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ORIGINAL ARTICLE

Effectiveness of a Multifaceted Cognitive Training Programme for People with Mild Cognitive Impairment: A One-Group Pre- and Posttest Design

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cognitive training;
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Summary *Objectives:* The effectiveness of a cognitive training programme in enhancing the functional abilities of elderly persons with mild cognitive impairments was tested in an integrated home and institutional training programme focused on performing daily tasks.
Methods: Twenty elderly participants were taught cognitive stimulation and memory encoding strategies for 10 weeks by an occupational therapist, or by nonprofessionals and community caregivers. The programme consisted of attention and memory stimulation, association-based and imagery-based strategies. Functional assessment (Chinese version of the disability assessment for dementia instrument and the instrumental activities of daily living scale) and neuropsychological tests (digit span forward test, word list memory subtest of the neuropsychological test battery developed by the Consortium to Establish a Registry for Alzheimer's Disease, Cognistat) were administered before and after the programme.
Results: After the 10-week programme the participants showed significant improvements in average attention and memory. The participants showed improved memory (word list memory: $p \leq .001$) and other cognitive function as measured by the naming ($p \leq .001$), construction ($p \leq .001$), memory ($p \leq .001$) and similarities ($p \leq .001$) subtests of the Cognistat.
Conclusion: These results provide initial evidence supporting the use of daily tasks as the context in teaching cognitive stimulation and memory encoding strategies to mildly impaired elderly people.

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Introduction

With normal aging, elderly people may suffer from deterioration in cognitive function that affects their functional independence. Cognitive function deterioration is particularly evident in people with mild cognitive impairment (MCI). For healthy elderly individuals, cognitive stimulation training is a popular approach for maintaining their cognition (Belleville, 2008; Jean, Bergeron, Thivierge, & Simard, 2010). For people with MCI, training focused on memory and cognition aims to alleviate the functional deterioration due to cognitive decline (Belleville, 2008). Under the classic taxonomy of memory (Anderson, 2000), under long-term memory, are declarative and procedure memory. In declarative memory, semantic and episodic memory are included. People with MCI are often found to have declarative memory problems, especially with poor episodic memory (Matsuda & Saito, 2009).

A systematic review has reported on the effectiveness of cognitive interventions targeted at remediating memory processes (Jean et al., 2010). They include training to stimulate visual and auditory attention, memory, abstract thinking, and constructional ability. Some are designed to improve a single area of cognition and some for multiple aspects of cognition. A study conducted by Matsuda and Saito (2009) showed that cognitive stimulation training is effective in improving the visual and auditory attention and memory, as well as constructional ability and abstract thinking. A multifaceted cognitive training that includes cognitive stimulation training for attention and memory, memory strategies that build up on their abstract thinking and constructional ability might be an effective intervention for people with MCI whose cognitive problems are multiple. Both cognitive stimulation and memory strategies are reported to enhance the cognitive function of people with MCI (Jean et al., 2010). The training on their general visual and auditory attention and memory aims at providing stimulation to multiple cognitive domains. The use of memory strategies intends to tap on the possibly intact procedural and implicit memory system of people with MCI. Association-based strategy encourages elaborations of a subject within a conceptual domain by linking it with others in the similar domain (Jean et al., 2010). For example, a spoon is used for eating and it goes together with other eating utensils such as a fork and a plate during a meal. Imagery-based strategies based on the method of loci and mental imagery have been found to enhance memory performance within an elderly population (Jean, et al., 2010; Tardif & Simard, 2011). The method of loci requires the person to imagine the stimulus to be remembered and place it in a predetermined spatial context. Effective strategies encourage deeper analysis and elaborative encoding of the material to be recalled, and a level of processing which enhances retrieval (Allan, Robb, & Rugg, 2000).

Involvement of caregivers has been reported to optimise intervention programmes for the elderly (van Eijken, Melis, Wensing, Rikkert, & van Achterberg, 2008). As there is a general lack of proper education to the public on the care of elderly with memory problems (Chung & Lai, 2011; Mundt, Kaplan, & Greist, 2001), including the general public as volunteers running a rehabilitation programme might help to raise their awareness of the need of people with MCI. No previous scholarly work has attempted to develop an intervention programme that used participants' daily activities as media and involve occupational therapists, caregivers, and the general public as volunteers, multifaceted personnel in the programme. Besides personnel, the programme also includes multifaceted domains of training by combining cognitive stimulation training to remediate memory deficits with memory encoding strategies to deal with the memory deficits specific to people with MCI. The majority of previous cognitive intervention studies have been conducted in a clinical environment that limits the generalisation of any findings to daily life in society (Jean et al., 2010). Any useful intervention must be suitable for application in the community using the participants' usual daily activities as media and caregivers and the general public as volunteers.

This study was designed to be a pilot exploration of the effects of daily task-specific cognitive training integrating home and institutional protocols on functional and neuropsychological functions for elderly persons with MCI.

Methods

Research design

This study was based on a pre- and posttest design. Participants were recruited by convenience sampling method.

Participants

Twenty community dwelling elderly persons with MCI (mean $\pm$ SD age $=$ 80.10 $\pm$ 7.07; 60% female; years of education $=$ 2.23 $\pm$ 3.14) participated in the study. They were attendees of four institutions offering day care, enhanced home care, and community services. Their mini-mental state examination (MMSE) scores ranged from 21 to 26. Their education levels ranged from none to 4 years of primary school. They were selected through convenience sampling. The selection criteria included: (a) age $\geq$60; (b) diagnosed with MCI according to research diagnostic criteria (Petersen, 2004); (c) memory complaints corroborated by other participants or family members; (d) mild cognitive impairment indicated by a clinical dementia rating $\leq$0.5, (5) largely intact functional status; (e) no diagnosis of dementia; and (f) MMSE score $\leq$26. The study was approved by the ethics committee of The Hong Kong Polytechnic University. Before enrolment, each participant indicated willingness to participate by signing a consent form.

Procedure

Baseline assessments were administered prior to the intervention by a research assistant not involved in the intervention. Posttest assessments were done within 1 week after the intervention.

The intervention consisted of 10 professionally-led centre-based sessions over 10 weeks. Each session lasted

for 1 hour. In parallel, health care workers conducted 10 home cognitive training sessions under the guidance of the professional, which supplemented the professionally-led training. Volunteers were also recruited to reinforce the training at the participants' homes. They ran another 10 sessions. The two home training programmes provided by health care workers and volunteers each involved about 30 minutes for each session. Therefore, each week, the participants received one professionally-led centre-based training session and two home-based training sessions delivered by health care workers and volunteers. The total time of the training for each week was 2 hours and the total time for the whole programme was 20 hours. The patients' caregivers joined in the training and were encouraged to continue reinforcing the training during their daily encounters with the participants.

Prior to the intervention, the occupational therapists, social workers, health care assistants, volunteers, and caregivers involved attended training sessions and were given guide books, notes and instructions.

Intervention

The 10 professionally-led sessions were held in the day care centres once weekly and each session lasted about 1 hour. They were conducted by occupational therapists. The first five sessions emphasised cognitive stimulaton training participants' visual attention and memory, auditory attention and memory, and their application in daily activities (Belleville, 2008). They included activities of encoding a story told and recalling the details to stimulate their attention and memory. Prompts were given from time to time to assist the participants in the recall. The subsequent five sessions emphasised memory strategies—using imagery-based and association-based strategies in specific daily tasks. Visual imagery of the task steps reinforced by using the method of loci was emphasised (Kliegl, Smith, & Baltes, 1990). Participants were taught to visualise each step of a task in detail, imagining performing that step in a familiar setting such as at home (Liu et al., 2009). A floor plan was used to assist participants who had difficulty imagining a familiar environment. Each daily task was broken up into 5 or 6 steps through activity analysis and picture cards of each step were used to help them form a deeper understanding of what was required. They were taught how to use the method of loci and mental imagery to make use of location and/or object cues for encoding and recall. They were guided through a series of instructions, and mental elaboration was taught whenever applicable by expanding the process in their mind through speaking aloud. In the association-based strategy training, the participants were asked to encode the task steps based on their implicit meanings. They were asked to form stories or associations linking the steps using the honeycomb concept, which makes use of the chunking association method to elaborate and encode the steps and their sequence. Word cues and categorisation were used in association-based strategy training to aid participants in generating a conceptual network associated with the cues. The word cues that were used in the association-based intervention dealt with times, places, objects, and persons. The choice of word cues as a strategy stemmed from previous studies that had demonstrated improved memory performance for people with memory impairments (Rasmusson, Rebok, Bylsma, & Brandt, 1999). The participants were taught to remember the word cues, guided through the use of picture cards and effective ways to remember the word cues. Related events or meaningful associations with the word cues were generated by the participants themselves with guidance provided by the occupational therapist. The task steps were formed into a story according to the place, time, characters, problem and solution that need to be tackled, and the story was verbalised with the help of pictures of the task steps. In both the imagery-based and association-based strategy training, the pictures of the task steps were gradually withdrawn and participants had to recall the steps by verbalising them. Participants were eventually progressed to doing the actual task in the real environment to promote their understanding (and that of their caregivers) of how to apply the strategies in their daily activities.

The training covered 15 common daily tasks such as folding laundry and cooking with a progression of increasing difficulty developed in previous functional training studies (Liu et al., 2009; Appendix I). A small group training format was used, with six to eight participants in each group, as this has been shown to be more effective in enhancing memory (Belleville, 2008).

For the two-home based training sessions delivered by health care workers and volunteers that came after the professional-led session in each week, an exercise to revise what was covered in the professional-led session using the specific daily tasks covered in that particular week in the participants' home environemnt was practiced.

Outcome measures

Functional assessment relied on the Chinese version of the disability assessment for dementia (CDAD; Mok et al., 2005) and the instrumental activities of daily living scale (IADLS; Lawton & Brody, 1969). Three cognitive and neuropsychological tests were used: Wechsler's digit span test (Wechsler, 1987); the word list memory subtest from the neuropsychological test battery developed by the Consortium to Establish a Registry for Alzheimer's Disease (CERAD-NAB; Liu et al., 2011; Morris, Mohs, Rogers, Fillenbaum, & Heyman, 1988); and the Cognistat instrument (Chan, Lee, Fong, Lee, & Wong, 2002). Reliability and validity were measured by respective authors. All were administered to each participant before and after the intervention.

The CDAD is an informant-based assessment covering 19 basic ADL and 26 IADL items. It requires the caregiver to make a comparison between the participant's current status with that observed 2 weeks previously. The IADLS is an eight-item measure covering a spectrum of functional activities such as shopping and meal preparation. The digit span test mainly assesses attention by asking the subject to repeat a string of numbers either in exactly the same sequence or in reverse order. The word list memory subtest from the CERAD-NAB was used to assess memory. It involves accurate free recall of lists of 10 words. The Cognistat is a general tool for assessing the degree of cognitive

disability in terms of language use, construction ability, memory, calculations and reasoning.

Data analysis

Due to a small sample size, paired *t* test with Bonferroni correction ($p \leq .05/15$ for 15 variables) was used to assess the significance of any differences between pre- and post-intervention results in terms of functional performance, attention, and memory, and general cognitive functioning.

Results

In the paired *t* tests, the participants showed improved memory (Word List Memory: $p \leq .001$) and general cognitive function as measured by the naming ($p \leq .001$), construction ($p \leq .001$), memory ($p \leq .001$) and similarities ($p \leq .001$) subtests of the Cognistat (Table 1).

Discussion

The results showed that the participants had improved memory and cognitive function after the programme. Such improvement was attributed to the cognitive stimulation training as well as the training in specific memory strategies aimed at improving their visual and auditory attention and memory within the context of their daily activities.

Matsuda and Saito (2009) have previously shown that the effectiveness of cognitive stimulation training. Integrating cognitive stimulation together with imagery-based and association-based memory strategies, this programme helped the participants with MCI to remediate attention and memory that might result from possible episodic memory loss by making use of their intact implicit memory system (Allan et al., 2000). Previous studies have shown that older adults can improve their performance in word list memory tasks through the use of the method of loci. Together with distinct elaboration, the enhancement of visual images in the brain allows deeper processing (Kliegl et al., 1990). The strategy has also been shown to activate the bilateral and medial parietal cortex of the brain, areas generally spared in the early stages of cognitive decline (Nyberg et al., 2003). In the imagery-based strategy training, visual imagery through the method of loci has been shown to be able to enhance attention and sequential processing in performing functional tasks (Kliegl et al., 1990; Liu et al., 2009).

The participants were taught how to use the method of loci and mental imagery to make use of location and/or object cues for encoding and recall. Picture cards and a floor plan layout were used to help them visualise the steps involved in each task. In addition to imagery-based strategy training using the method of loci and imagery, word cues and categorisation were used in association-based strategy training to further aid participants in generating a conceptual network associated with the cues. Related events or meaningful associations with the word cues generated by the participants themselves take into account differential individualised methods of contextualising tasks. The elaboration used in mental imagery to deliberate on the actions required for each step of the daily task creates a deeper impression for encoding.

All these methods used in imagery-based and association-based memory strategies helped the participants to attend to the tasks, remember the steps, construct images of the tasks, and infer similarities among various steps. This may explain the improvement in the naming, construction, memory, similarities subtests of the Cognistat

Table 1 Results in Pre- and Postintervention.

Domain	Test	Score		*p* value
		Pre-intervention	Post-intervention	
Functional performance	CDAD	63.73 ± 21.65	72.61 ± 28.80	.11
	IADLS	4.72 ± 1.90	4.79 ± 2.72	.14
Attention and memory	DF	4.76 ± 1.83	5.11 ± 1.56	.04
	DB	1.84 ± 0.76	1.72 ± 0.94	.22
	WLM-CERAD	2.89 ± 2.764	3.89 ± 3.65	< .001*
General cognitive function	Cognistat			
	Orientation	9.70 ± 2.22	9.73 ± 2.16	.36
	Attention	7.22 ± 2.04	7.49 ± 1.47	.04
	Repetition	5.23 ± 3.33	5.49 ± 3.43	.34
	Comprehension	5.38 ± 1.06	5.46 ± 0.96	.32
	Naming	5.65 ± 2.21	6.84 ± 1.77	< .001*
	Construction	2.35 ± 2.23	3.72 ± 2.13	< .001*
	Memory	5.32 ± 3.33	7.06 ± 4.09	< .001
	Calculation	2.36 ± 1.10	2.49 ± 1.45	.42
	Similarities	3.44 ± 1.83	4.65 ± 1.65	< .001*
	Judgement	4.70 ± 0.97	4.73 ± 0.99	.15

CDAD = Chinese disability assessment for dementia; IADLS = instrumental activities of daily living scale; DF = digit span test – forward sequence; DB = digit span test – backward sequence; WLM-CERAD = word list memory subtest of the Consortium to Establish a Registry for Alzheimer's Disease neuropsychological battery.
* Significance at the $p \leq .05/15$ confidence level.

and the word list memory subtest of the CERAD that assess immediate recall, and delayed recall, respectively. After the programme, the participants showed a significant improvement in the memory measures.

However, the results did not show any statistically significant improvements in functional performance as measured by either the CDAD or the IADLS before and after the intervention. The participants in this study were community dwellers who lived at home with support from their family. The selection criteria ensured that they were largely intact in terms of their functional status. The IADLS scores before the intervention confirm that most of them were independent in simple tasks like housekeeping, using the telephone, shopping, taking transportation and self-medication. They might rely on their family members in some of the tasks such as food preparation and handling finances. Since they had quite independent functional performance before the intervention, the absence of significant changes after 10 weeks of the intervention is perhaps not surprising.

Previous studies have highlighted the lack of generalisability of memory strategies in daily task performance (Belleville, 2008). The difficulty of the mental manipulations of concepts in the imagery-based strategy training and in making associations when using the association-based strategies might inhibit the generalisation of these strategies to daily task performance. Daily tasks were used as the training context in this study in a deliberate attempt to facilitate generalisation of the strategies learned to daily tasks. Moreover, this was programme was run in both the centre and home environments. All the procedures aimed at facilitating generalisability of the learning to daily life (Jean et al., 2010), although the results could not prove such postulation. To further promote the application of the learning, health care assistants, volunteers, family and caregivers were all involved. Involvement of family caregivers might be a useful adjunct to assist in reinforcing learning of these elderly persons with MCI in general.

Although the integrated model applied here has its advantages, it also limited the study, as the coordination among various personnel required was intense. Intensive coaching was followed up by monitoring each training session offered by a health care assistant, a volunteer and a family member or a caregiver. The study also did not segregate the effects of the professional and nonprofessional intervention. Further study is needed to verify it.

The study was limited by the small sample size and the absence of a control group. The programme itself combined various strategies. The improvement in the outcome measure detected could be due to the practice effect. As there is no alternative form to use, it remains as a limitation. Further studies with larger sample size with proper randomisation and controls and separate programmes to provide further insight into the relative effectiveness of different strategies are suggested.

Conclusion

This study derived some preliminary conclusions about combining home- and centre- based training for elderly persons with MCI and using personnel with different levels of training to implement it. The findings appear to have a positive benefit for people with MCI by using a combination of cognitive stimulation and memory encoding strategies keyed to daily tasks in such interventions.

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Appendix I Fifteeen Common Daily Tasks Used in The Intervention.

1	Hanging clothes on hanger
2	Folding laundry
3	Bed making
4	Making tea
5	Washing dishes
6	Use of telephone
7	Visiting doctor
8	Taking medication
9	Sweeping floor
10	Meal preparation
11	Cleaning after meals
12	Cutting of fruit
13	Going to the park
14	Shopping
15	Going to canteen to buy food