This is a prepublication version of the following article:

Westgate, B., Dunning, D., Roberts, H., Adlam, A-L,R. The clinical use of Cogmed Working Memory Training (CWMT): a clinician survey. The Neuropsychologist, Issue 4

The clinical use of Cogmed Working Memory Training (CWMT): a clinician survey

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Despite controversy surrounding the effectiveness of working memory training, Cogmed Working Memory Training (CWMT, Pearson) remains a popular choice of intervention. We surveyed 100 CWMT practitioners from Australia, U.S.A., the Netherlands, and the U.K. to find out how CWMT is used, who with, and what outcomes are measured. Practitioners reported that CWMT was easy-to-use and a valuable use of clinical resources. Findings are discussed in relation to current research and recommendations for practice are made.

Introduction

Cognitive-skill based training has been a core component of clinical rehabilitation for many years (e.g., Treat et al., 1978), with gains reported in the domains of attention and working memory (for review see Rabipour & Raz, 2012). Recent neuroimaging studies suggest that cognitive improvements following training might be due to neural plasticity leading to a change in neural structure and function (e.g., changes in cortical activity; Olesen et al., 2003; increase in fractional anisotropy, Takeuchi et al., 2010). Despite this, the potential added benefit of cognitive skill-based training in clinical rehabilitation and educational settings is a hotly debated topic, with the main criticism being the lack of generalisation and transfer of skills to functional outcomes (arguably, the main goal for rehabilitation). Working memory training is one example of this (Schwaighofer, Fischer, & Bühner, 2015).

Over the past 15 years, there has been significant interest in whether working memory (WM, the ability to store and manipulate information over a short period of time) can improve with training. This increased interest is due in part to research indicating that WM plays a role in many areas including, following instructions (Gathercole, Durling, Evans, Jeffcock, & Stone, 2008), maths (Adams & Hitch, 1997), and reading (Cain, Oakhill, & Bryant, 2004), thus improvements in WM might lead to gain in other functions. Early WM training studies (e.g., Klingberg, Forssberg, & Westerberg, 2002) suggested that that WM can indeed be improved with gains transferring to other domains (e.g., fluid intelligence), as well as reducing clinical symptoms of ADHD.

Cogmed Working Memory Training (CWMT, Pearson) is undoubtedly the most widely used WM training program. Briefly, it involves intensive practice (approx. 30mins per day, for 5 days per week, over 5 weeks) on memory span tasks that increase in difficulty as performance improves. Based on the 100+ studies evaluating CWMT to date, it is widely claimed that CWMT leads to sustained improvements in WM and attention in children, adults, and older adults. There is also some evidence that CWMT improves learning outcomes in reading and maths, and reduces attention difficulties in individuals with ADHD. Understandably then, CWMT is a popular choice of intervention for practitioners, with thousands of licences sold each year.

Despite the claims made by Cogmed, the efficacy of CWMT, and WM training in general, remains controversial (Melby-Lervåg & Hulme, 2013; Melby-Lervåg, Redick, & Hulme, 2016; Peijnenborgh, Hurks, Aldenkamp, Vles, & Hendriksen, 2016; Shipstead, Hicks, & Engle, 2012). The most replicated finding is that training improves performance on other non-trained WM measures. The reasons for this improvement, however, are also debated. Some argue that the improvements are due to neural plasticity either improving the efficacy of neuronal responses or extending the cortical map underpinning WM (Westerberg & Klingberg, 2007). Others suggest that WM training leads to neural processes, cognitive skills, and/or strategies that are specific to the structural features of the highly practiced tasks (Dunning & Holmes, 2014). This alternative explanation also fits with studies reporting no evidence of training gains on functions thought to depend on WM (e.g., academic performance, Dunning, Holmes, & Gathercole, 2013; Roberts et al., 2016), and the lack of evidence for reduced behavioural symptoms of ADHD following training (e.g., Chacko et al., 2013).

Given the recent null findings and the financial cost, time commitments, and potential loss of other learning opportunities (e.g., missing school lessons to complete CWMT, Roberts et al., 2016) associated with CWMT, it is of interest to better understand how CWMT is being used clinically. This survey aimed to help elucidate this and identify key areas for future clinical research. The findings of the survey are discussed in relation to current research literature to bridge practice-based evidence with evidence-based practice, and to make recommendations for clinical practice.

Methods

The survey was created using web-based software (SurveyMonkey Inc.) and included 8 questions about: who CWMT is used with; where it is administered; what factors affect engagement; ease of use; whether CWMT is a valuable use of clinical resources; outcome assessments and outcome effects; feedback from families; and what would be useful in terms of future research. Apart from two questions that used a 5-point rating scale (1 = strongly disagree to 5 = strongly agree), the questions were open-ended. Ethical approval was obtained through the University of Exeter Research Ethics Committee.

The survey was advertised online and via email by CWMT country managers, between April-June 2013. One hundred trained clinical CWMT practitioners in Australia, U.S.A, the Netherlands, and the U.K. completed the survey. No identifiable data were collected about the practitioners to ensure that participants felt able to freely express their views. CWMT practitioners were, however, defined as having passed the mandatory Cogmed certification program. Furthermore, Cogmed (personal communication, August 2017) report that the professional backgrounds of CWMT practitioners include: special educational teachers (the main practitioner group in the U.K.), psychologists (including clinical, educational, and occupational), speech and language therapists, and other allied health professions.

Data were coded by two researchers (BW and HR). Responses to the open-ended questions were noted and themes were identified and recorded; themes that appeared in fewer than 5% of responses were categorised under ‘other’. For the purpose of the Results and Discussion sections, survey participants will be referred to as ‘practitioners’ and their clients using CWMT will be referred to as ‘users’.

Results

A summary of the descriptive data is shown in Table 1.

1: Who do you use CWMT with?

The majority of responses indicated that CWMT is used with individuals with working memory or attention problems. Practitioners also indicated that they use CWMT with individuals with brain injury. Answers categorised under ‘other’ (<5% of responses) included: the use of CWMT with those with mental health difficulties; individuals with oppositional defiant disorder; individuals who are not reaching their full potential; the aging population; and students.

2a: Where do you use CWMT?

A majority of responses indicated that CWMT is used at home, next followed by use in clinic.

2b: When do you use CWMT?

The results indicate that CWMT is used all year round, both in school term and in school holidays. Of the two, using CWMT in the summer holiday appears to be the most popular choice.

2c: Do these factors affect engagement with CWMT?

Some practitioners indicated that users were more likely to engage at home due to family support, while other practitioners who work with children reported that it is more feasible for users to complete CWMT in the summer term at school. Using CWMT at school was seen to have the advantage of school support. Other factors important in the engagement with CWMT included: the quality of supervision; coach contact; motivation, and sufficient rest time.

3: CWMT is easy to use

As shown in Figure 1, a majority of practitioners indicated that CWMT is easy to use. Practitioners were asked to note any additional comments in response to this question and some challenges were highlighted. These included: exercises within CWMT are cognitively challenging; for child users of CWMT, ease of use can depend on a child's parent's involvement; setting-up difficulties; and loss of internet connection.

4: CWMT is a valuable use of clinical resources

Again, most practitioners agreed with this statement and, in fact, none strongly disagreed (see Figure 2). When practitioners were asked to leave any additional comments many commented that CWMT is worth the cost. Others advocated that CWMT needs to be performed alongside other interventions, and a few suggested that they can only see the benefits of CWMT with some users.

5: What feedback do families/clients give about CWMT?

Most practitioners reported that user feedback indicated that CWMT was challenging, but worthwhile. Feedback also indicated that users enjoy CWMT and it is easy to use. There was also some negative feedback including: the difficulty of CWMT (due to its adaptive nature); the time commitment needed; and the indication that some users find it boring.

6: What would be useful in terms of future research?

The majority of practitioners indicated the value of evaluating CWMT with different clinical groups. Other future directions included longitudinal follow up, and comparison with different treatment approaches.

7: What outcome assessments do you administer to measure CWMT effects?

Most practitioners reported using the Cogmed WM difficulties scale that Pearson provides. The next most popular outcome assessment was the use of the Behaviour Rating Inventory of Executive Function (BRIEF; Gioia, Isquith, Guy, & Kenworthy, 2000), followed by standardised measures including the Wechsler Intelligence Scales for Children (WISC, Wechsler, 2003) and the Automated Working Memory Assessment (AWMA, Alloway, 2007).

8: What outcome effects/training gains do you find?

Most practitioners reported observing academic improvements following CWMT (see Figure 3). Many also commented on the improvement in user's everyday memory, attention, and concentration. Self-confidence was also noted as a training gain. A small proportion of practitioners (5%) reported no gains at all.

Discussion

Given the controversy over whether cognitive skill-based training (e.g., CWMT) generalises to functional gains (i.e., gains beyond tasks that are structurally similar to the training tasks), practitioners who use CWMT in their everyday practice were invited to express their views on the usefulness of CWMT.

Findings indicate that CWMT is primarily used with individuals who have poor WM and ADHD, and that most CWMT practitioners observed training gains in the domains of attention/concentration and academic performance. These findings are not surprising considering the original claims that CWMT could reduce the attention difficulties associated with ADHD (Klingberg et al., 2002). Current literature supports the claim that CWMT improves performance on non-trained WM tasks (at least those that are structurally similar to the training tasks; Schwaighofer et al., 2015), however, recent RCTs (with sufficient power to detect change) have not found transfer of training gains to measures of attention or ADHD symptoms (Chacko et al., 2013), or academic performance (Dunning et al., 2013; Roberts et al., 2016). It is also worth noting, that the majority of CWMT practitioners surveyed used questionnaire/rating scales to measure training outcomes. The practitioner reported benefits of CWMT, therefore, need to be considered in the context of expectancy effects (i.e., users/family members might report gains because they expect improvements after investing time and effort in training).

With regards to acceptability, the findings suggest that CWMT is easy to use, challenging but enjoyable, and requires a large commitment from the user. CWMT was designed to be easy to use (e.g., simple instructions), challenging (e.g., the difficulty level of the task adapts to the individuals current performance based on the principle that learning occurs when tasks are ‘pitched’ at the appropriate level of difficulty; Klingberg, 2010), and enjoyable (e.g., game-like features and motivational rewards). Indeed, these factors are typically considered to be important features of effective interventions (e.g., Diamond & Lee, 2011; Jaeggi, Buschkuehl, Jonides, & Shah, 2011). In terms of user commitment, variables such as duration (e.g., 30-40 min per training session), dose (e.g., 25 training sessions), frequency (e.g., 5 training sessions per week for 5 weeks), and time interval between training sessions have not been systematically studied. In their recent meta-analysis, however, Schwaighofer et al. (2015) found that longer training duration and larger training dose positively influenced transfer effects (at least to performance on short-term memory measures), whereas training frequency and interval between training sessions did not have a significant effect. These findings are consistent with CWMT’s recommendation for practitioners to maintain training session duration and training dose but to modify the training frequency and interval to the needs of the individual (i.e., 5-week+ training protocols).

Practitioners reported that CWMT is mostly completed at home or in the clinic, with some child users completing training at school. Although the influence of CWMT setting on training gains has not been systematically studied, training location was included as a moderator variable in a recent meta-analysis (Schwaighofer et al., 2015). Findings suggested that training gains on visuospatial STM were larger when CWMT was delivered at home (rather than school), gains in verbal WM were larger when CWMT was delivered in school (rather than the laboratory), and gains in nonverbal ability was larger when CWMT was delivered in the laboratory (rather than school or home).

A majority of practitioners reported that CWMT is a valuable use of clinical resources. To date, only one study has been published reporting data on the cost-effectiveness of CWMT (Roberts et al., 2016). Roberts et al. evaluated CWMT relative to 'usual classroom teaching' (RCT design) in children aged 6 – 7 years and concluded that due to the lack of sustained benefits (at 12 and 24 months), lack of transfer to academic outcomes, and high cost of delivery (AUD $1035 per child, equivalent to £630 in 2017), CWMT is not cost-effective. We have recently completed an RCT evaluating CWMT with children (8 – 16 years) with acquired brain injury (Adlam et al., unpublished), and included an economic evaluation based on quality of life and service resource use. The findings will be available in due course.

The survey also aimed to identify key areas for future clinical research. Suggestions included evaluating CWMT with different clinical groups (e.g., who benefits the most from CWMT and what factors moderate outcome?), investigating the potential long-term effects of CWMT, and comparing CWMT with other interventions. These can be considered alongside recent recommendations in the research literature. For example, a commentary by Gathercole (2014) on Chacko et al.'s (2013) study also calls for research to focus on developing interventions that will maximise transfer to functional outcomes. Suggestions include developing hybrid training programmes that capitalise on the transfer associated with different WM training programme (e.g., combining elements of CWMT and n-back training); include a component to the training that enables the user to explicitly practice the skills learnt in practical situations (e.g., explicitly applying WM strategies to maths problems; our research group is currently developing an intervention for use with children 9-12 years, Jones, Milton, & Adlam, unpublished); and integrating adaptive WM training in to the functional activities that cause the most difficulty (e.g., training WM using maths problems; see Holmes & Dunning, 2017 for examples). Others suggest embedding WM training in complex contexts to facilitate transfer (e.g., Schwaighofer et al., 2015). There is some evidence to support this approach, for example, Tools of the Mind (Diamond, Barnett, Thomas, & Munro, 2007) focuses on developing executive functions within the context of the school curricula. Other research might want to focus on the clinical and cost-effectiveness of CWMT (or working memory training+ interventions) when delivered in a clinical context.

Recommendations

Based on the survey findings and the current evidence-based the following recommendations are made:

- Practitioners should consider the primary target for the intervention prior to embarking on CWMT – if the aim is to treat ADHD or improve academic performance, then this is not supported by the current evidence-base.
- Practitioners should evaluate outcomes using measures that are less influenced by user-expectancy (e.g., school assessments) and sensitive to change. It is also

recommended that, resources permitting, outcomes are systematically evaluated using single case experimental designs (Manolov, Gast, Perdices, & Evans, 2014).

- Given that training location (home, school, clinic) has not yet been systematically studied, it is recommended that practitioners consider the most optimal location to complete training based on factors such as, availability of supervision (shown to positively influence outcomes, Schwaighofer et al., 2015), and where training is least likely to interfere with access to other learning opportunities (e.g., the findings of Roberts et al., 2016 suggest that CWMT should not replace school lessons).
- Practitioners should encourage CWMT users to complete training sessions in one sitting (i.e., 30-40 mins), and consider modifying the frequency and interval of the training programme as per Cogmed's recommendations if users are likely to have difficulties completing their training over a 5-week period.
- Given the limited research evaluating the cost-effectiveness of CWMT with clinical groups, it is recommended that practitioners weigh up the potential costs (e.g., licence fees, coach/practitioner time, user time/missed opportunities for the user (i.e., would the user's time be better spent on something else?), burden to the user/family etc.) and benefits (i.e., enjoyable, easy-to-use, improved performance on WM measures) before using CWMT.
- Based on the suggestions for future research, practitioners might want to consider how CWMT can be used within the context of other intervention approaches. For example, although not yet empirically tested, it might be helpful for practitioners to include additional sessions post-training to help users practice applying the skills learnt through training to the areas where they are

having the most functional difficulty (e.g., following instructions, maths, and reading). This recommendation is based on the assumption that users learn new strategies when engaging in CWMT (Dunning & Holmes, 2014).

Limitations of the survey

The survey included responses from 100 CWMT practitioners across four countries, which although is a relatively large sample, the data represent the views of a subset of CWMT practitioners. The survey included only eight questions, which will have resulted in some key views about CWMT being missed or not fully explored. For example, although practitioners were asked who they use CWMT with, the survey did not specify the age group of the users. This might be an important factor when considering the clinical outcomes of CWMT, particularly when considering user engagement and feedback, and potential training gains (e.g., Wass et al., 2012, although see Schwaighofer et al., 2015). In addition, answers to some of the questions (e.g., what outcome effects do you find? is CWMT a valuable use of clinical resource?) might be influenced by the practitioners own decisions to use CWMT and the time/resource that they dedicate to delivering CWMT (e.g., expectancy effects). Due to these limitations this article drew on published research and other commentaries to more fully explore the usefulness of CWMT.

Conclusions

CWMT is widely used in clinical practice with individuals across the lifespan and with a range of disorders associated with WM difficulties. In terms of practice-based evidence, practitioners considered CWMT to be a valuable use of clinical resources, easy-to-use, enjoyable and challenging for the user, and leading to benefits in attention/concentration and academic performance. In terms of evidence-based practice, recent research does not support the view that CWMT leads to sustained gains in academic performance, and suggests that CWMT is not cost-effective (at least not for 6-7 year olds with WM difficulties, when CWMT is delivered in school). To help bridge the gap between practice-based evidence and evidence-based practice, it will be helpful to conduct pragmatic research (SCED and RCTs), which evaluate the clinical and cost-effectiveness of CWMT (or WM training+ interventions) in clinical settings.

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Table 1 Results (percentages) of the survey questions

Q1. Who do you use CWMT with?		
	Working memory problems	24.24
	ADHD/ADD	22.42
	Brain injury	12.2
	General cognitive problems	6.67
	Learning difficulties	6.06
	Autism	4.85
	Executive functioning problems	3.64
	Other	20
Q2a. Where do you use CWMT?		
	Home	59.32
	Clinic	22.03
	School	16.10
	Other	2.54
Q2b. When do you use CWMT?		
	School and Summer holiday	53.85
	Summer holiday	30.77
	School term	15.38
Q5. What feedback do families/clients give about CWMT?		
	Hard but worthwhile	28.69
	Enjoy it	27.87
	Large commitment	18.85
	Dull and/or boring	13.11
	Difficult	8.20
	Other	3.28
Q6. What would be useful in terms of future research?		

	CWMT with different clinical groups	29
	Longitudinal follow-up	21
	Comparison with different treatment approaches	18
	Generalisation of effects research	11
	Cost evaluation study	5
	Research on duration and intensity parameters	4
	Outcome studies	4
	Possible altered training protocol	4
	Research on normative data for the general population	4
Q7. What outcome assessments do you administer to measure CWMT training effects?		
	DSM Cogmed scales	29.79
	BRIEF	24.47
	WISC	9.57
	AWMA	8.51
	Clinical interviews	8.51
	Digit span	6.38
	Anecdotal	6.38
	Observational	6.38

ADD – Attention Deficit Disorder; ADHD – Attention Deficit Hyperactivity Disorder; WISC – Wechsler Intelligence Scale for Children; BRIEF – Behaviour Rating Inventory of Executive Function; AWMA – Automated Working Memory Assessment

Figure 1 Frequency of responses indicated on a rating scale in answer to the statement 'CWMT is easy to use'.

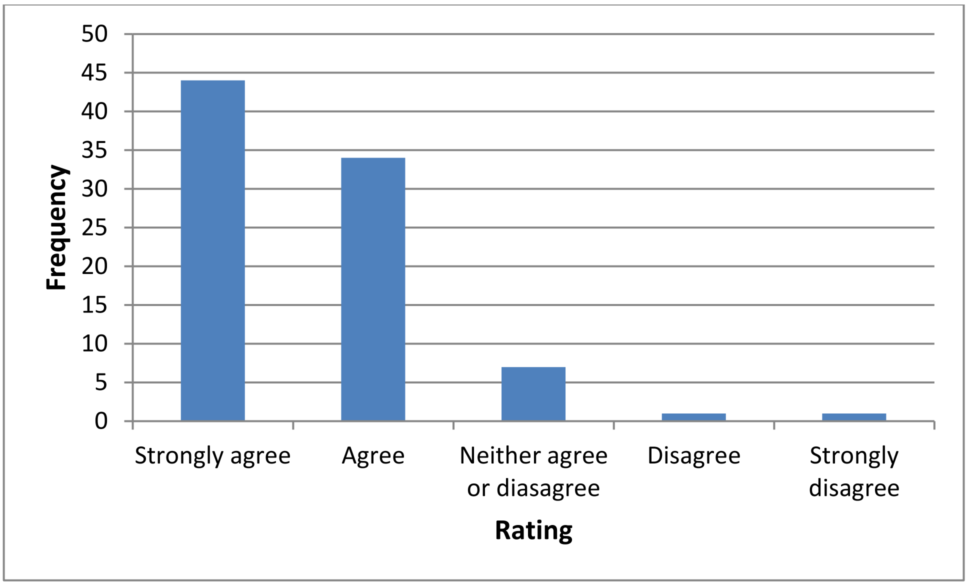


Figure 2 Frequency of responses indicated on a rating scale in answer to the statement ‘CWMT is a valuable use of clinical resources’.

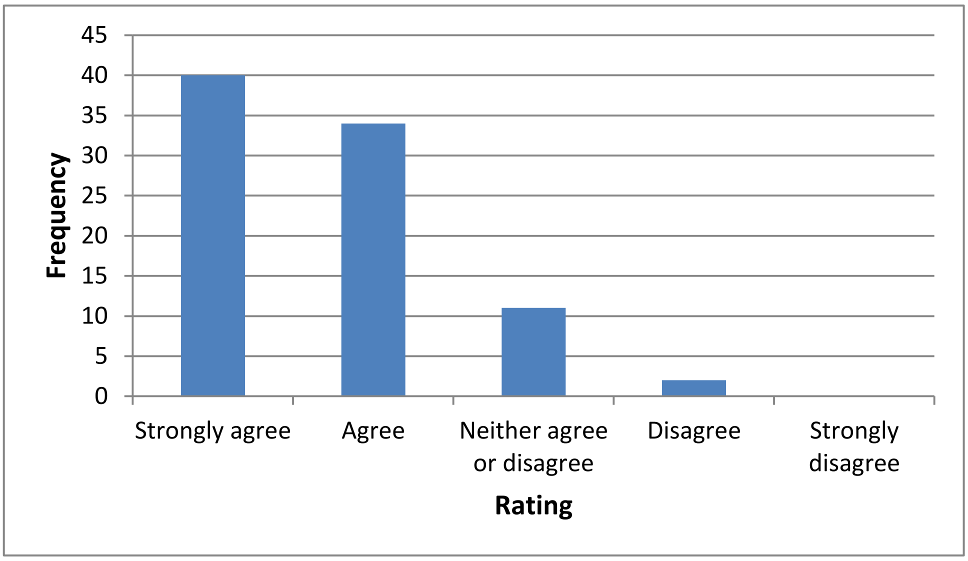
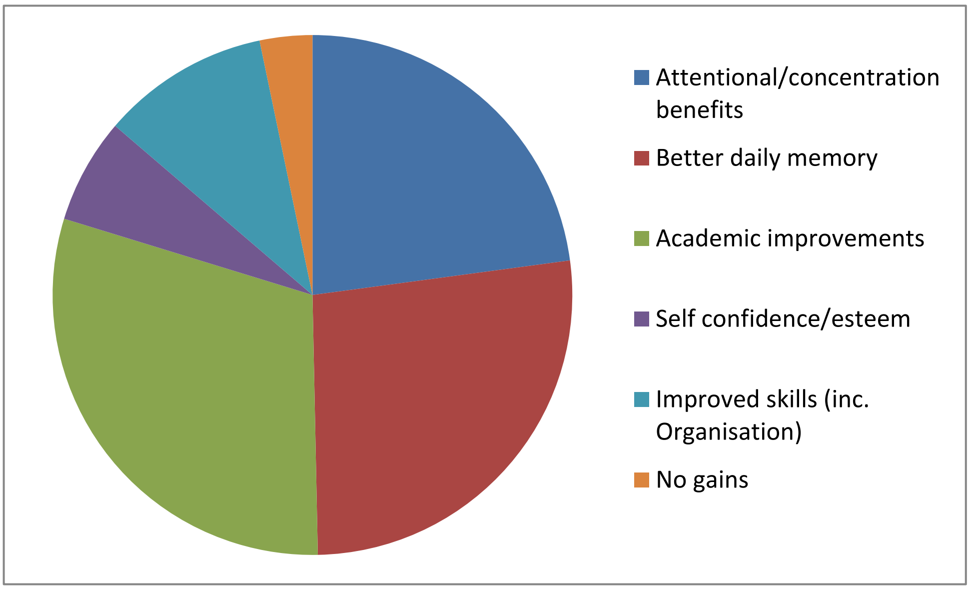


Figure 3 Percentage of responses to the question 'What outcome effects/training gains do you find?'



Acknowledgements

This survey was conducted independently of Pearson Cogmed, however, we would like to thank Pearson Cogmed for distributing this survey to CWMT practitioners via their mailing list. We would also like to thank everyone who completed the online survey. Thank you, also, to Dr Jenny Limond (University of Exeter) and the anonymous reviewer for their helpful comments on this article prior to publication. This project was supported by generous grants from the Henry Smith Charity and Action Medical Research.