

## **Teachers' beliefs about memory - what are the implications for in-service teacher education?**

1912 words, excl. references

### **Abstract**

Memory plays a key role in learning, and it is therefore important that teachers understand its workings in order to make decisions that benefit learning. However, previous research has shown that memory is an area which is subject to misconceptions. This study used an online survey with a 5-item Likert scale to determine teachers' responses to statements about memory and forgetting, including counterintuitive phenomena such as the spacing effect. It was found that participants scored better on the items compared to studies of the general public, but there were notable misconceptions. Accuracy of memory beliefs didn't increase in line with self-reported number of years of experience. Teachers of psychology scored higher, suggesting that an understanding of cognition can reduce misconceptions. Although small scale, this survey addressed an under-researched area, and future directions for research and implications for teacher CPD are suggested.

**Keywords:** professional knowledge, metacognition, spacing effect, retrieval practice

### **Introduction**

Teachers need an accurate understanding of human memory processes in order to present material effectively in the classroom, as they are responsible for guiding student learning. Several well-established psychological principles can inform this work. For example, incorporating a delay before restudying leads to more durable learning compared to more immediate restudy - the spacing effect (Cepeda et al. 2008). Retrieval practice means the active retrieval of information from memory, and is considered a more effective learning and revision strategy than popular choices such as re-reading (Karpicke et al., 2014; Dunlosky et al., 2013). Interleaving - mixing up different types of problems or examples - is another promising strategy.

However, memory is complex and its workings are not intuitively obvious (Bjork, 2011). Misconceptions about memory are rife; a survey by Simons and Chabris (2011, 2012) found the proposition that memory "*works like a video camera, accurately recording the events we see and hear so that we can review and inspect them later*" was endorsed by 63% of their sample of members of the public, but by 0% of memory researchers. Professionals serving as expert witnesses often endorse similar myths (Melinder & Magnussen, 2015). However, Ost et al. (2017) found that psychology PhD students did somewhat better on similar questions, suggesting that a theoretical understanding of human cognition can lead to more accurate memory beliefs; graduates scored better on the Simons and Chabris survey, too, suggesting that education more broadly could play a role.

Uncertainty about how memory works could lead to learners using flawed study strategies. In a survey of over 300 first year university students, Hartwig and Dunlosky (2012) found a preference for ineffective strategies such as re-reading, which correlate with lower grade point averages. Education has a relatively slow feedback loop, and learners tend to confuse performance in the here-and-now

with permanent learning. This means that experience of using one's memory is often not sufficient to develop an accurate understanding of its functions.

If learners are unable to fathom memory for themselves, it would appear to fall to teachers to guide the learning process. However, teachers too appear to be prone to mistaking immediate performance for long-term learning (Soderstrom & Bjork, 2015), suggesting that judgements in educators cannot be based solely on experience or reflection. Learning advice given to students often is characterised by misconceptions; Morehead et al. (2016) found that 91% of teachers endorsed the 'learning styles' myth (the idea that learners can be categorised by their preferred sensory modality e.g. auditory or visual and should be taught mainly via this modality; see e.g. Kirschner, 2017). In the same study, teachers did endorse some more effective strategies such as self-testing – which affords an opportunity for retrieval practice - but their reasoning did not indicate an understanding of how memories are formed.

The present survey aimed to establish whether teachers' beliefs about human memory are subject to similar misconceptions as have been found among other populations. On the basis of memory being counterintuitive, it was predicted that years of experience would have little impact on accuracy of response. The study also looked at participants teaching subjects, to investigate whether background psychological knowledge would affect accuracy of responses.

## **Method**

### Design and Materials

A survey was undertaken using the website PsyToolkit ([www.psychtoolkit.org](http://www.psychtoolkit.org)). It featured 24 statements relating to memory, each with a 5-point Likert scale labelled "strongly agree" to "strongly disagree". The first set of questions related to memory in general, with two drawn directly from Simons and Chabris (2011). The remaining questions focused on aspects of memory relevant to teaching and on which there is broad scientific agreement, for example the spacing effect, retrieval practice, and interleaving (see Table 1 for a full list of questions and summarised responses).

### Sample and Procedure

Participants were recruited from a Scottish secondary school (n = 45) or via weblink shared on Twitter (n=34) using the author's account, alongside a tweet inviting teachers to take part. 58 participants were from the secondary sector, 8 from primary, and 14 self-reported as "other including FE and HE". The online survey featured an ethics statement and consent form.

## **Results**

The general memory questions revealed misconceptions about memory, but at lower levels than had been found in the Simons and Chabris research (Fig 1).

	Present Study	Simons/Chabris (2012) online survey	Simons/Chabris (2011) survey
People suffering from amnesia typically cannot recall their own name or identity	17.5%	81.4%	82.7%
Once you have experienced an event and formed a memory of it, that memory does not change.	11.3%	28%	47.6%
Other general memory questions (mean)	20.05%	48.2%	72.5%

Fig 1: Percentages of participants out of line with the scientific consensus, combining 'weakly agree' and 'strongly agree' responses and the equivalent for 'disagree' responses.

The remainder of this section will focus on how often participants were *concordant* with the scientific consensus on aspects of memory relevant to teaching, combining correct weakly agree/strongly agree responses and the equivalent for 'disagree' responses.

The highest level of accuracy was found in a question on meaning: “*One of the best ways to remember something over the long-term is to focus on its meaning and how it links to other things*”, with 97.3% agreement. Questions 8, 12 and 20 (on student metacognition, forgetting and the role of inaccurate guessing, respectively) also prompted over 70% correct responses.

Questions to do with the spacing effect were associated with some of the most inaccurate responses. For example, the statement “*As a teacher, it is wise to wait until learners have almost forgotten things before you go over them again*” fits with the spacing effect, but only 12.2% agreed/strongly agreed, the lowest for any question (see Appendix 1). Similarly, just 27.4% disagreed/strongly disagreed with “*It makes sense to do a homework task soon after the material is done in class*”, which implies that spacing should be avoided. Interestingly, though, teachers appeared to be aware of the limited benefits of cramming, as 84.4% disagreed with the statement “*The best way to learn something is to go over it repeatedly within the same hour*”.

Another area where beliefs differed considerably from the scientific consensus was retrieval practice. Only 37.7% gave a correct response when asked if asking open questions is a good way to review a topic (Question 9), a slight majority disagreed with the proposal that re-reading is more useful than tests (Question 15), and just 26% rejected the idea that memories are mainly formed through frequent repetition.

Years of experience were self-reported on the survey in bands of 5 years (0-5 years; 6-10; 11-15; 16-20; over 20). To compare findings in terms of experience, a one-way between-subjects ANOVA was conducted ( $F[4,68] = 1.233, p = .305$ ). This did not indicate a significant difference; it was therefore concluded that years of experience were not associated with level of accuracy on the memory questions.

Finally, teachers with psychology as one of their main subjects scored higher overall, with a mean score of 91.0 (SD = 11.3, n = 13) compared to 77.74 (SD = 8.94, n = 61). This difference was

significant (between subjects t-test;  $p < .001$ ), supporting the importance of knowledge of cognition when it comes to memory-based judgements about learning.

## Discussion

An accurate understanding of human memory is likely to affect successful planning and teaching. The findings presented here suggest that teachers hold a better understanding of such issues than other professionals or the general public, perhaps because initial teacher education features input on learning theories. However, significant inaccuracies were also present, which showed in particular a lack of understanding of how the spacing effect and retrieval practice might be applied to teaching practice.

The finding that years of experience had little impact on the accuracy of teachers' beliefs supported the study's first hypothesis. The exact reasons why these misconceptions do not diminish with experience remain to be firmly established, but fits with the points made earlier about the counterintuitive nature of memory and the slow feedback loop when learning. Indeed, feedback may promote some teacher misconceptions - flawed strategies are sometimes better in the short-term, e.g. when cramming for an impending test (Kornell, 2009), and, as noted earlier, teachers may mistake current performance for learning.

It is possible that the findings are an artefact of other differences, such as generational differences between groups. Future research could include a longitudinal investigation via surveys with trainee/early career teachers at various stages.

Flaws in teachers' knowledge have implications for their professional learning. The current findings suggest that the CPD undertaken by teachers does not improve their understanding of memory, perhaps because this topic is absent from such training or because an in-depth understanding is not fostered. Teachers may benefit from more thorough training in memory and cognition, a conjecture that is supported by the finding that those teachers whose remit included psychology scored higher overall.

Higher scores among the sample compared to the general public may be attributable in part to their higher education level as qualified teachers, but there may also have been an effect of sampling bias. Twitter users are likely to engage more with the science of learning, e.g. by reading educational blogs which are easily shared through social media. Although a school sample was also used, this institution might not have a typical staff profile, and its location (Scotland) could affect the generalisability of the findings. Future work should feature a more representative sample.

The current study also did not provide baseline responses to the questions; this could be done by surveying beginner student teachers. Further research should also determine the practical effects (if any) of misconceptions about memory, perhaps via classroom observations. This would clarify whether flawed teacher beliefs have a detrimental impact in line with previous findings relating to learner beliefs. It would also be helpful to develop a taxonomy of memory-relevant educational tasks to inform the selection of future survey questions, and to survey memory experts (as in Simons & Chabris, 2011) to better establish the scientific consensus on the issues covered.

## **Conclusion**

Although small scale, the present survey addressed an under-researched area, and can be used as the foundation for further work. It found evidence that teachers' misconceptions about memory are lower than those of the general population, do not change in line with experience, and are higher among those without a psychology teaching remit. To tackle erroneous beliefs, psychology-based theories about learning and memory could form a greater part of teacher education including CPD.

## References

- Bjork, R. A. (2011). On the symbiosis of remembering, forgetting, and learning. In A.S. Benjamin (Ed.) *Successful Remembering and Successful Forgetting: A Festschrift in Honor of Robert A. Bjork* (pp. 1-22). New York: Psychology Press.
- Cepeda, N. J., Vul, E., Rohrer, D., Wixted, J. T., & Pashler, H. (2008). Spacing effects in learning: A temporal ridgeline of optimal retention. *Psychological Science, 19*(11), 1095-1102.
- Dunlosky, J., Rawson, K. A., Marsh, E. J., Nathan, M. J., & Willingham, D. T. (2013). Improving students' learning with effective learning techniques: Promising directions from cognitive and educational psychology. *Psychological Science in the Public Interest, 14*(1), 4-58.
- Ericsson, K. A., Prietula, M. J., & Cokely, E. T. (2007). The making of an expert. *Harvard Business Review, 85*(7/8), 114-21.
- Hartwig, M. K., & Dunlosky, J. (2012). Study strategies of college students: Are self-testing and scheduling related to achievement?. *Psychonomic Bulletin & Review, 19*(1), 126-134.
- Horvath, J. C. & Lodge, J. M. (2016). A framework for organising and translating science of learning research. In Horvath, J. C., Lodge, J. M., & Hattie, J. (Eds.), *From the Laboratory to the Classroom: Translating Science of Learning for Teachers* (pp. 7-20). Abingdon, Oxon: Routledge.
- Karpicke, J. D., Lehman, M., & Aue, W. R. (2014). Retrieval-based learning: An episodic context account. In B. Ross (Ed.), *Psychology of Learning and Motivation, Vol. 61* (pp. 237-284). Waltham, MA: Academic Press.
- Kirschner, P. A. (2017). Stop propagating the learning styles myth. *Computers & Education, 106*, 166-171.
- Kornell, N. (2009). Optimising learning using flashcards: Spacing is more effective than cramming. *Applied Cognitive Psychology, 23*, 1297-1317.
- Melinder, A., & Magnussen, S. (2015). Psychologists and psychiatrists serving as expert witnesses in court: what do they know about eyewitness memory?. *Psychology, Crime & Law, 21*(1), 53-61.
- Morehead, K., Rhodes, M. G., & DeLozier, S. (2016). Instructor and student knowledge of study strategies. *Memory, 24*(2), 257-271.
- Ost, J., Easton, S., Hope, L., French, C. C., & Wright, D. B. (2017). Latent variables underlying the memory beliefs of chartered clinical psychologists, hypnotherapists and undergraduate students. *Memory, 25*(1), 57-68.
- Simons, D. J., & Chabris, C. F. (2011). What people believe about how memory works: A representative survey of the US population. *PLoS one, 6*(8), e22757.
- Simons, D. J., & Chabris, C. F. (2012). Common (mis)beliefs about memory: A replication and comparison of telephone and Mechanical Turk survey methods. *PLoS one, 7*(12), e51876.

Soderstrom, N.C. and Bjork, R.A. (2015). Learning versus performance: An integrative review. *Perspectives on Psychological Science*, 10(2), 176–199.

**Appendix 1: Table of Questions and Findings**

Q No.	Question	Correct response	Rationale	% of Ps correct*	Weighted mean from Likert scale (5= maximum accuracy)
1	People suffering from amnesia typically cannot recall their own name or identity.	Disagree	Media myth about amnesia.	51.9	3.49
2	Sometimes people who have committed murder have no memory for the crime because they have repressed the memory.	Disagree	Generally discredited theory.	24.1	2.72
3	Very high stress during an event can harm a person's ability to remember the event accurately at a later date.	Agree	Eyewitness memory literature.	93.7	4.42
4	When small children describe events they have experienced, their accounts are usually more accurate than those of adults.	Disagree	Eyewitness memory literature.	31.6	3.11
5	A person's perception and memory for an event may be affected by his or her attitudes and expectations.	Agree	Social perception and eyewitness memory literature.	94.9	4.58
6	Once you have experienced an event and formed a memory of it, that memory does not change.	Disagree	Eyewitness memory literature; memory retrieval literature.	81.0	4.2
7	Improvements in learning always require spending more time studying.	Disagree	Memory techniques can improve performance with study time held constant.	54.5	3.32
8	Most learners have a good idea of how practice/study will impact on their memory.	Disagree	Metacognitive literature on study habits - most students	70.1	3.79

			make flawed choices.		
9	When reviewing a topic, it's best to give learners open questions rather than multiple-choice questions or verbal summaries.	Agree	Literature on retrieval practice.	37.7	3.01
10	The best way to learn something is to go over it repeatedly within the same hour.	Disagree	Techniques such as retrieval practice and deep processing more effective than repetition.	84.4	4.17
11	Learners benefit from mixing up lots of different types of problems, rather than doing one type of task at a time.	Agree	Literature on interleaving as a study/practice technique.	63.6	3.73
12	The majority of information taught during a class will still be retained by learners 2-3 weeks later.	Disagree	Forgetting curve.	77.9	4.065
13	Learners are in the best position to judge what and how they should study.	Disagree	Metacognition; students' study habits.	64.9	3.58
14	It's always best to simplify things for learners in some way, because making something easier helps it to be processed into long-term memory.	Disagree	Literature on desirable difficulties - more difficult tasks e.g. retrieval, distributed practice can be more effective.	44.6	2.96
15	As a teacher, it is wise to wait until learners have almost forgotten things before you go over them again.	Agree	Spacing effect.	12.2	1.87
16	Multiple re-readings are more useful for learning than doing lots of tests.	Disagree	Retrieval practice is more effective than re-reading.	55.4	3.45
17	Good study advice for learners should include telling them to find a place where they are comfortable and to do all their revision there.	Disagree	Literature on variable environmental context & memory.	32.4	2.75

18	A learner's current performance on a task is not a reliable guide to their long-term learning.	Agree	Performance v's learning distinction.	67.6	3.605
19	One of the best ways to remember something over the long term is to focus on its meaning and how it links to other things.	Agree	Deep processing; elaborative processing.	97.3	4.395
20	If a learner guesses and is not correct they may remember the wrong answer, so it's best to avoid guessing/predictions during lessons.	Disagree	Pretesting effect; questions prior to study can boost later learning.	75.3	3.84
21	Including extra information or examples in a written passage makes it harder for learners to remember the main points.	Agree	Research into embellishment and extraneous details.	17.8	2.34
22	Ultimately, learners form new memories through frequent repetition.	Disagree	Retrieval practice more important than repetition.	26.0	2.50
23	It makes sense to do a homework task soon after the material is done in class.	Disagree	Spacing effect.	27.4	2.41
24	Once learners have got a question wrong and then been corrected, they will be able to predict whether they will get it right in future.	Disagree	Metacognition: feedback doesn't always lead to accurate judgements of learning.	41.1	3.09