the earliest memories. Distributions of responses ( $n=1000$ ) to the question quoted above the diagram, with the different response categories noted on the abscissa. Inset shows the cumulative distribution of the responses.

the general public to be more optimistic regarding early memories. The response alternatives offered to the respondents in the present survey were: from birth on, 1, 2, 3, 4, 5 years, and later than 5 years. The results are shown in Figure 5, with a cumulative distribution in the inset. These results indicate that the ideas of the general public conform to the present state of scientific knowledge. Few respondents (1%) believed it was possible to have memories from birth on, a few more believed that it was possible to have memories from the first year, and more than 30% believed that no memories were available before 4 years of age. The similarity between the cumulative distribution of the responses of the respondents in the survey and what we know about the growth of autobiographical memory (Rubin, 2000) suggests that the respondents based their belief on their own childhood memories, and that the distribution of the memory-onset times reflects individual differences in accessing early memories.

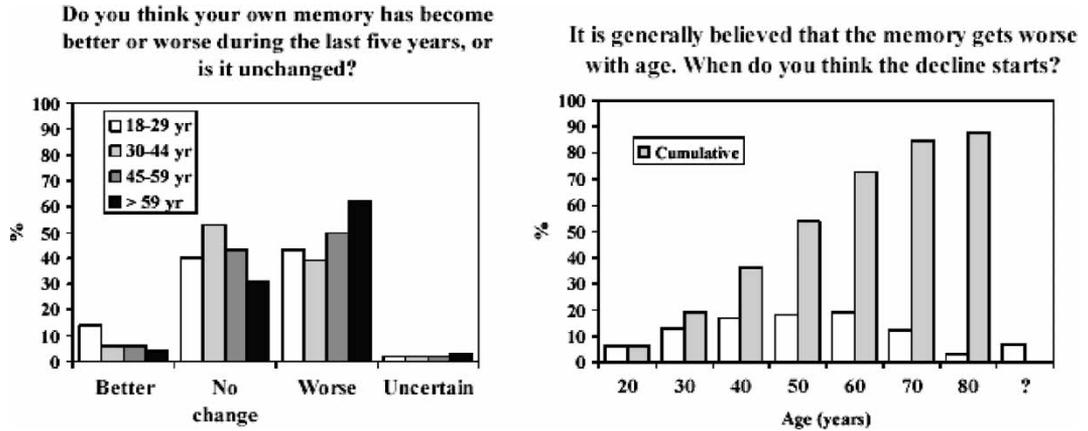
### Changes in memory performance

Episodic memory is the last form of memory to develop. It is the form of memory that is most vulnerable to neuronal dysfunction and the form of memory that deteriorates most rapidly with ageing (Tulving, 2002). Large-scale studies on memory and ageing indicate that episodic memory starts to decline around 35 years of age (Hedden & Gabrieli, 2004; Nilsson et al., 1997), whereas semantic memory remains stable up to 70 years of age (Nilsson et al., 1997). In cross-sectional data, the decline for episodic memory is practically linear (Nilsson, 2003). However, in longitudinal data, controlling for practice effects, the performance level is stable up to 60 years of age, whereafter there is a dramatic decline (Rönnlund, Nyberg, Bäckman, & Nilsson, 2005). Thus the current evidence suggests that explicit memory has minor variations across the major portion of adult life, and the changes that are detectable in controlled studies with healthy participants are not sufficiently large to be subjectively experienced as memory problems until well after 70 years of age. We asked our respondents about changes in their own memory performance during the last 5 years (“Do you think your own memory has become better or worse during the last five years, or is it unchanged?”). Figure 6 shows the distribution of

responses, divided into four age groups of approximately equal sample size. From objective data, one would expect that the two youngest age groups would have responded “no change”, as there is no general deterioration below 60 years of age in longitudinal studies (Nilsson, 2003; Rönnlund et al., 2005). However, the number of respondents in these age groups who replied “better” or “no change” surpassed by only 10% the number of those who replied “worse”. In the two oldest age groups, the number of respondents who claimed that their memory has deteriorated surpassed the number of those who reported no change, and the change was progressive with age. The result for the oldest age group agrees with empirical findings, but the subjective experience of change in the memory performance of younger respondents does not match the change measured in controlled studies. We might conjecture that when healthy young to middle-aged people claim increased memory problems with age, that claim probably derives from misattribution of the normal memory problems that all people experience, rather than genuine age changes.

### Memory decline and ageing

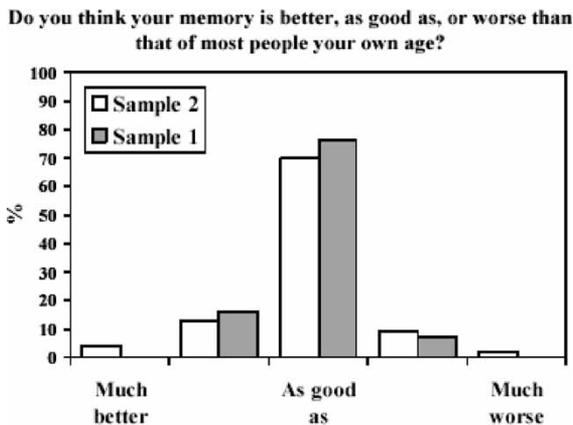
The previous result might, however, reflect what people believe about the onset of memory decline. Therefore, we asked the second sample of respondents when they believed memory deterioration started (“It is generally believed that memory gets worse with age. When do you think the decline starts?”), giving them 10-year-interval response alternatives. The results are presented in the right panel of Figure 6, plotted in terms of both a frequency distribution and a cumulative distribution. The figure shows that a small minority of the respondents believes that memory problems start before 30 years of age and less than 20% of the respondents believed such problems start before 40 years of age. Of interest, there were no differences among age groups in the estimates of the onset of memory decline. Thus, there is a discrepancy between young to middle-aged people’s reports of their own memory problems and what they believe about the onset of such problems in general, and the changes that are detected in controlled studies of ageing and memory.



**Figure 6.** Self-reported changes in memory and beliefs about memory decline. Left panel shows distributions of responses ( $n = 1000$ ) to the question on one’s own changes in memory, quoted above the diagram. Results for four age groups as indicated in the figure. Right panel shows the responses of a second sample ( $n = 1000$ ) to the question about onset of memory decline (white bars) and the cumulative distribution of the responses (grey bars).

**Age comparisons**

One might wonder if the distribution of responses is partly a matter of expression, rather than being based on one’s own observations of memory performance, because when the respondents were asked about their own memory in relation to peers, they were realistic. This question (“Do you think your memory is better, as good as, or worse than that of most people your age?”) was included twice, the first time with a three-alternative response option (better – as good as – worse), the second time with a five-alternative format (much better – somewhat better – as good as – somewhat worse – much worse). The results are quite similar, with somewhat above 70% of



**Figure 7.** Judgements of own memory in relation to peers. Distribution of responses to the question quoted above the diagram. Results for two separate samples of respondents. Sample 1 ( $n = 1000$ ) was given a three-alternative choice; Sample 2 ( $n = 1000$ ) was given a five-alternative choice.

the respondents endorsing “as good as”. Figure 7 shows the results of the two samples. Assuming that the concept of “most people” covers something like  $\pm 1$  standard deviations of the mean, this is a pretty realistic view of one’s own memory performance, although there were somewhat more people who responded better than average than there were people who responded worse than average (see Klar & Giladi, 1997, for a similar bias).

The incongruence between the responses to the memory decline questions (Figure 6), and the judgements of one’s own memory in relation to others, applies in particular to the younger respondents. De Beni, Mazzoni, and Pagotto (1996) also found that elderly people have a strong sense of memory decline, reporting that they thought they had better memory in the past and anticipating a progressive worsening of memory in the future. At the same time, they did not think they had better or worse memory than their peers, whom they expected to share the same type of decline. However, due to the larger individual differences in memory performance among the elderly compared to younger age groups, also in a context where there was a balance between responses of a better and worse memory in comparison to people of the same age, a realistic description of memory abilities in the elderly should have produced a lesser proportion of “as good as” responses compared to other age groups. This also suggests that people answering these questions are influenced by general ideas about memory, rather than conveying an accurate perception of their own memory.

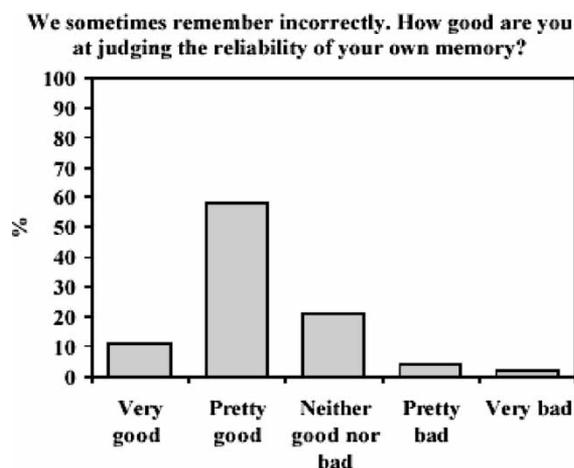
## Metacognition

It is obviously difficult to judge one's own memory performance, and the answer might depend on the manner in which the question is phrased. Metacognition, the ideas we have about the way memory and cognition operate and our judgements about our own memory, requires a certain level of sophistication, some kind of reflection on the fallibility of memory. Nevertheless, the current interest in memory illusions and false memories, and the problem of source monitoring (e.g., Goodman, Magnussen, Anderson, Endestad, Løkken & Mostue, in press; Loftus, 1997, 2003; Schacter, 1995; Schooler & Eich, 2000) led us to ask respondents to rate the reliability of their own memory, or rather to rate how good they were in judging the reliability of their memory ("We sometimes remember incorrectly. How good are you at judging the reliability of your own memory?"). This question was motivated by frequent reports of low or even zero correlations between confidence and accuracy in eyewitness memory research (Sporer, Penrod, Read, & Cutler, 1995). These results, replicated many times (e.g., Ihlebæk, Løve, Eilertsen, & Magnussen, 2003), might indicate that we do not have a realistic perception of the reliability of own memory.

Actually, the research literature on the relation between confidence and accuracy tells two different stories (see Perfect, 2004). On the one hand, research focusing on the ability of participants to recall a particular detail from a crime or to identify the perpetrator in a line-up has yielded low confidence–accuracy correlations (Read, Lindsay, & Nicholls, 1998). That research has typically focused on a between-individuals analysis, which is, perhaps, the more relevant in a forensic context: We want to know whether an eyewitness can be trusted better when he/she is confident in the testimony than when he/she expresses low confidence. Similarly, if there are two witnesses, we would like to know whether the more confident among them is likely to be the more accurate. Thus, in this context the general finding is that a person's confidence in his/her memory is not a good predictor of the accuracy of that memory. On the other hand, research focusing on within-person variation has typically yielded moderate-to-high confidence–accuracy correlations. Thus, calibration studies, in which participants answer a number of questions and for

each question report their confidence in the correctness of the answer, typically yield high confidence–accuracy correlations (e.g., Koriat & Goldsmith, 1996). This research suggests that people can generally discriminate between answers (or memory reports) that are likely to be correct and those that are likely to be false. Several recent studies designed in the context of eyewitness memory have shown that when participants are given a series of judgements of varying difficulty, a quite high positive correlation between judged performance and actual performance occurs (Juslin, Olson, & Winman, 1996), but as the participants' performance is individually calibrated to a confidence scale, the absolute subjective confidence is not a good indicator of objective performance.

In a post-survey insight we now realise that the question that was posed to the respondents ("We sometimes remember incorrectly. How good are you at judging the reliability of your own memory?") is open to both interpretations: It could be understood in the between-individual sense ("How good are you in comparison with others?"), or in a within-individual sense ("There are cases when you remember incorrectly. How good are you at telling whether your memory is accurate and when it is inaccurate?"). Figure 8 shows that about 70% of the respondents thought they were good or very good in judging the reliability of their own memory. There is, of course, no discrepancy between the eyewitness research and this finding. Indeed, the very low correlations obtained in these studies might be partly a result of an inflated belief in the perfec-



**Figure 8.** Meta-cognitive beliefs about memory. Distribution of responses ( $n=1000$ ) to the question quoted above the diagram.

tion of one's own memory, or insufficient basis for judging how good one's eyewitness memory is, and consequently how confident one should be (Perfect, 2004).

### Memory for dramatic vs everyday events

The survey included three questions on the relation between emotional activation and memory. The first question (“Sometimes people become witnesses to dramatic events. Do you think the memory for such events is worse, as good as, or better compared with the memory for everyday events?”) simply probed memory for dramatic events. Is it better, as good as, or worse than memory for ordinary events? The answer is not obvious from any point of view. For example, it might be argued that such events are frequently fast moving and that such observations are unreliable, or that the drama of the event would lead to emotional activation that might interfere with or block observational capacities and memory encoding. On the other hand, it might be hypothesised, as some memory researchers have, that emotional activation might act by focusing attention and facilitating encoding of the attended details, leading to enhanced memory for central details at the expense of peripheral details (Christianson, 1992; Ochsner & Schacter, 2000). In addition, it is likely that dramatic and unusual events are more rehearsed internally, or through story telling, than are ordinary events. Results of empirical studies of the memory for dramatic events in the flashbulb memory tradition show that such events are better remembered than are ordinary events (Christianson & Engelberg, 1999; Talarico & Rubin, 2003), even though they are both subject to similar distortions, and the many studies of memory for war experiences, natural disasters, and accidents (reviewed by McNally, 2003) confirm this. Recent studies of the memory for events that are associated with high positive emotional activation suggest that such events are also well remembered (Berntsen, 2001; Porter & Birt, 2001).

The results of the survey (Figure 9) show that the majority of respondents concurred with this type of evidence, with about 70% responding “better” and only 10% responding “worse”. As no follow-up questions were asked, we do not know why some respondents believe that memory for dramatic events is worse than memory for

Sometimes people become witnesses to dramatic events. Do you think memory for such events is worse, as good as, or better compared to memory for everyday events?

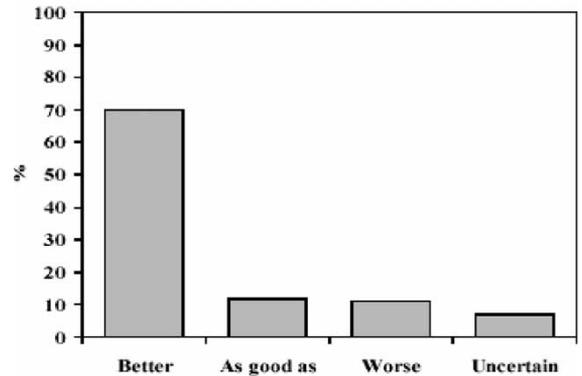


Figure 9. Emotions and memory. Distributions of responses ( $n=1000$ ) to the question quoted above the diagram.

ordinary events. However, they might have in mind an explanation that is implicit in the next question, namely repression of traumatic memories. Of interest, the responses of our respondents to the question of emotional memories substantially agree with the beliefs expressed 25 years ago by the participants in Loftus's (1979) study.

### Memory for frightening and dramatic events

The next question (“Sometimes people who have experienced frightening and dramatic events claim to have no memory for the event. Do you think they actually do not remember, or do you think they choose not to talk about it?”) hinted specifically at the idea of repression—stating that people who have had frightening and dramatic experiences sometimes claimed memory loss—and asked the participants if they believed this loss was genuine. The idea that traumatic memories are blocked from consciousness can be traced to the psychoanalytic concept of repression, originally developed to explain the apparent forgetting of painful and personally threatening childhood memories. The concept of repression does not belong to the arsenal of mechanisms of forgetting in current memory research (see for example Schacter, 2001; Tulving & Craik, 2000), as it does not seem to stand the test of relevant real-life studies of traumatised individuals (Alexander et al., 2005; Goodman et al., 2003; McNally,

2003). However, it is not unusual that murderers claim not to remember committing the criminal acts, even where blackouts due to alcohol and drug intoxication can be ruled out (Christianson & Merckelbach, 2004; Parkin, 1997). In the small country of Norway, at least five such cases were recently publicised within less than a year, and the claims are frequently believed. For example, in a fairly recent Norwegian court trial, the accused was convicted on the basis of overwhelming evidence but claimed complete amnesia for the killing. The court ruled, “shattering events in the accused’s life in the previous year, plus the dramatic events on the night of the murder, may explain why NN has repressed (the memories of) his actions” (*Dagbladet*, June 2001). Empirical evidence suggests that trauma-induced psychogenic amnesia is extremely rare, if it exists at all (Christianson & Merckelbach, 2004; Kihlstrom & Schacter, 2000). Rather, studies of war veterans, some of whom may themselves have committed gruesome acts, and of victims of such acts, point to the opposite: These memories persist all too well (McNally, 2003).

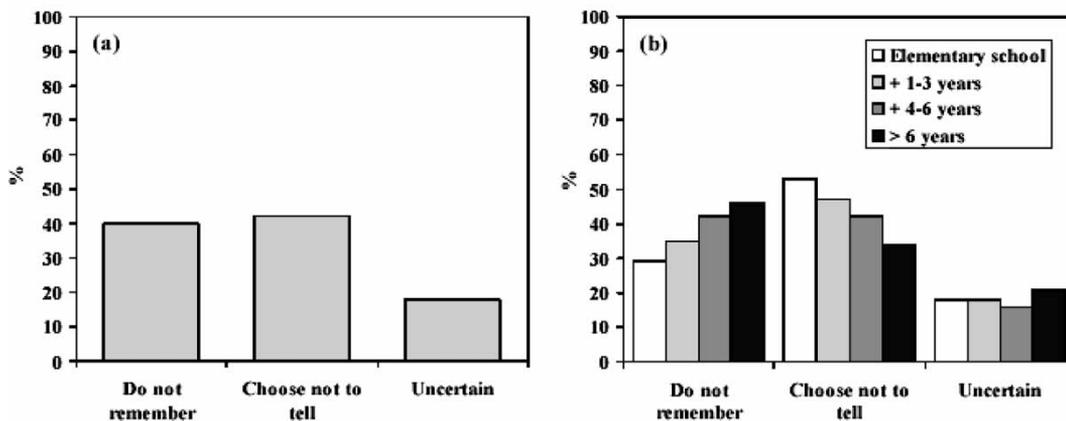
The results of the survey showed that a sizeable minority of the respondents could not decide on this question, and of those who decided about half believed in amnesia, whereas the other half did not. A closer analysis of the data revealed an interesting pattern of responses, illustrated in Figure 10b, namely that the belief in genuine memory loss increased with the number of years of formal education. Less than 30% of the

respondents with elementary school education believe in the memory loss, about 45% of the respondents with a college or university degree so believe.

### Memory for murder

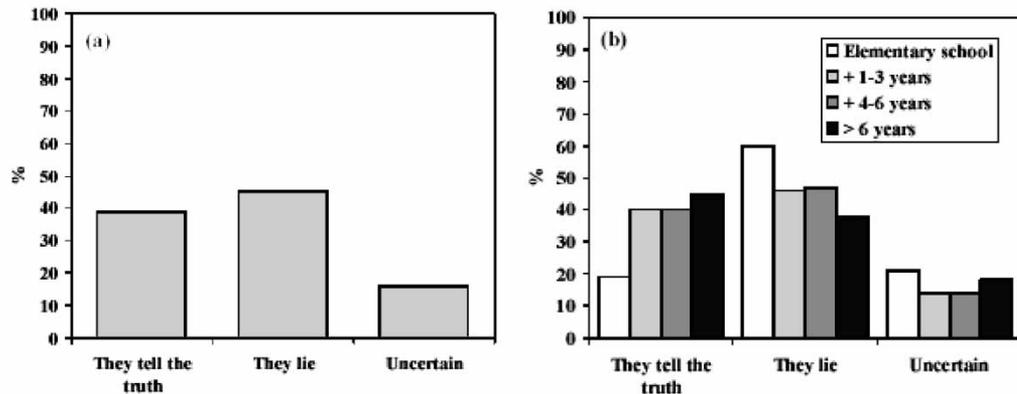
The previous question had been formulated with the example of the self-reported amnesic murderer in mind, but the formulation covered all frightening and dramatic experiences as victims or witnesses. We therefore asked the second sample of respondents a more direct question regarding the amnesic murderer (“Sometimes people who have committed murder claim to have no memory for the crime. Do you think such memories can be repressed and that the perpetrators are telling the truth, or do you think they are lying?”). Is the amnesia real or fake? The answers to this question are presented in Figure 11, which shows a distribution of responses that is quite similar to the responses of the first sample that was asked the more general question. Again, there is a substantial minority who did not volunteer an opinion (uncertain), and the remaining sample split equally between those claiming genuine repression and those arguing for faked amnesia. In parallel to the more general question on frightening experiences and amnesia, an inverse relation between scepticism towards amnesic murderers and education appeared in the second sample (Figure 11b).

**Sometimes people who have experienced frightening and dramatic events claim no memory for the event. Do you think they actually do not remember anything, or do you think they choose not to talk about it?**



**Figure 10.** Can frightening experiences be repressed? (a) Distributions of responses in the sample ( $n = 1000$ ) to the question quoted above the diagram. (b) Distributions of responses, with participants divided with respect to educational level. “Years” refers to length of formal education – years in school.

**Sometimes people who have committed murder claim to have no memory for the crime. Do you think such memories can be repressed and that the perpetrators are telling the truth, or do you think they are lying?**



**Figure 11.** Can murderers repress their actions? (a) Distributions of responses of a second sample ( $n = 1000$ ) to the question quoted above the diagram. (b) Distribution of responses with participants divided with respect to length of formal education.

## Collaborative memory

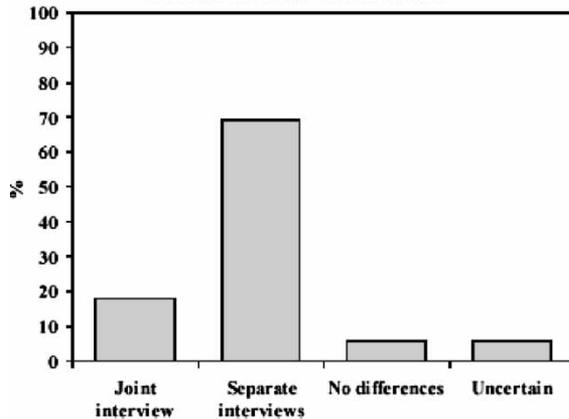
Recent studies of collaborative memory indicate that when two people are asked to remember a conjointly witnessed event, they produce more information when collaborating on the memory report than when each person is tested individually (Stephenson, Kniveton, & Wagner, 1991). However, collaborative memory reports contain less information than collapsed memory reports of both persons tested individually (Andersson, Helstrup, & Rönnerberg, in press; Andersson & Rönnerberg, 1995; Basden, Basden & Henry, 2000; Weldon & Bellinger, 1997), an effect referred to as the net negative effect of collaboration (Andersson & Rönnerberg, 1997; Johansson, Andersson & Rönnerberg, 2005). This negative effect has been widely supported for explicit, episodic memory tasks but not for semantic and implicit memory tasks (Andersson & Rönnerberg, 1996; Johansson et al., 2005). The current explanation for this effect is the reduced cue distinctiveness hypothesis (RCD, Andersson et al., in press). The hypothesis suggests that words (cues) spoken by one of the group members does not constitute a sufficiently distinctive cue for the other partner, and tend to inhibit his or her retrieval process (as well as the encoding phase).

The results on collaborative memory were initially believed to be counterintuitive, because it may be expected that: (a) collaborative retrieval would produce similar amounts of information compared to the collapsed individual tests, or (b)

that social cross-cueing would facilitate memory, resulting in the collaborating groups producing more information. However, perhaps such results would seem less counterintuitive when obtained with regard to memory for complex real-life events. In that case, the quantity of potential information is unlimited and ill defined, and accuracy is more important than the quantity of recalled information. Therefore, the retrieval of information from two separate points of view may assure greater accuracy. One hypothesis suggested is that wrong answers are "filtered out" during collaboration (Ross, Spencer, Linardatos, Lam, & Perunovic, 2004), but others have found that more false memories are produced during collaboration (Basden, Basden, Thomas, & Souphasith, 1998).

We tested whether the results of the empirical studies are indeed counterintuitive to most people by phrasing the question ("Sometimes two or more persons are witnesses to the same event. A police investigator may interview the witnesses together or separately. When do you think he will obtain the most information?") within the context of a witnessed event (an episodic memory task). The result, presented in Figure 12, show that the great majority of the public agrees with the results of memory research, that separate memory tests are preferable to joint tests in terms of the amount of information that is obtained. Thus, a phenomenon that initially was treated as counterintuitive in the memory literature was already "known" to the public.

Sometimes two or more persons are witnesses to the same event. A police investigator may interview the witnesses together or separately. When do you think he will obtain most information?



**Figure 12.** Are two heads better than one? Distribution of responses ( $n=1000$ ) to the question quoted above the diagram.

## GENERAL DISCUSSION

The results of the present survey indicate that beliefs about memory among lay persons in a Western European country are in good agreement in many respects with the findings of memory research, but in other respects, the beliefs of the public deviate from current scientific knowledge, sometimes in ways that have implications for interpreting daily events.

Starting with the agreements, people seem to have a realistic impression of their own memory performance in comparison with peers. People also have realistic views on the development of memory and the time of their earliest memories, which on the average starts around 3 years of age (Howe, 2000; Rubin, 2000). This might be somewhat surprising given the frequent articles on age regression in the popular media and the current popularity of various regression exercises offered in courses, seminars, and non-professional therapies. Obviously, the overwhelming majority of the readers and listeners remain soundly unconvinced by such claims. People are also sceptical of the beneficial effects of collaborative efforts on memory, in agreement with the experimental data (Basden et al., 2000), and they have a realistic view on the relation between emotions and memory, believing that dramatic events are better remembered than ordinary events (McNally, 2003). On all these questions, people are probably able to draw on their own general

experiences, and memory research has by and large confirmed folk psychology.

One question was relevant to the fact that people are in the position to systematically observe the changes in their own memory performance—specifically, they can observe the effects of age on memory during adulthood. One might therefore expect that the pattern of self-reported memory change would correspond to the objective facts of memory change in the population, and perhaps even be a little delayed, as experimental memory studies would be far more sensitive detectors of memory change than are personal observations. However, the results indicate the opposite: Personal observations are ahead of experimental studies. Around 40% of the respondents below 45 years of age reported that their memory had declined over the last 5 years, whereas such changes are detected in ageing and memory studies from about 60 years of age and on, and are probably not subjectively notable before 70 years of age (Nilsson, 2003; Rönnlund et al., 2005). Perhaps this is an illusion of hindsight, an example of the general belief we often nurture that the past was better than the present.

On other questions, people might rely on personal experiences, but their experiences are probably not sufficiently systematic to support a fully realistic opinion. For example, on the issue of children's memory, few people possibly have had a chance to directly compare the memories of different age groups for the same event. Although a large majority of respondents believed that the memory performance of small children is equal to or better than that of adults, it is unlikely that they have observed this effect in any systematic manner, but must have based their judgements on occasional evidence, anecdotal in nature, of impressive memory performance in children, or on more general beliefs about children. However, memory research shows that trust in small children's memory must be qualified. It is true that children's memories are largely correct, but their memory reports typically contain fewer details and can be more malleable compared with those of older children and adults (Fivush, 2002; Peterson, 2002; Quas et al., 1999).

A similar discrepancy between anecdotal evidence and experimental data was observed when respondents were asked to compare olfactory memory with visual and verbal memory. It is interesting to note that so many people claim vivid olfactory memories, without considering the

frequency of such memories compared with all the other things we remember in daily life, or the difficulty of subjectively producing olfactory memory images compared to visual images (Crowder & Schab, 1995; Stevenson & Case, 2005). One possible explanation as to why people believe that memory for odours is better than for other types of sensory information may be that odour-cued memories often yield strong emotional activation and also produce a strong sense of travelling back in time (Chu & Downes, 2002; Herz, 1996; Willander & Larson, *in press*). This, in combination with the fact that odour-cued memories are thought of less often and also occur suddenly, may underlie and drive the misconception of the superiority of olfactory memory over other sensory representations. Also, and more speculatively, the belief in olfaction might also be influenced by the great attention that is given to smells in western society, and the large industry that supports that attention: If smell is important, olfactory memories must be highly developed.

On other questions, people might not benefit from personal experience, but rely on socially conveyed beliefs. The survey included two questions on repression of dramatic and traumatic memories. Although the respondents acknowledged that, in general, dramatic events are better remembered than ordinary events, a large proportion also believed that such memories might be forgotten and that people who have committed murder might have blocked out the memories of a crime. Why do so many people believe such claims? We think this is an example of the cultural impact of psychoanalysis. Psychoanalytically inspired ways of thinking have been absorbed by society, especially by intellectuals, but detached from their empirical and theoretical basis, and diluted. In Norwegian daily language, the concept of repression has become almost synonymous with forgetting but with special reference to unpleasant memories such as not remembering an appointment with the dentist. So the idea that extremely unpleasant memories can be completely blocked is readily available. The finding that the proportion of respondents accepting the idea of repression increased with years of formal education suggests that the belief derives from contact with theoretical notions rather than from folk psychology. However, there is little evidence that such memories of traumatic events in adult life can be repressed, and the evidence that even temporary psychogenic amnesia is extremely rare, if it exists (Christianson & Merck-

elbach, 2004; Kihlstrom & Schacter, 2000; McNally, 2003).

Finally, we probed the public's beliefs about two very general questions on memory. First, can memory be trained? The public believes that it can, in analogy with physical exercise and body strength. But did Ebbinghaus's memory improve after years of rote learning? Perhaps the answer is both yes and no. Yes in the sense that memory may benefit from a series of factors related to practice and experience—there is extensive evidence for learning-to-learn and transfer-of-training effects (Tulving & Craik, 2000). But transfer is task dependent: Memory training does not carry over to remote tasks, and memory expertise does not carry over to memory in general (Kimball & Holyoak, 2000). On the other hand, the absence of age decline in episodic and semantic memory among university professors reported by Shimamura, Berry, Mangels, Rusting, and Jurica (1995) is an indication that maintaining intellectual activity over the years benefits memory in general, as nearly every intellectual activity involve memory. Furthermore, specific training focused on the use of memory strategies can help people in learning not only the trained strategies, but also associated strategies, and increase the confidence in their memory (Cornoldi & De Beni, 1996; Cornoldi, Gobbo, & Mazzoni, 1991; Lucangeli, Galderisi, & Cornoldi, 1995). Finally, perhaps certain types of memory exercise do indeed produce more general cognitive improvements. Recent data by Klingberg, Forssberg, and Westerberg (2002) showed that intense visuo-spatial working memory training in children with ADHD results in significant transfer to other memory tasks and to non-memory tasks, such as solving Raven's matrices. Moreover, children with such training received higher teacher ratings on concentration and focused attention. Olesen, Westerberg, and Klingberg (2004) also found that practice effects in working memory could be monitored by means of neurophysiological changes in a prefrontal-parietal network in adults, which is the network that develops in childhood as working memory capacity improves.

The belief that there is a capacity limitation on memory, also adhered to by the majority of the respondents, is closely associated with the idea of memory as a storehouse to be filled (Koriat & Goldsmith, 1996). The focus on memory limitations by the majority of those interviewed was probably affected by assumptions associated with the popular views of physical and mind limits,

such as a limited number of brain neurons and well-known observations of other limitations of the mind, such as limited attentional resources and limited working memory capacity. However, we are not aware of empirical evidence suggesting a limit to long-term memory, or the number memories each of us has stored. But the current view of memory as a set of neurocognitive systems widely distributed in the brain (Cabeza & Nyberg, 2000), and of the brain as continuously forming new synapses and even growing new neurons (Gould, Reeves, Graziano & Gross, 1999), suggests a system that might be expanding according to one's needs.

## Two types of memory believers

The patterns of beliefs expressed by a large and representative sample of Norwegians indicate that people in general have realistic ideas on many general issues about memory.

Are people's beliefs about the various memory issues random or interconnected? The high reproducibility of the effect of education on the answers to the "repression" questions suggests that beliefs might be quite stable, and perhaps form patterns. We therefore subjected the nine questions from the main survey to two statistical analyses. First we carried out a factor analysis—a principal component analysis with Varimax rotation. The result of this analysis indicated that people's ideas about memory differ along two dimensions. The first dimension is linked to the judgements of one's own memory, a meta-cognitive dimension that included questions 6, 8, 9, and 11. If the respondents considered their own memory to be good and reliable, they scored high on this dimension. The second dimension is defined by the limitations that people assume are linked to memory performance, and includes questions 1, 2, 4, 5, and 10; questions about memory capacity, how well we remember dramatic events, and how far back we remember. A high score on this dimension reflects an optimistic view on boundaries and realistic views on early memories.

The second analysis included a cluster model to see if the population could be subdivided into groups of memory believers. To answer this question, we performed a K-means cluster analysis. The result of a cluster analysis is sensitive both to the type of analysis performed and to the status of the input variables used. In this analysis, both

the original values and  $z$ -scores for the eight variables were tested. To ensure the optimal interpretation of the number of clusters, several solutions were tested and compared. A two-group solution provided the best explanatory power when tested with a confirmatory factor analysis,  $\chi^2(8) = 462.929$ ,  $p < .001$ . There were no significant difference between the groups regarding gender and age. The two groups differed significantly both regarding meta-cognitive judgements,  $t(669) = 27.80$ ,  $p < .001$ , and beliefs about memory limitations in general,  $t(669) = 2.78$ ,  $p < .001$ . The two groups might be characterised by optimism versus pessimism regarding memory in general and their own memory in particular: the realists who have realistic metacognitive judgement and realistic views on the limitations of memory, and the pessimists who have relatively poor meta-cognitive judgement and a somewhat conservative estimate of the limitations of human memory.

The results of these analyses thus suggest that there are distinct groups of memory believers in the adult population. We do not know which other psychological characteristics might be linked to this pattern, or whether they correlate with actual memory performances. It would also be interesting to know whether these beliefs govern the way people approach learning and memory problems in everyday life.

Manuscript received 26 January 2005

Manuscript accepted 31 January 2006

First published online 05 May 2006

## REFERENCES

- Alexander, K. W., Goodman, G. S., Schaaf, J. M., Edelstein, R. E., Quas, J. A., & Shaver, P. R. (2002). The role of attachment and cognitive inhibition in children's memory and suggestibility for a stressful event. *Journal of Experimental Child Psychology*, *83*, 262–290.
- Alexander, K. W., Quas, J. A., Goodman, G. S., Ghetti, S., Edelstein, R. S., Redlich, A. D., et al. (2005). Traumatic impact predicts long-term memory for documented child sexual abuse. *Psychological Science*, *16*, 33–40.
- Andersson, J., Helstrup, T., & Rönnerberg, J. R. (in press). Collaborative memory. In T Helstrup & S. Magnussen (Eds.), *Everyday memory*. Hove, UK: Psychology Press.
- Andersson, J., & Rönnerberg, J. R. (1995). Recall suffers from collaboration: Joint recall effects of friendship and task complexity. *Applied Cognitive Psychology*, *9*, 199–211.

- Andersson, J., & Rönnerberg, J. R. (1996). Collaboration and memory: Effects of dyadic retrieval on different memory tasks. *Applied Cognitive Psychology, 10*, 171–181.
- Andersson, J., & Rönnerberg, J. R. (1997). Cued memory collaboration: Effects of friendship and type of retrieval cue. *European Journal of Cognitive Psychology, 9*, 273–287.
- Basden, B. H., Basden, D. R., & Henry, S. (2000). Costs and benefits of collaborative memory. *Applied Cognitive Psychology, 14*, 497–507.
- Basden, B. H., Basden, D. R., Thomas, R. L. III, & Souphasith, S. (1998). Memory distortion in group recall. *Current Psychology, 16*, 225–246.
- Bauer, P. J., & Wewerka, S. S. (1995). One- to two-year-olds' recall of events: The more expressed, the more impressed. *Journal of Experimental Child Psychology, 59*, 475–496.
- Berntsen, D. (2001). Involuntary memories of emotional events: Do memory of trauma and extremely happy events differ? *Applied Cognitive Psychology, 15*, 135–158.
- Brigham, J. C., & Spier, S. A. (1992). Opinions held by professionals who work with child witnesses. In H. Dent & R. Flin (Eds.), *Children as witnesses*. Chichester, UK: Wiley.
- Bruck, M., Ceci, S. J., & Hembrooke, H. (2002). The nature of children's true and false narratives. *Developmental Review, 22*, 520–224.
- Cabeza, R., & Nyberg, L. (2000). Imaging cognition II. An empirical review of 275 PET and fMRI studies. *Journal of Cognitive Neuroscience, 12*, 1–47.
- Christianson, S. Å. (1992). Emotional stress and eyewitness memory. A critical review. *Psychological Bulletin, 112*, 284–309.
- Christianson, S. Å., & Engelberg, E. (1999). Memory and emotional consistency: The MS Estonia ferry disaster. *Memory, 7*, 471–482.
- Christianson, S. Å., & Merckelbach, H. (2004). Crime-related amnesia as a form of deception. In P. A. Granhag & L. A. Strömwall (Eds.), *The detection of deception in forensic contexts* (pp. 195–225). Cambridge, UK: Cambridge University Press.
- Chu, S., & Downes, J. J. (2002). Proust nose best: Odours are better cues to autobiographical memory. *Memory & Cognition, 30*, 511–518.
- Cornoldi, C., & De Beni, R. (1996). Mnemonics and metacognition. In D. Herrmann, C. McEvoy, C. Hertzog, P. Hertel, & M. Johnson (Eds.), *Basic and applied memory research. Practical applications* (Vol. 2, pp. 237–253). Mahwah, NJ: Erlbaum.
- Cornoldi, C., Gobbo, C., & Mazzoni, G. (1991). On metamemory–memory relationship: Strategy availability and training. *International Journal of Behavioural Development, 14*, 101–121.
- Crowder, R. G., & Schab, F. R. (1995). Imagery for odours. In F. R. Schab & R. G. Crowder (Eds.), *Memory for odours* (pp. 93–108). Mahwah, NJ: Lawrence Erlbaum Associates Inc.
- Cycowicz, Y. M. (2000). Memory development and event-related brain potentials in children. *Biological Psychology, 54*, 145–174.
- De Beni, R., Cornoldi, C., Larsson, M., Magnussen, S., & Rönnerberg, J. (in press). Memory in experts: Visual learning, wine tasting, orienteering and speech-reading. In T. Helstrup & S. Magnussen (Eds.), *Everyday memory*. Hove, UK: Psychology Press.
- De Beni, R., Mazzoni, G., & Pagotto, S. (1996). Fiducia nel proprio sistema di memoria e stili attributivi nell'anziano. Confronti tra differenti età e diversi contesti abitativi. *Ricerche di Psicologia, 20*, 63–93.
- Eacott, M. J., & Crawley, R. A. (1998). The offset of childhood amnesia: Memory for events that occurred before age 3. *Journal of Experimental Child Psychology: General, 127*, 22–23.
- Everson, M. D., Boat, B. W., Sherries, B., & Robertson, K. R. (1996). Beliefs among professionals about rates of false allegation of child sexual abuse. *Journal of Interpersonal Violence, 4*, 541–553.
- Farah, M. (1990). *Visual agnosia*. Cambridge, MA: MIT Press.
- Fivush, R. (2002). The development of autobiographical memory. In H. L. Westcott, G. H. Davies, & R. H. C. Bull (Eds.), *Children's testimony. A handbook of psychological research and forensic practice* (pp. 55–68). Chichester, UK: Wiley.
- Flavell, J. H. (1999). Cognitive development: Children's knowledge about the mind. *Annual Review of Psychology, 50*, 21–45.
- Gaensbauer, T. J. (1995). Trauma in the preverbal period: Symptoms, memories, and developmental impact. *Psychoanalytic Study of the Child, 49*, 412–433.
- Ghetti, S., & Alexander, K. W. (2004). 'If it happened, I would remember it': Strategic use of event memorability in the rejection of false autobiographical events. *Child Development, 75*, 542–561.
- Gobet, F. (1998). Expert memory: A comparison of four theories. *Cognition, 66*, 115–152.
- Goodale, M., & Milner, D. (2004). *Sight unseen*. Oxford, UK: Oxford University Press.
- Goodman, G. S., Ghetti, S., Quas, J. A., Edelstein, R. S., Alexander, K. W., Redlich, A. D., et al. (2003). A prospective study of memory for child abuse. New findings relevant to the repressed-memory controversy. *Psychological Science, 14*, 113–118.
- Goodman, G., Magnussen, S., Andersson, J., Endestad, T., Løkken, L., & Mostue, C. (in press). Memory illusions and false memories in the real world. In T. Helstrup & S. Magnussen (Eds.), *Everyday memory*. Hove, UK: Psychology Press.
- Goodman, G. S., & Melinder, A. (in press). The development of autobiographical memory: A new model. In T. Helstrup & S. Magnussen (Eds.), *Everyday memory*. Hove, UK: Psychology Press.
- Goodman, G. S., & Reed, R. S. (1986). Age differences in eyewitness testimony. *Law and Human Behaviour, 10*, 317–332.
- Gore-Felton, C., Koopman, C., Thoresen, C., Arnow, B., Bridges, E., & Spiegel, D. (2000). Psychologists' beliefs and clinical characteristics: Judging the veracity of child sexual abuse memories. *Professional Psychology: Research and Practice, 31*, 372–377.
- Gould, E., Reeves, A. J., Graziano, M. S. A., & Gross, C. G. (1999). Neurogenesis in the neocortex of adult primates. *Science, 286*, 548–552.

- Hedden, T., & Gabrieli, J. D. (2004). Insights into the ageing mind: A view from cognitive neuroscience. *Nature Neuroscience Reviews*, *5*, 87–96.
- Herculano-Houzel, S. (2003). What does the public want to know about the brain? *Nature Neuroscience*, *6*, 325.
- Herz, R. S. (1996). A comparison of olfactory, visual and tactile cues for emotional associated memories. *Chemical Senses*, *21*, 614–615.
- Howe, M. L. (2000). *The fate of early memories: Developmental science and the retention of childhood experiences*. Washington, DC: APA.
- Hutcheson, G. D., Baxter, J. S., Telfer, K., & Warden, D. (1995). Child witness statement quality: Question type and errors of omission. *Law and Human Behaviour*, *19*, 631–648.
- Ihlebaek, C., Löve, T., Eilertsen, D. E., & Magnussen, S. (2003). Memory for a staged criminal event witnessed live and on video. *Memory*, *11*, 219–327.
- James, W. (1890). *Principles of psychology*. New York: Holt.
- Johansson, O., Andersson, J., & Rönnerberg, J. (2005). Compensating strategies in collaborative remembering in very old couples. *Scandinavian Journal of Psychology*, *46*, 349–359.
- Juslin, P., Olson, N., & Winman, A. (1996). Calibration and diagnosticity of confidence in eyewitness identification: Comments on what can and cannot be inferred from the low confidence–accuracy correlation. *Journal of Experimental Psychology: Learning, Memory and Cognition*, *5*, 1304–1316.
- Kassin, S. M., Tubb, V. A., Hosch, H. M., & Memon, A. (2001). On the “general acceptance” of eyewitness research: A new survey of experts. *American Psychologist*, *56*, 405–416.
- Katz, Z. (2001). Canadian psychologists’ education, trauma history, and the recovery of memories of child sexual abuse. *Dissertation Abstracts International*, *61*(7–B), 3848.
- Kihlstrom, J. E., & Schacter, D. L. (2000). Functional amnesia. In F. Bollner & J. Grafman (Eds.), *Handbook of neuropsychology* (Vol. 2, 2nd ed., pp. 409–427). Amsterdam: Elsevier Science.
- Kimball, D. R., & Holyoak, K. J. (2000). Transfer and expertise. In E. Tulving & F. I. M. Craik (Eds.), *The Oxford handbook of memory* (pp. 109–122). Oxford, UK: Oxford University Press.
- Klar, Y., & Giladi, E. E. (1997). No one in my group can be below the group’s average: A robust positivity bias in favor of anonymous peers. *Journal of Personality and Social Psychology*, *73*, 885–901.
- Klingberg, T., Forssberg, H., & Westerberg, H. (2002). Training of working memory in children with ADHD. *Journal of Clinical and Experimental Neuropsychology*, *24*, 781–791.
- Koriat, A., & Goldsmith, M. (1996). Memory metaphors and the real life/laboratory controversy: Correspondence versus storehouse conceptions of memory. *Behavioural and Brain Sciences*, *19*, 167–228.
- Koriat, A., Goldsmith, M., & Pansky, A. (2000). Toward a psychology of memory accuracy. *Annual Review of Psychology*, *51*, 481–537.
- Larsson, M., & Bäckman, L. (1998). Modality memory across the adult life span: Evidence for selective age-related olfactory deficits. *Experimental Ageing Research*, *24*, 63–82.
- Landauer, T. K. (1986). How much do people remember? Some estimates on the quantity of learned information in long-term memory. *Cognitive Science*, *10*, 477–493.
- Leichtman, M. D., & Ceci, S. J. (1995). The effects of stereotypes and suggestions on preschoolers’ reports. *Developmental Psychology*, *31*, 568–578.
- Loftus, E. F. (1979). *Eyewitness testimony*. Cambridge MA: Harvard University Press.
- Loftus, E. F. (1997). Creating false memories. *Scientific American*, September, 50–55.
- Loftus, E. F. (2003). Make-believe memories. *American Psychologist*, *58*, 867–873.
- Lucangeli, D., Galderisi, D., & Cornoldi, C. (1995). Specific and general transfer effects following metamemory training. *Learning Disabilities, Research & Practice*, *10*, 11–21.
- McNally, R. J. (2003). *Remembering trauma*. Cambridge, MA: Harvard University Press.
- Melinder, A., Goodman, G. S., Eilertsen, D. E., & Magnussen, S. (2004). Beliefs about child witnesses: A survey of professionals. *Psychology. Crime and Law*, *10*, 347–365.
- Milne, R., & Bull, R. (1999). *Investigative interviewing: Psychology and practice*. Chichester, UK: Wiley.
- Murphy, C., Cain, W. S., Gilmore, M. M., & Skinner, R. B. (1991). Sensory and semantic factors in recognition memory for odours and graphic stimuli. *American Journal of Psychology*, *104*, 161–192.
- Nelson, K. (1993). The psychological and social origins of autobiographical memory. *Psychological Science*, *4*, 85–92.
- Nelson, K., & Fivush, R. (2004). The emergence of autobiographical memory: A social cultural developmental theory. *Psychological Review*, *111*, 486–511.
- Nilsson, L-G. (2003). Memory function in normal ageing. *Acta Neurologica Scandinavica*, *107*(Supplement 179), 7–13.
- Nilsson, L-G., Bäckman, L., Erngrund, K., Nyberg, L., Adolfsson, R., Bucht, G., et al. (1997). The Betula prospective cohort study: Memory, health and ageing. *Aging, Neuropsychology and Cognition*, *4*, 1–32.
- Ochsner, K. N., & Schacter, D. L. (2000). A social cognitive neuroscience approach to emotion and memory. In J. C. Borod (Ed.), *The neuropsychology of emotion*. Oxford, UK: Oxford University Press.
- Olesen, P., Westerberg, H., & Klingberg, T. (2003). Increased prefrontal and parietal activity after training of working memory. *Nature Neuroscience*, *7*, 75–79.
- Parkin, A. J. (1997). *Memory and amnesia*. Oxford, UK: Blackwell Publishers.
- Perfect, T. J. (2004). The role of self rated ability in the accuracy of confidence judgments in eyewitness memory and general knowledge. *Applied Cognitive Psychology*, *18*, 157–168.

- Peterson, C. (2002). Children's long-term memory for autobiographical events. *Developmental Review, 22*, 370–402.
- Pillemer, D. B., & White, S. H. (1989). Childhood events recalled by children and adults. In H. W. Reese (Ed.), *Advances in child development and behaviour* (Vol. 21, pp. 297–340). New York: Academic Press.
- Poole, D. A., & Lindsay, S. D. (2002). Reducing child witnesses' false reports of misinformation from parents. *Journal of Experimental Child Psychology, 81*, 117–140.
- Porter, S., & Birt, A. R. (2001). Is traumatic memory special? A comparison of traumatic memory characteristics with memory of other emotional life experiences. *Applied Cognitive Psychology, 15*, 101–117.
- Quas, J. A., Goodman, G. G., Bidrose, S., Pipe, M.-E., Craw, S., & Ablin, D. S. (1999). Emotion and memory: Children's long-term remembering, forgetting and suggestibility. *Journal of Experimental Child Psychology, 72*, 235–270.
- Read, J. D., Lindsay, D. S., & Nicholls, T. (1998). The relation between confidence and accuracy in eyewitness identification studies: Is the conclusion changing? In C. P. Thompson, D. J. Herrmann, J. D. Read, D. Bruce, D. G. Payne, & M. P. Toglia (Eds.), *Eyewitness memory. Theoretical and applied perspectives* (pp. 107–130). Mahwah, NJ: Erlbaum.
- Reese, E., & Fivush, R. (1993). Parental styles of talking about the past. *Developmental Psychology, 29*, 596–606.
- Reese, E., Haden, C. A., & Fivush, R. (1993). Mother-child conversations about the past: Relationships of style and memory over time. *Cognitive Development, 8*, 403–430.
- Robinson, J. A. (1992). Autobiographical memory. In M. Gruneberg & P. Morris (Eds.), *Aspects of memory. Volume 1: The practical aspects* (2nd ed., pp. 223–245). London: Routledge.
- Ross, M., Spencer, S. J., Linardatos, L., Lam, K. H. M., & Perunovic, M. (2004). Going shopping and identifying landmarks: Does collaboration improve older people's memory? *Applied Cognitive Psychology, 18*, 683–696.
- Rönnlund, M., Nyberg, L., Bäckman, L., & Nilsson, L.-G. (2005). Stability, improvement, and decline in adult-life development of declarative memory: Cross-sectional and longitudinal data from a population-based sample. *Psychology and Ageing, 20*, 3–18.
- Rubin, D. C. (2000). The distribution of early childhood memories. *Memory, 8*, 265–269.
- Rubin, D. C., Groth, E., & Goldsmith, D. J. (1984). Olfactory cuing of autobiographical memory. *American Journal of Psychology, 97*, 493–507.
- Schacter, D. L. (Ed.). (1995). *Memory distortion: How minds, brains, and societies reconstruct the past*. Cambridge, MA: Harvard University Press.
- Schacter, D. L. (1996). *In search of memory*. New York: Basic Books.
- Schacter, D. L. (2001). *The seven sins of memory: How the mind forgets and remembers*. Boston, MA: Houghton Mifflin.
- Schacter, D. L., Wagner, A. D., & Buckner, R. L. (2000). Memory systems of 1999. In E. Tulving & F. I. M. Craik (Eds.), *The Oxford handbook of memory* (pp. 627–643). Oxford, UK: Oxford University Press.
- Schooler, J. W., & Eich, E. (2000). Memory for emotional events. In E. Tulving & F. I. M. Craik (Eds.), *The Oxford handbook of memory* (pp. 379–392). Oxford, UK: Oxford University Press.
- Shimamura, A. P., Berry, J. M., Mangels, J. A., Rusting, C. L., & Jurica, P. J. (1995). Memory and cognitive abilities in university professors: Evidence for successful ageing. *Psychological Science, 6*, 271–277.
- Simcock, G., & Hayne, H. (2002). Breaking the barrier? Children fail to translate their preverbal memories into language. *Psychological Science, 13*, 225–231.
- Sporer, S. L., Penrod, S., Read, D., & Cutler, B. (1995). Choosing, confidence, and accuracy: A meta-analysis of the confidence-accuracy relation in eyewitness identification studies. *Psychological Bulletin, 118*, 315–327.
- Standing, L. (1973). Learning 10,000 pictures. *Quarterly Journal of Experimental Psychology, 5*, 207–222.
- Stephenson, G. M., Kniveton, B. H., & Wagner, W. (1991). Social influences on remembering: Intellectual, interpersonal and intergroup components. *European Journal of Social Psychology, 21*, 463–475.
- Stevenson, R. J., & Case, T. I. (2005). Olfactory dreams: Phenomenology, relationship to volitional imagery and odour identification. *Imagination, Cognition and Personality, 24*, 69–90.
- Talarico, J. M., & Rubin, D. C. (2003). Confidence, not consistency, characterizes flashbulb memories. *Psychological Science, 14*, 455–461.
- Terr, L. C. (1988). What happens to early memories of trauma? A study of twenty children under age five at the time of documented traumatic events. *Journal of the American Academy of Child and Adolescent Psychiatry, 27*, 96–104.
- Tulving, E. (2002). Episodic memory: From mind to brain. *Annual Review of Psychology, 53*, 1–25.
- Tulving, E., & Craik, F. I. M. (2000). *The Oxford handbook of memory*. Oxford, UK: Oxford University Press.
- Vicente, K. J., & Wang, J. H. (1998). An ecological theory of expertise effects in memory recall. *Psychological Review, 105*, 33–57.
- Waters, A. J., Gobet, F., & Leyden, G. (2002). Visuo-spatial abilities of chess players. *British Journal of Psychology, 93*, 557–565.
- Welch-Ross, M. K. (2000). A mental state reasoning model of suggestibility and memory source monitoring. In K. P. Roberts & M. Blades (Eds.), *Children's source monitoring* (pp. 227–255). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.
- Weldon, M. S., & Bellinger, K. D. (1997). Collective memory: The nature of individual and collaborative recall. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 23*, 1160–1175.
- Willander, J., & Larsson, M. (in press). Autobiographical odour memory. *Psychonomic Bulletin & Review*.