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Title: Memory magic: Is it just a bunch of hocus pocus?

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Memory magic: Is it just a bunch of hocus pocus?

A cognitive mechanism that has often been investigated for its connection with, and impact on, learning is working memory. Although there are several different perspectives and models of working memory (see Miyake & Shah's review, 1999), the literature typically refers to Baddeley's (2000; Baddeley & Hitch, 1974) conceptualisation; a cognitive system, with limited capacity, that is responsible for storing and manipulating information during complex and demanding mental tasks. Within a school setting, such tasks may include mathematical calculations, planning an essay or simply remembering what the teacher has instructed the class to do. Therefore, although the mechanism is not yet fully understood, if working memory is involved in such tasks, it could be argued that working memory deficits could impact on learning (Alloway, Gathercole, Adams, & Willis, 2005) and that improvements in working memory could lead to improved learning and academic achievement.

The literature outlines two main approaches for helping children with working memory difficulties. The two approaches, although different, are not mutually exclusive and could be used in combination. The environmental approach, supported by Alloway and Gathercole (2008), proposes that the curriculum delivery and classroom environment should be adapted to the needs of the learner. This may involve giving simpler task instructions and/or providing memory aids such as number lines and word banks (Alloway, 2006; Alloway & Gathercole, 2008). The within-child approach focuses on skill development, which can be further divided into two categories. While some take the perspective that an individuals' working memory capacity or efficiency can be developed and improved through practice (similar to lifting weights to increase muscle and strength), others suggest teaching

strategies to overcome or to get around the barrier (using a pulley-system to lift a heavy weight). *Memory Magic* is a working memory intervention based on the latter of these two perspectives and is also the subject of this critique.

Memory magic

Memory Magic is an intervention developed by Jane Booth (2009), which provides teachers with six different 'tricks', or strategies, to support children with working memory difficulties. The *Memory magic* pack provides an instructional booklet, explaining the process, and a CD ROM, which contains worksheets, games and activities. Booth's description and claim of what the intervention achieves is vague. This makes it difficult to either confirm or refute the effectiveness of this intervention.

Although the specific aims of *Memory magic* are not made explicitly clear, Booth does state that the strategies can "help to improve a child's memory" (Booth, 2009, p.3), that the activities/games provided will help the child to learn the strategies and that a child would benefit from selecting a strategy that they find to be the most effective. To the present author's understanding, this suggests that Booth is implying that the intervention should help children's memory performance. The intervention is said to achieve this aim by asking teachers to teach the child six different strategies, using the materials and activities provided, followed by asking the child to select and employ the strategy they find to be the most effective.

Unfortunately, there is no publically accessible published research specifically supporting the claims of *Memory magic* and so it is difficult to answer some important questions: Do the strategies outlined in *Memory magic* help children to overcome

working memory difficulties?; are children able to apply a taught strategy?; how long

do any positive effects last?; and are children able to select the strategy they find to be

the most effective? In order to gain some understanding as to the effectiveness of this

intervention, this critique will draw upon associated theoretical underpinnings and

empirical research. Unfortunately, it is not within the scope of the present critique to

discuss each of *Memory magic*'s suggested strategies in depth. Consequently, a

broader discussion of the surrounding literature will be provided, including a

discussion of the theoretical underpinnings and empirical support for *Memory magic's*

strategies, the value of *Memory magic*'s approach and its application to children,

followed by the implications for Educational Psychologists (EPs).

Theoretical underpinnings and empirical support

Baddeley's (2000; Baddeley & Hitch, 1974) widely accepted model suggests

that working memory consists of four parts: The central executive is a limited

capacity system concerned with attentional control; the phonological loop is

responsible for maintaining auditory information; the visuo-spatial sketchpad is

responsible for processing visual and spatial information; and the episodic buffer is

said to integrate information from long-term and working memory. It is the

somewhat under researched episodic buffer (Baddeley, 2000) that provides some

explanation as to how self-taught strategies might improve memory recall. This is

linked to Ericsson's (1985) theory of skilled memory, which proposes that the process

of passing information between the long and short-term memory storage could

become more efficient with the aid of memory strategies because they provide more

structure and meaning for the information being processed. However, this is only one

of several perspectives and, despite a wealth of research on this subject, a clearly

defined explanation and an agreed consensus for what working memory is, how it works and why certain strategies might improve performance is yet to be established.

Based on Baddeley and Hitch's models, two types of strategies for improving memory performance have been hypothesised: *Articulatory rehearsal* involves simply verbally repeating the information one hopes to remember; *elaborative rehearsal* refers to connecting the information to something meaningful and to something already in one's long-term memory. It is thought that training children to use these memory strategies may be beneficial because children do not appear to employ strategies, unprompted, until around seven years of age (Bjorkland & Douglas, 1997; Gathercole, 1998). Studies have shown that when explicit instructions are given, children do attempt to employ the strategies taught (Ornstein, Baker-Ward, & Naus, 1988). Therefore, it has been argued that training children to employ certain strategies could help to improve their ability to remember and that, in turn, this could help children in class by, for example, improving their ability to remember the teacher's instructions (Engle, Carullo, & Collins, 1991).

The strategies outlined in *Memory magic* appear, although not explicitly stated as such, to be underpinned mainly by Baddeley's (2000; Baddeley & Hitch, 1974) model. However, other theoretical models (i.e. Craik and Lockhart's Levels of processing model, 1972) may also have inspired particular strategies. As stated above, *Memory magic* involves teaching children a series of six 'tricks', each of which are based on strongly empirically supported strategies: *Focus* is concerned with improving attention (supported by Redick & Engle, 2006; Shipstead, Harrison & Engle, 2012; Unsworth & Spillers, 2010); *Rehearse* is based on research supporting the strategy of verbally rehearsing (Broadley, MacDonald, & Buckley, 1994; Gardiner,

Gawlick, & Richardson-Klavehn, 1994); *Group* teaches the heavily supported

elaborative rehearsal technique, known as chunking (Miller, 1956; Carr & Schneider,

1991; Bor, Cumming, Scott Owen, 2004), *Picture it* refers to the visual/imagery

based strategies, which have been supported since 1975 (Atkinson, 1975; De La

Iglesia, Buceta, & Campos, 2005); *Map* is based on research supporting strategies

that propose categorising information and developing schemas (Brewer & Treyens,

1981; Shelble, therriault and Miller, 2012); and *Link* is concerned with mnemonics,

which is also strongly supported by empirical research (Baleghizadeh & Ashoori,

2010; Levin, Levin, Glasman & Nordwall, 1992).

Further support for *Memory magic*'s strategies can be found in Apter's (2012)

review, which stated that much of the memory recall gains achieved through

computerised working memory programmes (e.g. *Cogmed*), designed to increase

working memory capacity, are more likely to be the result of participants learning

memory strategies. For example, Ericsson and Chase (1982) describe a participant

who was able to increase his digit span recall from seven to 80 after taking part on an

extensive training course. It later became apparent, after an interview with the

participant, that the improved performance was in fact achieved by learning and

perfecting the chunking strategy (Foer, 2011, as cited in Apter, 2012). However, like

Ericsson and Chase's (1982) study, much of the research in this area is based on adult

samples. Literature on teaching strategies to younger children is less clear.

The value of Memory magic's approach and its application to children

A potential positive of Booth's *Memory magic* is the provision of an initial

assessment tool, which aims to measure a child's initial working memory score and to

be used as guide of how a child compares to the norm. The normative data had been

taken from a study carried out and produced by Pearson Education Ltd (Semel, Wiig & Secord, 2006). The assessment tool measures the child's ability to recall the order of words (both forwards and backwards) and pictures. This is generally considered an acceptable and valid method of assessing working memory capacity (Conway et al., 2005; St. Clair-Thompson, 2010). Booth suggests that if the child does not fall within the 'normal range', then the strategies would benefit the child. Interestingly, Booth does not appear to suggest that the assessment tool could be used as a pre and post measure. This may have improved the scientific rigour of *Memory magic* or at least helped children and support staff to measure the effectiveness of the intervention.

As stated above, some evidence has shown that children do attempt to employ strategies when instructed (Ornstein, Baker-Ward, & Naus, 1988). However, there is also contrasting research demonstrating that, even after instruction, effective use of elaborative and organisation based strategies are not observed in children under six years of age (Reese, 1962). Furthermore, Bjorklund et al's (1997) review looked closely at the literature on teaching children memory strategies and found that younger children (under ten years of age) were less likely to show improvements, especially when the strategies were any more complex than simply rehearsing.

A key question concerning *Memory magic*'s value, and the value of memory training strategies for children in general, is whether the skills are purely task or domain specific? Even with adult samples, transference and generalisation is still in question. Ericsson and Chase's (1982) participant, for example, was highly skilled in remembering numbers but showed no improvements in other working memory measures.

In addition to Ericsson and Chase (1982), other researchers have suggested that although performance on trained cognitive tasks can increase dramatically as a result of strategy training, transfer of such improvements to other tasks or domains is rare (Healey, Wohldmann, Sutton, & Bourne, 2006; Jaeggi, Buschkuhl, Jonides, & Perrig, 2008). There is some evidence that skills acquired through strategy training are not just task specific, but the literature base is somewhat limited. Carretti, Borella and De Beni (2007) found that benefits can be transferred to various working memory tasks involving similar stimuli but this was only tested on adults and so cannot be generalised to children. Comblain (1994) taught rehearsal strategies to participants with Down syndrome, including children, and found improved recall for untrained stimuli. However, like the majority of the research in this area, participants were placed in the artificial situation of being asked to recall the items immediately after being heard. A more ecologically valid study by Cavallini, Pagnin and Vecchi (2003) demonstrated that elaborative rehearsal strategies improved memory performance in both self-reported everyday memory tasks and laboratory based assessments. However, once again, this was only tested on adults. Finally, as Morrison and Chein (2011) point out in their review, the observable memory improvements found in most of the relevant research could be the result of expectancy bias, which is rarely controlled for.

Similar to placebo effects in drug trials, the belief that training should have a positive effect may lead to a measurable improvement in memory. Although only tested on adults and unable to confirm causation, Yamada's (2011) recent study found a positive correlation between measures of optimism and working memory. In anticipation of the expected achievement, participants may make more of an investment and put greater effort into the post-test assessment. For example, Yates

(2002) found that optimism predicted academic achievement in children, potentially moderated through the consequential behaviours of their beliefs. It could also be related to positive psychology theories, such as the broaden and build theory, by Fredrickson (2001). Individuals experiencing the positive emotion of optimism may be in a better position to think broader, more creatively and be more open and receptive to information being processed.

A key feature of *Memory magic* is the constructivist-like aspect of encouraging children to identify and employ the strategies that they find the most effective. Booth has clearly acknowledged the significance of individual differences and perspectives, which is in agreement with such humanist theorists as Maslow (1943; 1970), Rogers (1995) and Kelly (1970). The issue is whether children are indeed able to accurately identify whether a strategy is effective, which strategy is the most effective and when each strategy should be employed.

Some evidence has suggested that children are indeed capable of accurately selecting an effective strategy from a choice of strategies that they have been taught. St. Clair-Thompson, Stevens, Hunt and Bolder (2010) investigated whether *Memory Booster*, a very similar working memory intervention tool to *Memory magic,* significantly increased the working memory scores of children between five and eight, compared to a control group, after completing two 30 minute sessions over a period of six to eight weeks. St. Clair-Thompson et al. (2010) also found improvements in mental arithmetic and the ability to follow instructions, thus indicating transference of skills and generalisation. However, the study did not find improvements in other academic assessments and there were no positive effects found five months later.

Shing, Werkle-Bergner, Li and Lindenberger (2008) demonstrated that the skill of applying the correct cognitive strategy (including memory tasks) to the correct situation develops with age. Bjorklund, Miller, Coyle, and Slawinski (1997) used the term*, utilization deficiency,* to explain how the use of memory strategies may not necessarily lead to memory improvement in all children. They proposed that younger children and children with cognitive difficulties may in fact rely on an appropriate memory strategy but fail to apply it correctly or in an appropriate situation. In support of this, a recent study by Mata, Helverson and Rieskamp (2011) found that when asked to select a strategy, children (particularly those under ten years of age) found it difficult to know which information to attend to and which to discard or ignore. Therefore, some children (under ten years old or those with learning difficulties) may be less able to attend to, and process, information indicating an occasion when a strategy could be employed, situations when a strategy would not be useful and/or information that might inform them as to which strategy they find the most helpful.

A positive of *Memory magic* is that an awareness of utilization deficiency is indicated in the instruction pack. Booth explicitly states, assumingly in light of the issue, that children under ten years of age should not be expected to choose when to use each strategy and that they should be supported. However, given the significance of this issue, it could be argued that the comment should be repeated or made clearer in the pack.

Conclusion & implications for practice

The strategies suggested by *Memory Magic* appear to have a sound theoretical and empirical base, which may help to improve memory recall for some children. However, with no available empirical evidence specifically investigating *Memory*

magic, the efficacy of the tool is still unclear. The literature suggests that the majority

of younger children (10 and under) are only really able to learn the simpler strategies

(e.g. rehearsal, chunking) and find it more difficult to select the most suitable strategy,

which *Memory magic* acknowledges. Therefore, it may beneficial to use *Memory*

magic in conjunction with environmental adaptions, as suggested by Alloway and

Gathercole (2008), and for EPs to make it very explicit to educators that younger

children will need to be reminded as and when a strategy could be used. Children

may also benefit from being reminded of strategies regularly, given that the benefits

do not appear to last longer than a few months. Arguably, the underlying rational for

employing such an intervention is to support learning. However, the evidence

supporting the claim that working memory strategy interventions have a positive

impact on academic achievement and learning is still limited. Therefore, EPs

considering *Memory magic,* as they would for any intervention*,* should think critically

and should question whether *Memory magic* is actually fit for the purpose for which

they are aiming. It might also be useful for EPs to use interventions like *Memory*

magic as a point of discussion (with Heads, SENCOs, EPs, etc) around the quality and

quantity of research behind educational interventions, what constitutes 'good

evidence' and how different professionals conceptualise the term, 'evidence based'.

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