

**Title: Maximizing cognition in Mild Cognitive Impairment and early-stage dementia**

**Abbreviated Title: Maximizing Cognition**

<b>Senior/ Corresponding author:</b>  Dr Bridget Regan Lincoln Centre for Research on Ageing Australian Institute for Primary Care & Ageing School of Nursing and Midwifery La Trobe University Level 1 Health Sciences 1 Bundoora 3083 Victoria Australia Email: <a href="mailto:18348146@students.latrobe.edu.au">18348146@students.latrobe.edu.au</a> Alternative Email: <a href="mailto:AIPCA@latrobe.edu.au">AIPCA@latrobe.edu.au</a> Fax: 9479 5977	<b>Departmental Contact (for communications in absentia)</b>  Samantha Nugent Administration Officer AIPCA/Nursing & Midwifery College of Science, Health and Engineering La Trobe University Level 1, room 105 Health Science 1 Victoria 3083 Telephone: +61 3 94793933 Email: <a href="mailto:s.nugent@latrobe.edu.au">s.nugent@latrobe.edu.au</a> Fax: 9479 5977
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<b>Co-author:</b>  Prof Yvonne Wells Lincoln Centre for Research on Ageing Australian Institute for Primary Care & Ageing School of Nursing & Midwifery La Trobe University Level 1 Health Sciences 1 Bundoora 3083 Victoria Australia Email: <a href="mailto:y.wells@latrobe.edu.au">y.wells@latrobe.edu.au</a> Alternative Email: <a href="mailto:AIPCA@latrobe.edu.au">AIPCA@latrobe.edu.au</a> Fax: 9479 5977	<b>Co-author:</b>  Dr Paul O'Halloran Senior Lecturer School of Psychology and Public Health La Trobe University Level 5 Health Sciences 2 Bundoora 3083 Victoria Australia Email: <a href="mailto:p.ohalloran@latrobe.edu.au">p.ohalloran@latrobe.edu.au</a> Fax: 9479 5607
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## **Abstract**

Cognitive interventions aim to positively impact cognition and ideally enable function in day-to-day life. A range of approaches have been developed for people with MCI and early-stage dementia, including cognitive training, cognitive strategy training, single component training and cognitive rehabilitation. Cognitive rehabilitation shows promise as the only approach that specifically tailors the intervention to the goals of individuals, whereas the other approaches typically utilize a standardized approach. A growing body of research suggests that individualized cognitive rehabilitation helps people reach their goals in day-to-day life and may even delay the onset of institutionalisation. However, there is less evidence to suggest that cognitive rehabilitation impacts on broader outcomes such as quality of life, mood and self-efficacy. Implications for future research and clinical practice are discussed including the need for more research into cognitive rehabilitation in MCI groups and direct comparisons with other approaches.

## **Key Words**

Mild Cognitive Impairment, Alzheimer's disease, dementia, cognitive interventions, cognitive training, cognitive strategy training, single component training, cognitive rehabilitation, mnemonics.

## **List of Abbreviations**

AD – Alzheimer's Dementia

CR – Cognitive Rehabilitation

MCI – Mild Cognitive Impairment

RCT – Randomized Controlled Trial

VD – Vascular Dementia

## **Background**

Although it might be possible to reduce the risk of cognitive decline through a healthy lifestyle, increased exercise and an active social life, there is no way to avoid cognitive decline or dementia altogether in later life (see table 1). In the absence of curative pharmaceutical options, it is essential that effective psychosocial interventions that support people to live well with cognitive impairment and assist in tackling the challenges that people face in day-to-day life are identified. Interventions delivered at an early stage in the dementia process, if effective, have the potential to increase the duration of independence, decrease symptoms of depression or behavioural difficulties, improve quality of life and, ultimately, delay institutionalisation. Economic modelling has demonstrated that even small improvements in function, or delays in decline, create substantial cost savings (Access Economics, 2004).

Insert Table 1 about here

MCI and dementia were once seen as conditions that were not amenable for rehabilitation because of their associated cognitive impairment and progressive course. Nevertheless, research has demonstrated that people with MCI and early-stage dementia do retain some of the necessary cognitive capabilities to learn new strategies, although extra support may be required (Fernández-Ballesteros, Zamarrón, Tárraga, Moya, & Iñiguez, 2003). Evidence also suggests that some people with MCI and early dementia experience excess disability, where functional disability is greater than

would be predicted by the degree of impairment. This can occur because a range of factors, such as an unsupportive environment or personal factors including stigma. Therefore it should be possible to assist an individual with MCI or early dementia to function optimally by teaching new strategies and finding ways to tackle excess disability via positive and supportive environments (Clare et al., 2018).

Given these factors, there has been growing interest in whether people with MCI and early dementia may benefit from cognitive intervention and rehabilitation techniques (Chandler, Parks, Marsiske, Rotblatt, & Smith, 2016)

### **Different Approaches to Cognitive Interventions**

All cognitive interventions aim to impact cognitive function positively and, ideally, to maximize everyday function. They can be contrasted with interventions that focus primarily on behavioural symptoms (e.g., wandering) or emotional states (e.g., depression).

A range of different cognitive approaches have been developed. Specifically, the focus of this chapter is mainly on individualized CR. This type of approach shows the most promise in relation to facilitating real everyday outcomes for people with MCI and dementia, whereas the evidence for the impact of cognitive training and standardized programs on everyday life is more equivocal. However, a brief description of the other three common techniques is provided below. The chapter then goes on to describe the CR approach in detail and to outline research on the topic to date. Finally, implications for future research and clinical practice will be discussed.

Cognitive rehabilitation (CR) is compared with cognitive training, cognitive strategy training and single component training in Table 2. Cognitive training relies largely on rehearsal. The other interventions use a variety of techniques including compensatory strategies (e.g., external aids) and internal strategies (see below). CR is unique in tailoring the intervention to individuals' goals.

Insert Table 2 about here

### **Common techniques utilized in cognitive interventions**

A range of common techniques utilized in cognitive interventions are outlined in table 3. Rehearsal-based approaches involve repeated exposure to a stimulus. External compensatory aids include the use of memory aids to support the individual to function better in a task. Such aids may include diaries, calendars or smart phones. Internal compensatory aids are cognitive "tools" used to assist with new learning and organisation of information and help to process the information at a deeper level (Hampstead, Gillis, & Stringer, 2014). These can include semantic organisation, semantic elaboration and mental imagery.

A range of environmental and psychosocial approaches can also be utilized to assist an individual to manage their cognitive problems. For instance, finding ways to self soothe and manage anxiety may assist an individual to stay more alert and better process what is happening.

During learning sessions, instructional strategies can be applied such as using an errorless-learning paradigm and/or strategies that require effortful processing (e.g., trial and error) (Clare & Jones, 2008). However, Clare & Jones (2018) in their review of the literature found that people with early-stage dementia appear to learn equally well regarding the method of learning that is applied.

Insert Table 3 about here

### **Cognitive Training**

Cognitive training (CT), also known as ‘brain training’ (Bahar-Fuchs, Martyr, Goh, Sabates, & Clare, 2018) aims to provide specific manualized and usually standardized training in a particular domain of cognition, such as speed of information processing, memory, attention or problem-solving. It is geared towards clients who have sufficient cognitive resources to engage in supported practice of tasks either with a therapist or computer. The aim is either to target cognitively impaired domains or to practice relatively intact cognitive skills to support more impaired cognitive skills. The technique is based on the concept of *neuroplasticity* – the idea that repeated practice in a domain may help to improve or at least maintain performance in that domain.

There is, however, controversy as to the benefits of cognitive training approaches (Owen et al., 2010). Although research has often demonstrated an improvement on cognitive testing in the domain in which the training occurred, this approach may not generalize to improved function in day-to-day life (Bahar-Fuchs et al., 2018).

The evidence for the benefits of cognitive training in dementia remain relatively poor. A Cochrane systematic review found no evidence for significant benefits in early stage dementia on any outcome (Bahar-Fuchs, Claire, & Woods, 2013) and a more recent systematic review also showed no improvements (Hill et al., 2016).

Findings have been more positive for MCI groups. For instance, both Chandler et al. (2016) and Hill et al. (2016) concluded that despite a lack of benefit in everyday activities cognitive training does improve mood.

### **Cognitive Strategy Training**

Group programs involving cognitive strategy training have been attempted, particularly for those with relatively mild cognitive difficulties. Typically, a range of more generic strategies are discussed and practiced in a group setting, rather than as a subset of strategies targeted to individual goals. Sessions are not conducted in the home environment but in an external location. Consequently, in a group program there is often limited time to explore and practice individual functional goals and to ensure they will impact everyday life. Nevertheless, group programs offer advantages, including opportunities to make friends and share experiences with other participants (Kinsella et al., 2016).

The extent to which cognitive strategy training results in improvements remains equivocal, with some research suggesting positive outcomes (e.g., Kinsella et al., 2009; Rojas et al., 2013), but other research reporting few or no effects (Kinsella et al., 2016; Troyer, Murphy, Anderson, Moscovitch, & Craik, 2008; Unverzagt et al., 2007). Further, the extent to which cognitive strategy training translates from performance on cognitive tests to everyday function remains unclear.

### **Single Component Training**

A small group of studies have utilized a single standardized technique or strategy taught to all participants (e.g., Finn & McDonald, 2015; Greenaway, Duncan, & Smith, 2013; Jean et al., 2010). The technique or strategy learned in a single component intervention may be relevant to the individual’s day-to-day life, depending on their particular difficulties. So far, all single-component

interventions have focussed on improving memory in groups of clients with amnesic MCI. For instance, Greenaway et al. (2013) trained participants in the use of a diary, Finn and McDonald (2015) utilized repetition lag training, and Jean et al. (2010) compared errorless learning and spaced retrieval with effortful learning. Such techniques differ from the tailored approach taken in CR, where a more diverse group of individuals with a range of cognitive difficulties are included and strategies are targeted to individual goals. To date, all these single component type studies demonstrate an improvement in the specific task participants have been trained to do. However, studies vary in the extent to which improvements generalize to day-to-day function, mood and self-efficacy.

## **Cognitive Rehabilitation**

Cognitive rehabilitation (CR) refers to a more individualized approach involving goal setting with clients and often a family member. It is based on a problem-solving approach (Clare, 2017; Wilson, 2002) and uses rehabilitation principles to address the impacts of cognitive impairment. The aim is to enable an individual to function at their best possible level, given the nature and extent of their cognitive impairments. It targets daily function and engagement in worthwhile and meaningful activities to sustain as much independence as possible. Cognitive rehabilitation utilizes a person-centred approach, in that each person's unique life experience, motivations, values, preferences, skills and needs are taken into account. It is also holistic, in that relationships and the environment are also considered.

CR involves firstly the setting of realistic personal goals. The process of goal-setting itself is a powerful behavioural strategy (Locke & Latham, 2002) and is widely used in rehabilitation interventions in a variety of populations, including brain injury (Rockwood, Joyce, & Stolee, 1997; Trombly, Radomski, Trexel, & Burnett-Smith, 2002) and stroke (Pan, Chung, & Hsin-Hwei, 2003). A therapist assists the individual to develop SMART goals (i.e., specific, measurable, achievable and realistic within a defined timescale). Examples of goals used in the MAXCOG intervention include developing a simpler system to manage paperwork or learning all the names of the people at the bowls club (Regan, Wells, Farrow, O'Halloran, & Workman, 2017).

After goals are collaboratively identified and realistic targets selected, the therapist selects from an array of strategies that can be taught to assist an individual to reach their goal (Clare, 2007). The choice of strategies depends on the therapist's assessment of barriers facing an individual undertaking a task. Barriers can include cognitive (e.g., not remembering what to do or struggling to concentrate), emotional (e.g., feeling anxious or fearful), environmental (e.g., being in a place which is not conducive to carrying out the activity), social (e.g., not having someone to undertake the task with), or behavioural (e.g., lacking some of the necessary skills) factors, or a combination of these. Understanding barriers provides a starting point for the problem-solving process to generate strategies that might be useful in overcoming such issues. For instance, if the problem is related to difficulty remembering, a memory aid such as an alarm might be useful. However, if the problem is emotional, the solution might be to find ways of regulating emotions. Once possible solutions are developed, a plan for goal attainment is devised.

## **How effective is Cognitive Rehabilitation in Dementia?**

Several randomized controlled trials (RCTs) have now been conducted using an individualized cognitive rehabilitation approach in clients with mild-to-moderate dementia (see Table 4).

Insert Table 4 about here

A pioneering randomized controlled trial was conducted by Clare et al. (2010) in the UK. This trial, with 69 participants with mild-to-moderate dementia (MMSE 18 or above), was a single-site, single-blind study that compared an eight-session cognitive rehabilitation intervention with relaxation therapy (with equivalent therapist time) and a no-treatment control. Intervention clients reported improved performance and higher satisfaction with goal achievement, while there was no change in either of the comparison groups. An innovative aspect of this study was their client-centred approach; the client's role in collaborative goal-setting was central, and perception of change was the primary outcome measure.

Since then, several randomized control trials of cognitive rehabilitation have been completed. The GREAT trial involved 426 participants with a diagnosis of dementia (Alzheimer's, vascular or mixed dementia) and was conducted in multiple centres in the United Kingdom by occupational therapists (Clare et al., 2018). Clare and colleagues compared CR with treatment as usual. Participants underwent baseline assessment and goal setting to identify areas of everyday function that could be improved or managed better prior to randomization. All participants had mild-to-moderate cognitive impairment (MMSE score 18 or more) and a family member to participate, and were stable on their medications (if prescribed). A similar approach to their initial pilot study was used, in that self-reported goal attainment was the primary outcome measure, and carers also provided independent ratings of goal attainment at both points. Secondary outcomes included participant quality of life, mood, self-efficacy and cognition, and carer stress, health status and quality of life. Statistically, significant large positive effects were reported for participant-rated goal attainment (at both 3 and 9 months) which were consistent with carers' ratings. However, no significant effects on any of the secondary outcomes were detected. Limitations associated with the study included the absence of any functional measure or any long term follow up to assess whether the intervention had an impact on rates of institutionalization.

The ETNA-3 trial is another large-scale trial (n= 653) of individualized cognitive rehabilitation recently conducted in France (Amieva & Dartigues, 2013; Amieva et al., 2016). This trial had four separate arms—individualized cognitive rehabilitation, group-based cognitive training, group-based reminiscence therapy and usual care—undertaken with individuals with mild-to-moderate Alzheimer's disease (MMSE 16-26). Each of the three therapy arms comprised weekly sessions (duration 1.5 hours) for three months followed by maintenance sessions held every six weeks for the following 21 months. The primary outcome was the rate of survival without progression to moderately-severe-to-severe dementia at two years. Secondary outcomes included cognitive impairment, functional disability, behavioural disturbance, quality of life, and carer burden and resource utilization. None of the therapies impacted on rate of dementia progression. However, individualized cognitive rehabilitation resulted in lower functional disability and a six-month delay in institutionalization at two years.

The ETNA-3 study employed experienced psychologists to carry out the intervention. The first two sessions were devoted to selecting meaningful activities with the person with dementia and their carer. Goals could be amended at any time. Unfortunately, other details of the methodology have not been published. The study did not appear to have used a structured interview schedule to facilitate identification of concerns and goals. Therefore, although the authors indicate that activities to be trained were consistent with personally-relevant goals it is not clear how this was achieved. Also, the 'training' approach was not clearly specified. While the psychologist was required to adapt the program depending on the cognitive difficulties of the participant and to use an "errorless learning procedure" when appropriate, it remains unclear whether the approach to CR in the ETNA-3 trial resembled the flexible and multifaceted problem-solving approach targeting everyday tasks

used in the GREAT study or if it was more similar to a “cognitive training” approach (i.e., with repeated rehearsal) teaching functional skills, as has been utilized by other researchers (see Thivierge, Jean, & Simard, 2014); Voigt-Radloff et al., 2017).

### **How effective is cognitive rehabilitation in MCI and mixed populations?**

To date, the bulk of studies including MCI participants have involved group programs or single component interventions. As far as we are aware there are currently no studies of individualized cognitive rehabilitation utilising only MCI clients.

One study has been conducted utilising a mixed sample of participants, most with MCI (n = 34) but including a small number with early-stage dementia (n = 6) (Regan et al., 2017). Regan and colleagues from Australia conducted the MAXCOG RCT (n = 40), which compared a relatively short four-session CR intervention with treatment as usual. This study was more translational than many of the other studies, as the intervention co-opted an existing early intervention team from the local Alzheimer Association. A manual was developed to encourage consistency between counsellors in implementing the approach. A set of information handouts provided easy access to range of ideas and strategies that could be utilized as part of a face-to-face intervention (Regan & Wells, 2018). The primary outcomes were goal performance and satisfaction. The main finding was that participants in the intervention group reported higher post-test levels of performance and satisfaction. This was the case for the first goal and partially the case for the second goal (where satisfaction but not performance increased for the intervention group). These improvements had moderate effect sizes. Findings suggest that the MAXCOG intervention was effective at assisting clients to reach at least one goal in comparison with the control group. Impacts of the intervention on secondary measures, including mood, quality of life and functional status, were largely non-significant. Further qualitative analysis was conducted on the intervention participants in this study using the method of Most Significant Change. This research, which analysed at narrative accounts provided by intervention participants, identified some broader outcomes such as participants’ improved acceptance of their cognitive difficulties (Regan & Wells, 2017).

### **Summary of Results**

A growing body of research suggests that individualized CR is successful at helping individuals with early-stage dementia achieve their goals in everyday life. Certainly, most studies involving individualized CR demonstrate improvements in goal attainment. The ETNA-3 study also provides evidence to suggest that individualized CR may also result in key real-world outcomes such as improved functional status and delayed institutionalisation. The evidence for the success of individualized CR for individuals with MCI is currently less robust, with only one small study involving a short four-session intervention showing promise to date.

Of note is that, except for the ETNA-3 trial and its impact on functional status, no studies have succeeded in demonstrating any impact on broader outcomes such as mood, quality of life or carer burden as measured by questionnaires. Reasons for this are unclear. One possibility is that the changes in individuals’ abilities to carry out specific activities that occur in response to CR, whilst very important in their own right, simply do not impact on broader appraisals of carer burden or quality of life. Alternatively, it is possible that functional change does result in changes to quality of life or carer burden, but the available measures are not sufficiently sensitive to detect these. Results from qualitative studies that do show evidence of broader impacts for individuals, such as improved

confidence and insight into their memory difficulties, support this conclusion (Clare et al., 2018; Regan & Wells, 2017).

### **Implications for future research**

The most obvious gap in research currently is the lack of individualized CR studies with MCI clients. Arguably, the earlier in the disease process that one intervenes, the more likely it is that an individual will retain sufficient cognitive capabilities to take on board new strategies and approaches to solving problems. Therefore, it may be that implementing individualized CR in clients with MCI, as opposed to those with dementia, will result in stronger, longer-lasting improvements in day-to-day function, which in turn may increase the duration of independence and potentially further delay institutionalisation. Further longitudinal research is needed to test this hypothesis.

As mentioned earlier, most research in this area has utilized group-based or standardized approaches to clients with MCI that may be less expensive to run than individualized programs, which are time-intensive. Whilst group programs may confer some advantages, such as the capacity to share strategy use, typically there is a lack of time in such programs to develop and practice individualized approaches to solving the unique goals of each individual. Such programs may also be too ambitious, in that attempting to teach a range of strategies to people with memory impairment in a group setting may be too taxing on the memory capabilities of such individuals. A one-on-one targeted approach that minimizes the amount of material to be learned may be more appropriate and effective.

Similarly, whilst there may be benefits to the standardized approaches used in single component studies with homogeneous groups such as those with amnesic MCI, such approaches may not effectively meet all the individual needs of participants, particularly those in more diverse groups. For instance, teaching diary use may be ineffective if the person is struggling more with their language than memory. Likewise, it may not be helpful to focus on a particular strategy or technique for learning if anxiety is the main factor that needs to be addressed. Research is needed to explore the questions of which approach is more effective at improving everyday outcomes for MCI clients and whether the value-add of offering a time-intensive individualized program justifies the cost.

Two large scale clinical trials of CR in dementia have now been conducted: the UK GREAT study and the French ETNA-3 study. These larger scale trials add to the body of evidence suggesting that individualized CR interventions, although time-consuming and costly, result in important positive outcomes for people with early-stage dementia, including goal attainment and delay of institutionalisation. Further research is needed, however, to replicate the ETNA-3 finding that individualized CR may delay institutionalisation. A challenge in undertaking this task is insufficient detail on the interventions utilized in the ETNA-3 trial. Researchers need to describe carefully the methods utilized to enable replication and avoid confusion. For instance, it is important to distinguish between a nuanced problem-solving approach in which a range of techniques (e.g., internal, external, rehearsal, environmental or social) can be utilized and a “cognitive training” type approach in which repeated rehearsal of a particular functional task is undertaken.

The literature in this area is plagued by the vague and imprecise use of terms. For instance, some authors have utilized the term ‘cognitive rehabilitation’ as an overarching term (e.g., Huckans et al., 2013). In their Cochrane review, Bahar Fuchs et al. (2013) emphasized the specific meaning of CR and its differences from cognitive training. In this chapter we have emphasized the need to



differentiate further between different intervention approaches, such as cognitive strategy training and single component training. Grouping disparate intervention approaches in meta-analyses makes it difficult to compare the impacts of different approaches.

### **Implications for clinical practice**

Research suggests that CR can be administered by a range of allied health professions. Amieva et al. (2016) utilized psychologists in the ETNA-3 study. In contrast, Clare's research group have exclusively utilized occupational therapists to implement CR (Clare et al., 2018), but are hoping to adapt their program so that it can be applied within the UK National Health System. They have undertaken some feasibility testing that suggests that improvements in goal attainment can be achieved, utilizing a more pragmatic approach involving fewer sessions and less-qualified staff under supervision. Certainly, Regan et al. (2017) were able to demonstrate improvements in goal attainment for their mixed sample of participants (including early-stage dementia and MCI) utilising counsellors from the local Alzheimer's Association, most of whom had completed only basic studies in psychology.

The necessary duration of a CR intervention is less clear and may vary depending on the issues for the individual involved. The GREAT study implemented a total of 10 sessions with a further four maintenance sessions over 6 months, and the ETNA-3 study comprised a total of 12 sessions with a further 21 maintenance sessions over 21 months. In contrast, Regan et al. (2017) were able to show some benefits with a total of four sessions, albeit with predominantly higher-functioning MCI clients. Indeed, as Clare et al. (2018) have pointed out, the exact duration of the program may vary depending on the individual's needs and stage of dementia progression.

One of the issues with the MAXCOG study (Regan et al., 2017) was that a subset of individuals who initially expressed interest in being part of the research program subsequently struggled to identify any areas of need in which they could formulate goals. Clare et al. (2018) have also acknowledged a subgroup of individuals who did not proceed to randomisation for this reason. Therefore, it may be that CR is not appropriate for some individuals, as it requires active engagement. Such individuals may decide later that they do wish to engage. Alternatively, particularly in the case of clients with limited insight, it may be possible to work more directly with the carers to try to manage any difficulties and work on goals.

### **Conclusion**

Individualized CR stands out as a type of cognitive intervention that shows promise in its capacity to assist people with MCI and early dementia to improve their day-to-day function and, potentially, to delay institutionalisation. Further research is needed, particularly to confirm its efficacy for people with MCI and to compare it with other approaches, such as cognitive strategy training and single component training.

## **Mini-Dictionary of Terms**

**Mild Cognitive Impairment (MCI):** a condition characterized by a cognitive concern, cognitive impairment on psychometric testing, largely intact activities of daily living (ADLs), and not meeting criteria for dementia (Albert et al., 2011).

**Cognitive rehabilitation:** utilizes a problem-solving approach individually tailored to each person's goals in day-to-day life.

**Cognitive training:** repeated practice of a cognitive activity, typically via computer (e.g., brain training).

**Cognitive strategy training:** teaching a range of strategies to combat cognitive problems, typically in a group context

**Single Component Training:** standardized teaching or training one particular technique (e.g., diary use) to facilitate cognitive function.

**Rehearsal-based Approaches:** techniques that rely on rehearsal to learn new information.

**Errorless Learning:** techniques that minimize the errors made when learning new information or activities.

**Effortful Learning:** techniques that maximize the effort involved in learning new information or activities.

### **Key Facts of Cognitive Interventions**

- Intervening at an early stage in the dementia process potentially increases the duration of independence, decreases symptoms of depression or behavioural difficulties, improves quality of life and delays institutionalisation.
- Small delays in decline in function for people with dementia create substantial cost savings.
- The four main types of cognitive interventions are cognitive training, cognitive strategy training, single component training, and cognitive rehabilitation.
- All cognitive interventions involve one or more techniques, including rehearsal, external aids, internal approaches, and environmental and psychosocial approaches.
- Cognitive rehabilitation refers to an individualised approach involving goal setting with clients and often a family member.

### **Summary Points**

- Research findings into the efficacy of cognitive training, cognitive strategy training and single component training are equivocal. In particular, the extent to which improvements on trained tasks generalize to day-to-day function is uncertain.
- At least five randomized controlled trials have investigated an individualized cognitive rehabilitation approach in early-stage dementia. The bulk of these demonstrate goal attainment with moderate-to-large effect sizes.
- Most studies have looked at the impact of cognitive rehabilitation for people with dementia; there is a gap in research for people with Mild Cognitive Impairment.
- Future research should focus on the efficacy of cognitive rehabilitation versus other approaches, such as cognitive strategy training.
- Further research is also needed to identify the optimal duration of cognitive rehabilitation for different groups.

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Table 2: Different approaches to cognitive interventions

Table 3: Techniques utilized in cognitive interventions

Table 4: RCT intervention studies in MCI and early dementia

## Legends to tables

Table 1: This table provides an overview of the features of dementia that may occur as the disease progresses. From Mayo Clinic (1998-2018)

Table 2: This table provides an overview and description of the four main approaches to cognitive interventions.

Table 3: This table provides an overview of different techniques used in cognitive interventions and has been adapted from the MAXCOG handouts: see Regan and Wells (2018)

Table 4: This table provides a summary of recent research studies with cognitive rehabilitation interventions, including details about sample size, duration, and outcomes. AD = Alzheimer's Dementia, MCI = Mild Cognitive Impairment, VD = Vascular Dementia, mixed D = Mixed Dementia

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Table 1: Features of Dementia

Domain	Issues
Cognitive	<p>Memory Loss</p> <p>Difficulty communicating or finding words</p> <p>Difficulty reasoning or problem solving</p> <p>Difficulty with planning and organizing</p> <p>Confusion and disorientation</p>
Psychological	<p>Personality changes</p> <p>Depression</p> <p>Anxiety</p> <p>Inappropriate behavior</p> <p>Paranoia, agitation, and hallucinations</p>
Functional	Difficulty handling complex tasks
Muscular	Difficulty with coordination and motor functions

This table provides an overview of the features of dementia that may occur as the disease progresses. From Mayo Clinic (1998-2018)



**Table 2: Different approaches to cognitive interventions**

	<b>Cognitive rehabilitation (CR)</b>	<b>Cognitive training</b>	<b>Cognitive strategy training</b>	<b>Single Component Training</b>
<b>Description</b>	Teaching a range of techniques tailored to individual goals in day-to-day life	Use of cognitive exercises to improve cognitive function	Teaching a range of techniques to improve function in day-to-day life	Utilising a single technique (e.g., diary use) to improve function
<b>Target</b>	Function and participation restriction	Impairment	Function	Function
<b>Format</b>	Individualized	Individual or group	Typically group	Individual or group
<b>Techniques taught/ utilized</b>	All types of cognitive techniques	Mainly rehearsal	All types of cognitive techniques	A single technique, typically either rehearsal or external or internal strategies
<b>Goals</b>	Performance and function in relation to collaboratively set goals	Improved or maintained ability in specific cognitive domains	To learn a new range of strategies that can be used in daily life	To learn to apply a single technique

This table provides an overview and description of the four main approaches to cognitive interventions.

**Table 3: Examples of techniques utilized in cognitive interventions**

<b>Rehearsal-based Approaches</b>	<b>External Aids</b>	<b>Internal Approaches (Mnemonics)</b>	<b>Environmental/ practical approaches</b>	<b>Psychosocial Approaches</b>
Repeated exposure	Diary/ Calendar/ Lists/ Notes	Semantic Organisation	Reduce distractions in environment	Anxiety management
Spaced retrieval/ Vanishing Cues	Smart Phones/ Alarms	Semantic elaboration	Plan activities at the best time of day	Ask people to repeat what they have said
Computer training programs/ games	Dosette Box	Mental Imagery	Establish regular weekly routine	Take someone along to help with recall

This table provides an overview of different techniques used in cognitive interventions and has been adapted from figure 2 in Hampstead, Gillis, & Stringer, 2014, and from the MAXCOG handouts see: Regan and Wells (2018)

**Table 4: RCT intervention studies in MCI and dementia**

Reference/ Location	Intervention Group	Control Group	Intervention	Sessions/ Duration	Follow Up	Outcomes	Effect Sizes
Amieva & Dartigues, 2013; Ameiva et al, 2016, France	AD (n =157)	AD reminiscence (n = 172) AD cognitive training (n = 170) AD no treatment (n = 154)	Individualized cognitive rehabilitation	Weekly 90-minute sessions for three months followed by 90 minute maintenance sessions for the next 21 months	3 months 6 months 12 months 18 months 24 months	Lower functional disability and Six month delay in institutionalisation	Not reported
Clare et al. (2010); UK	AD (n = 20)	AD relaxation (n = 23) AD no treatment (n = 22)	Individualized cognitive rehabilitation	Weekly 60-minute session for 8 weeks	Post intervention 6 months	Significant improvement in goal performance and satisfaction	Large effect sizes CR vs relaxation = 1.18 CR vs NT = 0.91
Clare et al. (2018); UK	AD, VD and mixed D (n = 208)	AD, VD and mixed D no treatment (n = 218)	Individualized cognitive rehabilitation	10 60-minute sessions over 3 months followed by 4 maintenance sessions over 6 months	3 months 9 months	Significant improvement in goal performance and satisfaction	Large effect sizes for three and nine months with 0.81 and 0.8 respectively.
Regan et al. (2017); Australia	AD and MCI (n = 25)	AD and MCI no treatment (n = 15)	Individualized cognitive rehabilitation	Weekly 60-minute sessions held over four weeks	At conclusion	Significant improvement in goal performance and satisfaction	Moderate effect sizes of 0.11 for the first performance goal

This table provides a summary of recent research studies with cognitive rehabilitation interventions, including details about sample size, duration, and outcomes. AD = Alzheimer's Dementia, MCI = Mild Cognitive Impairment, VD = Vascular Dementia, mixed D = Mixed Dementia