Prospective memory problems in patients with neurological disorders: assessment and cognitive rehabilitation

Prof. David Man, PhD

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Definitions of Prospective Memory

Prospective memory (PM) refers to remembering to do things in future time points or respond when occurrence of a particular event

(Radford, Lah, Say, & Miller, 2011)

The cognitive ability of remembering to carry out planned intentions or actions at future points in time

(McDaniel & Einstein, 2007)

A process of:

formation, retention, delayed initiation and execution intentions

(Kliegel, Mackinlay, & Jäger, 2008)

A key component in multitasking situation

•Core in daily living (ADL, IADL)

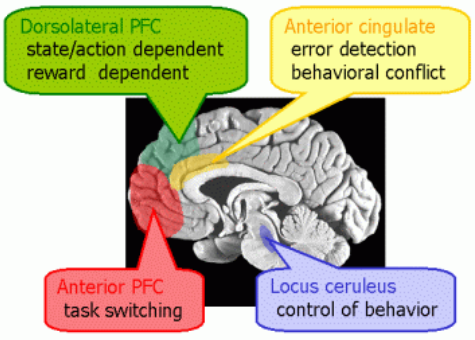
PM's impact on daily living

- Prospective memory has a major impact on individuals' ADL as well as quality of life.
- It leads to difficulty in making plan and performing the future task in everyday life such as remembering to meet the teacher at 2 p.m., remembering to buy grocery items in shop.

- More negative effects in social life, vocational activities and instrumental activities of daily living

(Fleming et al,2008)

Anterior prefrontal cortex



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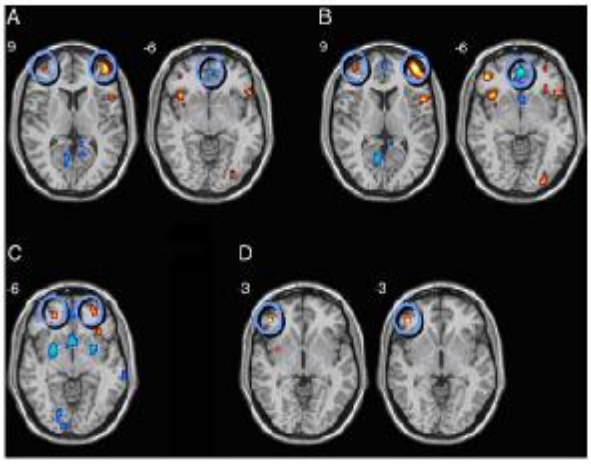


Significant activation in both the cue identification and intention retrieval PM conditions in anterior prefrontal cortex (BA10), with activation bilaterally in lateral BA10 and deactivation in medial BA10 (see Fig. A and B).
Medial BA10 appeared to be more active in the cue identification PM condition (see blue activation in Fig.C). (Simons et al., 2006)

Components of PM

I. Prospective Component

– Remembering at an appropriate moment that one must do something

(Kvavilashvili & Ellis, 1996)

II. Retrospective Component

– Recalling what is to be done

(Kvavilashvili & Ellis, 1996)

Key sub-types of PM

I. Event-based PM (e.g. buying a book when seeing a bookshop)

- Event-based tasks are those that must be carried out in association with a particular event (for example passing on a message when you see a particular colleague)

(Einstein and McDaniel, 1990)

- Involves an environmental cue to initiate an action

(Guynn, Einstein, & Breneiser, 2004)

II. Time-based PM (e.g. attend an appointment at 11am)

- Time-based tasks are those that must be carried out at a particular time or after a certain amount of time (Einstein and McDaniel, 1990)
- Requires a self-initiated strategy to monitor the environment to recognize the time to react

(Einstein & McDaniel, 2005)

III. Activity-based (e.g. take medication after meals)

PM deficit in neurological disorders

- Head injury
- Dementia
- Mild cognitive impairment
- Parkinson's disease

(Costa, Peppe, Caltagirone, & Carlesimo, 2008; Kliegel et al., 2011; Shum, Levin, & Chan,2011; van den Berg, Kant, & Postma, 2012)

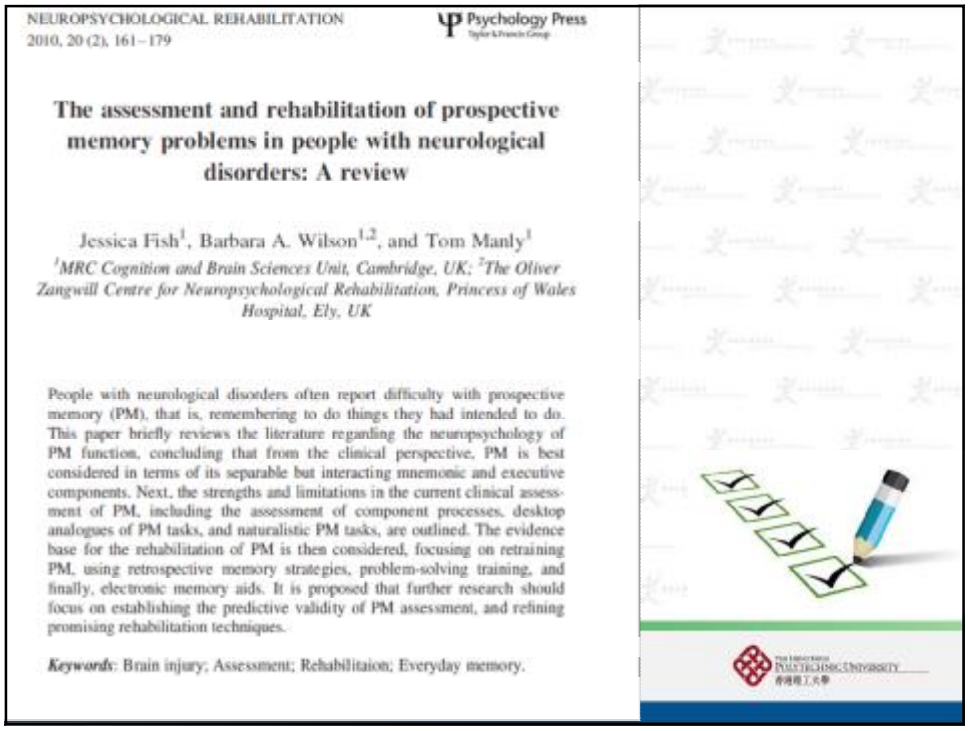
Relationships between stroke and PM

Some studies in the past 11 years

Year	Studies	Author
2003	Prospective Follow-Up Study Between 3 and 15 Months After Stroke: Improvements and Decline in Cognitive Function Among Dementia-Free Stroke Survivors >75 Years of Age.	Ballard, C., Rowan, E., Stephens, S., Kalaria, R., & Kenny, R.
2004	Assessing stroke patient's prospective memory using virtual reality	Brooks, B., Rose, F., Potter, J., Jayawardena, S., & Morling, A.
2009	Impairments in prospective and retrospective memory following stroke.	Kim, H., Craik, F., Luo, L., & Ween, J.
2010	Time-based prospective memory impairment in patients with thalamic stroke	Cheng, H., Tian, Y., Hu, P., Wang, J., & Wang, K.
2014	Functional correlates of prospective memory in stroke	Kant, N., van den Berg, E., van Zandvoort, M., Frijns, C., Kappelle, L., & Postma, A.

Prospective memory problems in dementia

- Prospective memory as an early indicator of dementia
  (Huppert & Baardsall, 1993)
- High prevalence of PM impairment in elderly and early-stage dementia
  (Huppert, Johnson & Nickson, 2001)
- Reduced PM function in age-related decline, MCI and dementia
  (Farina, Young, Tabet & Rusted, 2013; Thompson, Henry, Rendell, Withall & Broadaty, 2010; 2011)
- Affecting prospective memory and retrospective memory in MCI (Costa, Caltagirone, Carlesimo, 2011) AD and vascular dementia [and similar pattern of functional impairment]
  (Livner, Laukka, Karisson, Bäckman, 2009)



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The assessment and rehabilitation of prospective memory problems in people with neurological disorders: A review

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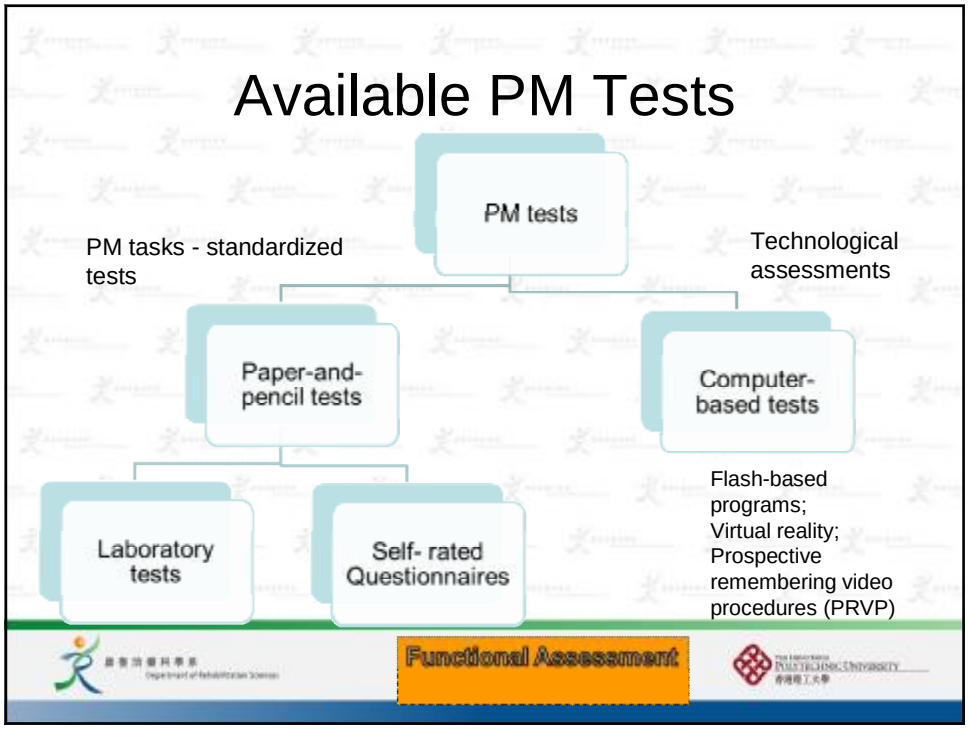
People with neurological disorders often report difficulty with prospective memory (PM), that is, remembering to do things they had intended to do. This paper briefly reviews the literature regarding the neuropsychology of PM function, concluding that from the clinical perspective, PM is best considered in terms of its separable but interacting mnemonic and executive components. Next, the strengths and limitations in the current clinical assessment of PM, including the assessment of component processes, desktop analogues of PM tasks, and naturalistic PM tasks, are outlined. The evidence base for the rehabilitation of PM is then considered, focusing on retraining PM, using retrospective memory strategies, problem-solving training, and finally, electronic memory aids. It is proposed that further research should focus on establishing the predictive validity of PM assessment, and refining promising rehabilitation techniques.

Keywords: Brain injury; Assessment; Rehabilitaion; Everyday memory.



Paper-and-pencil Tests

Three common PM assessment -Laboratory Tests (Shum, Fleming, & Neulinger, 2000)

1.The Rivermead Behavioral Memory Test (RBMT)
(RBMT; Wilson, Cockburn, & Baddeley, 1985; Wilson, Cockburn, & Baddeley, 2003)

2.The Cambridge Behavioural Prospective Memory Test (Groot et al., 2002) with its revised version, the CAMPROMPT (Wilson et al., 2005), The Cambridge Prospective Memory Test (CAMPROMT)
(Wilson et al., 2005)

3.The Memory for Intentions Screening test (MIST)
(Raskin, 2009)

RBMT

- Although it contains three within-session event-based PM tasks, there is not enough evidence to support its reliability and validity of the PM items separately (Shum et al., 2002).
- The validity is also further limited by its lack of time-based tasks and long-term tasks which extend beyond assessment session (Mathias & Mansfield, 2005; Shum, Ungvari, Tang, & Leung, 2004).

MIST (Raskin, 2004)

- Comprises four time-based and four event-based tasks intermixed with on-going tasks plus a long-term task (asking a tested person to phone back in 24 hours).
- Internal consistency and test-retest reliability for the scores are reportedly good and it was also found to be sensitive to PM deficits

(Raskin, 2009).

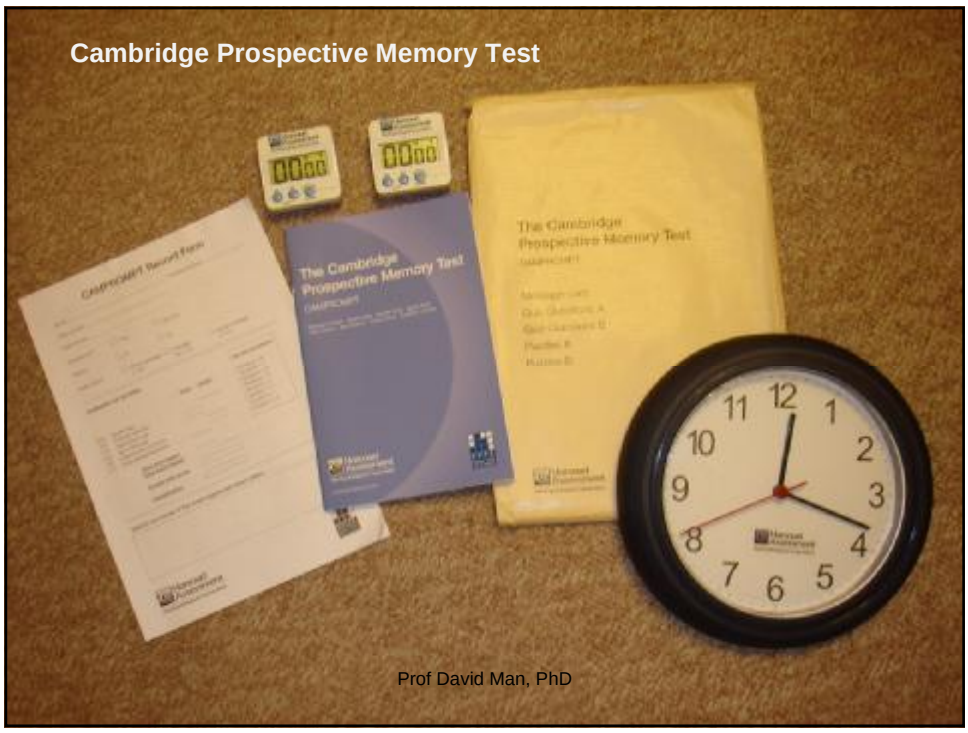
- No alternative version is developed to minimize the practice effects after repeated assessments.
- It takes around 30 – 40 minutes to administer, which is again too long and difficult to incorporate into a standard neuropsychological assessment

(Radford et al., 2011).

CAMPROMPT

- In the CAMPROMPT, there are three time-based and three event-based PM tasks which take over 30 minutes to complete.
- Good reliability and validity has been reported by the authors.
- No correlation was found between the short term PM performance in the test and the long-term PM tasks in daily life.

(Fish, Evans, Nimmo, Martin, Kersel, Bateman, Wilson, & Manly, 2007)


Cambridge Prospective Memory Test
The Cambridge Prospective Memory Test
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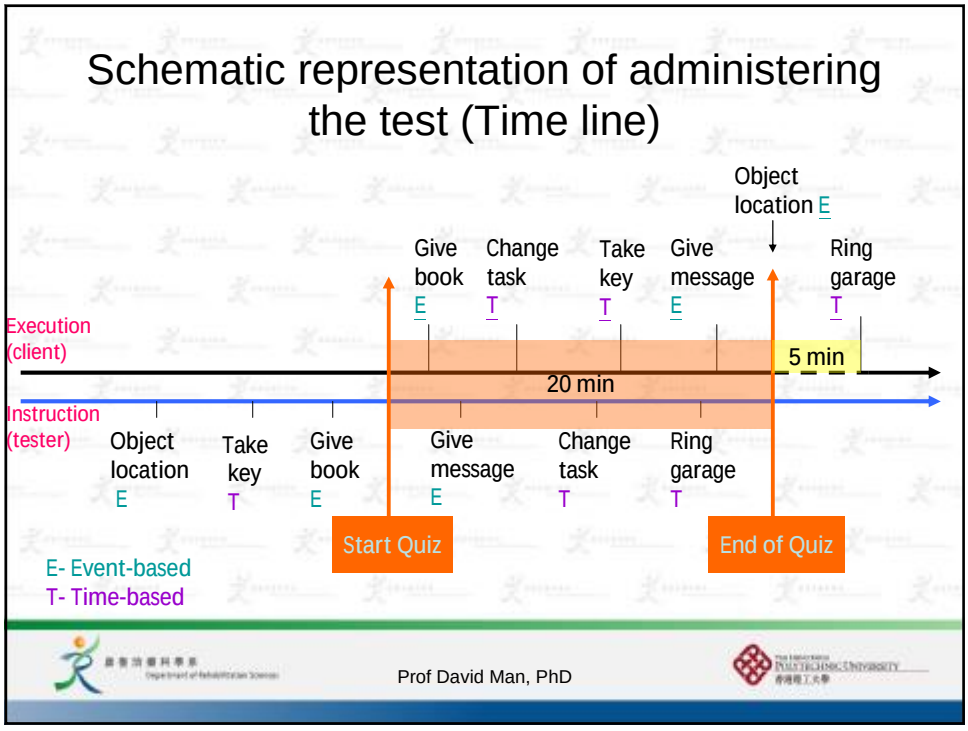
Schematic representation of administering the test (Time line)
Object location E
Give book E
Change task T
Take key T
Give message E
Ring garage T
Execution (client)
5 min
20 min
Instruction (tester)
Object location E
Take key T
Give book E
Give message E
Change task T
Ring garage T
Start Quiz
End of Quiz
E- Event-based
T- Time-based
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Scoring

- 8 scoring criteria
- Total score: 36 (event-based + time based)

Scoring criteria	Score
Client spontaneously carries out some tasks	
Correct task	**Score A= 6**
Wrong task à Prompt à Correct task	**Score B= 4**
Wrong task à Prompt à Wrong task	**Score C= 2**
No response	
Prompt à Correct task	**Score D= 4**
Prompt à Wrong task à Prompt à Correct task	**Score E= 2**
Prompt à Wrong task à Prompt à Wrong task	**Score F= 1**
No response	
Prompt à 'No' à Prompt à Correct task	**Score G= 1**
Prompt à ' No' à Prompt à 'No'/ Wrong task	**Score H= 0**

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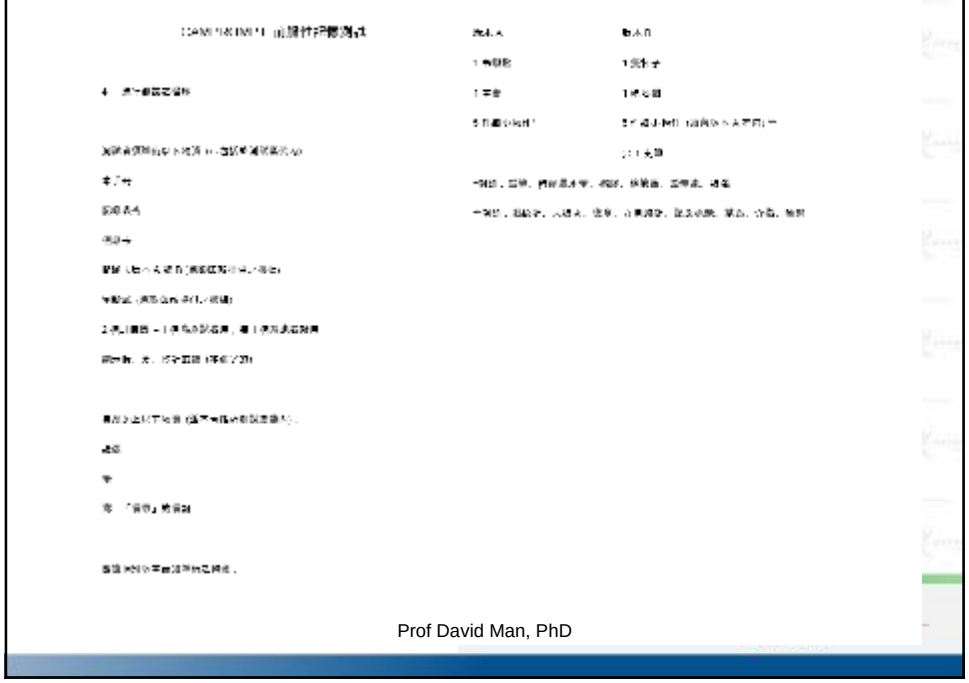

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Paper-and-pencil Tests

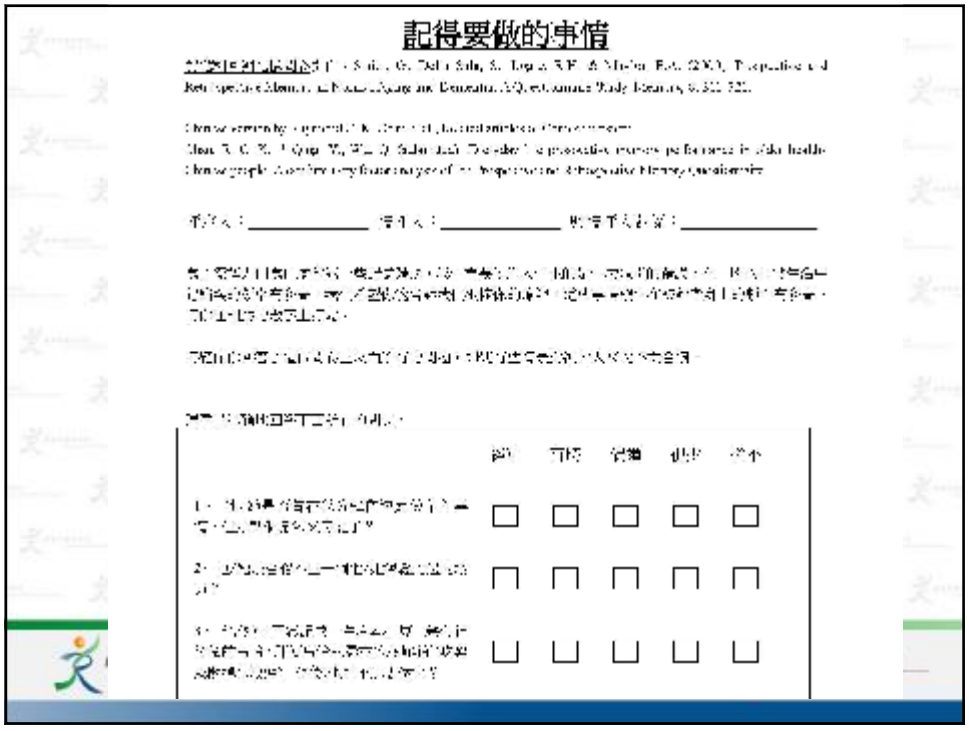
Self-rated/self-report type of questionnaires

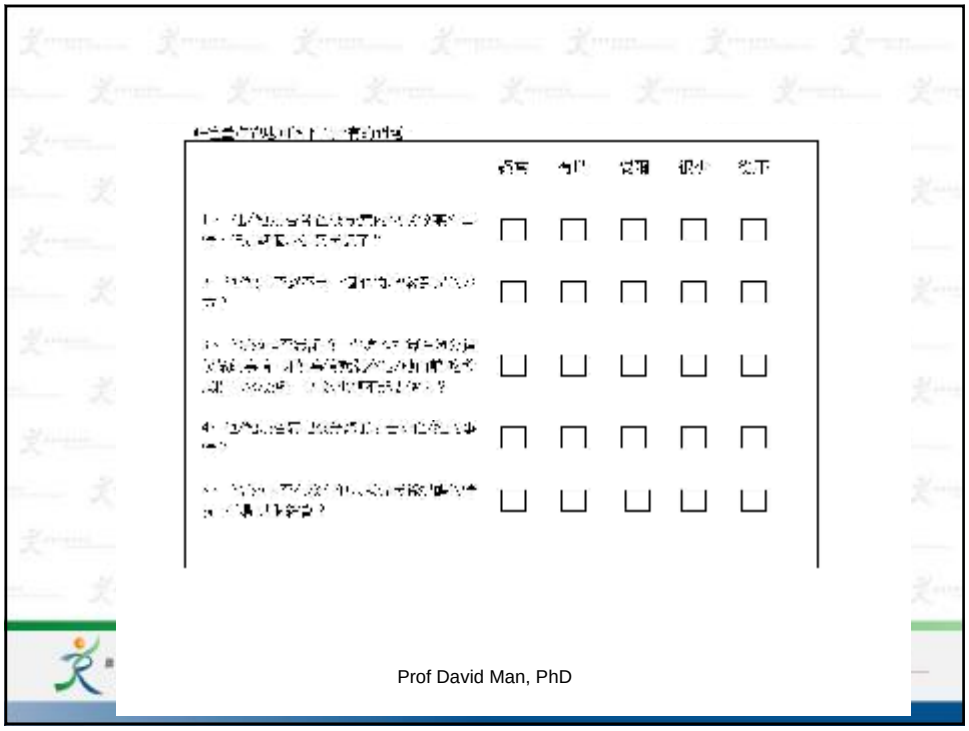
1.The Prospective Memory Questionnaire (PMQ; Hannon, Adams, Harrington, Fries-Dias, & Gibson, 1995)

2.The Prospective and Retrospective Memory Questionnaire (PRMQ; Smith, Della Sala, Logie, & Maylor, 2000)

3.The Comprehensive Assessment of Prospective Memory (CAPM; Waugh, 1999; CAPM-SF, Man et al, 2012; Cantonese Version –ongoing study)

4.The Royal Prince Alfred Prospective Memory Test (Radford, Lah, Say & Miller, 2010)





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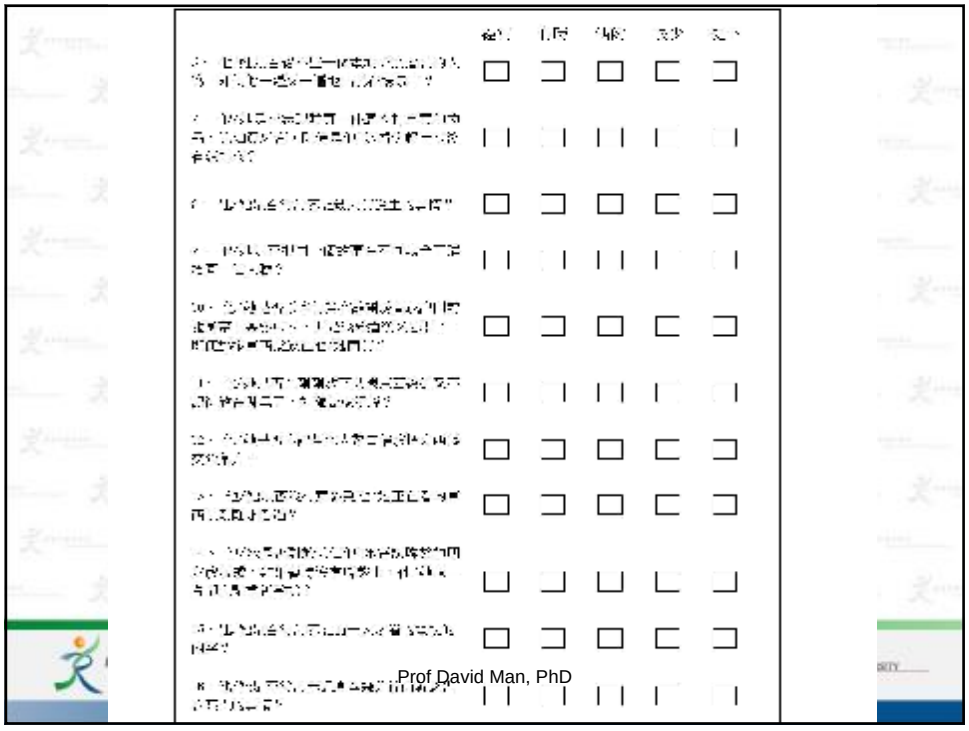

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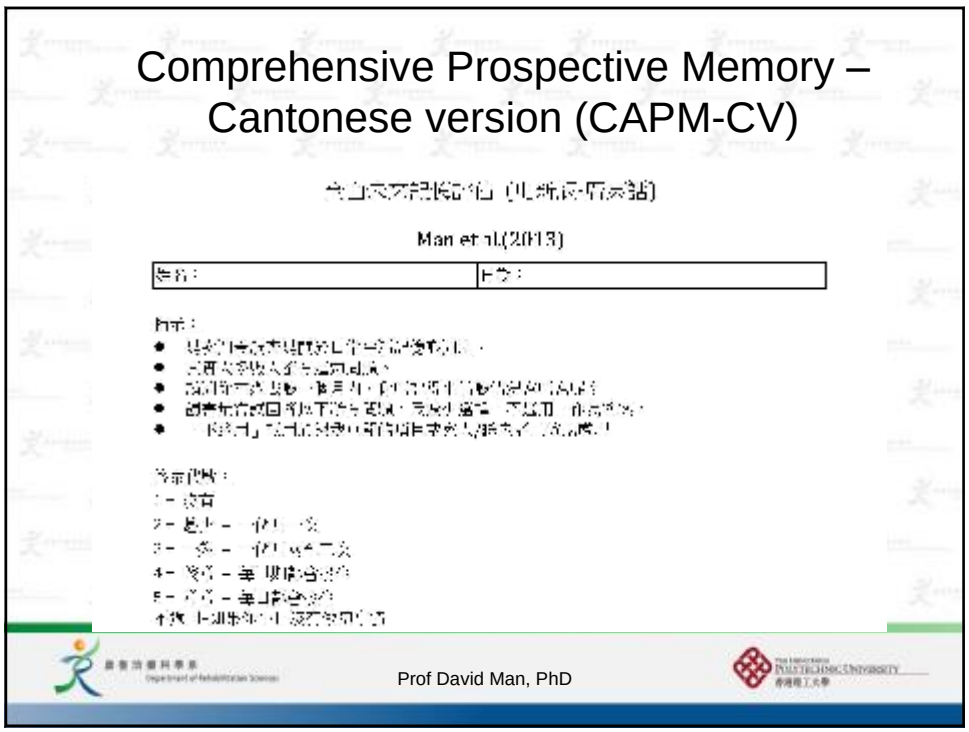
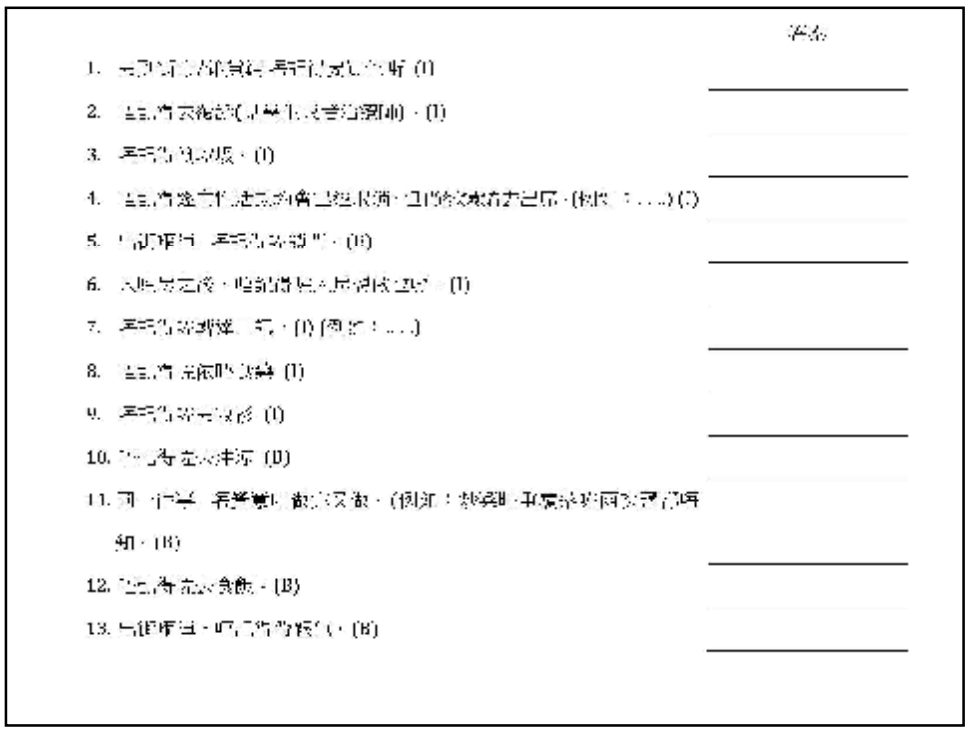
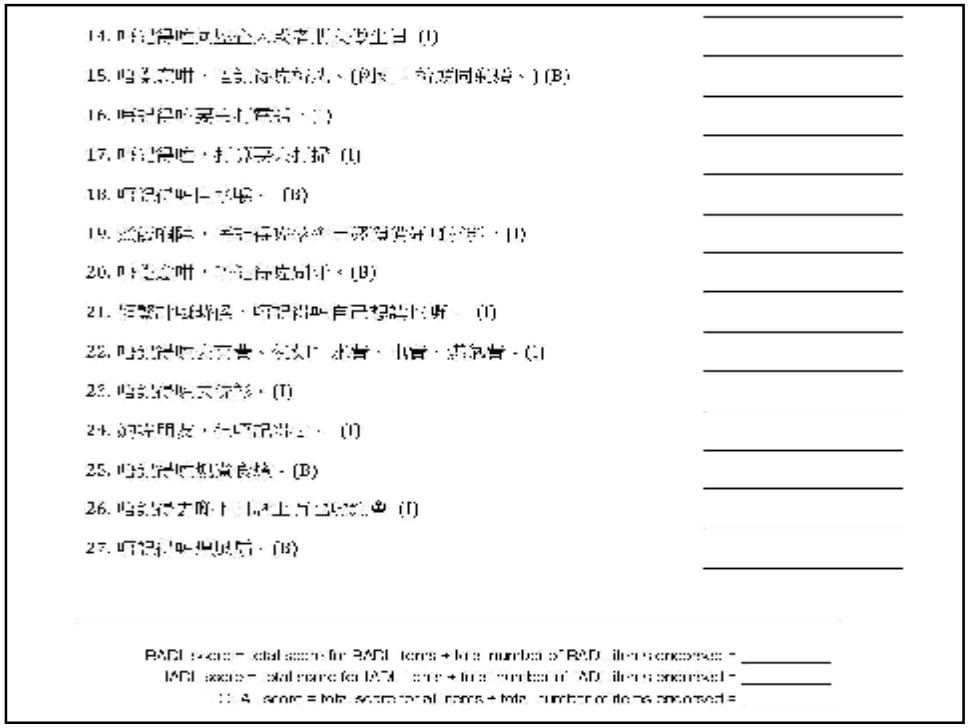
Comprehensive Prospective Memory – Cantonese version (CAPM-CV)







The Royal Prince Alfred Prospective Memory Test

(RPA-ProMem ;Radford, Lah, Say & Miller, 2010)

- Featuring both time-based (x2) and event-based tasks (X2)
- Measured over short- (within-session) or long-term retention (a week following the test session) intervals
- Three alternative forms of the test
- The ‘‘everyday’’ functional relevance (face validity) of test items is a key concern.
- Designed to be brief and easily administered

Royal Prince Alfred Prospective Memory Test (RPA-ProMem): Test items and scoring criteria

RPA-ProMem TEST ITEMS		SCORING FOR ALL TEST FORMS	
Form	*Part 1* (Short-term, Time-based)	*Part 1* (Short-term, Time-based)	
1	In 15 minutes time I would like you to tell me it's time for a coffee break	Correct response, up to 2 minutes delay (or ahead of time)	3
		Correct response, 2–5 minutes delay (or ahead of time)	2
2	In 15 minutes time I would like you to stop what we are doing and tell me the last thing you had to eat	Incorrect response, 2–5 minutes delay (or ahead of time)	2
		Correct response, >5 minutes delay (or ahead of time)	1
3	In 15 minutes time I would like you to remind me to move my car so I don't get a ticket	Incorrect response, up to 2 minutes delay (or ahead of time)	0
		No response volunteered at any stage during session	0
	Part 2 (Short-term, Event-based)	*Part 2* (Short-term, Event-based)	
1	At the end of our session today, I would like you to ask me for an information sheet on note-taking strategies	Spontaneous* and correct response	3
		Spontaneous* but incorrect response	2
2	When this alarm goes, I would like you to ask me to get (*a personal object*) back from me (*Set alarm half an hour*)	Correct response, 120–300 seconds delay	2
		Correct response, >300 seconds delay	1
3	When my mobile phone rings, tell me you would like a drink (*Set to ring in half an hour*)	Response neither correct nor at correct time	0
		**response immediately following target cue*	
	Part 3 (Long-term, Event-based)	*Part 3* (Long-term, Event-based)	
1	When you arrive home today, I want you to phone and leave a message on my voice mail, telling me what the weather is like	Calls at correct time*, leaves correct message	3
		Calls at correct time, leaves incorrect message	2
2	When you arrive home today, I want you to phone and leave a message on my voice mail, telling me your mother's name	Calls at incorrect time, leaves correct message	2
		Calls at incorrect time, leaves incorrect message	1
3	When you arrive home today, I want you to phone and leave a message on my voice mail, telling me what time it is.	Does not call (*up to 2 days*)	0
		**allow 2 hour margin of error from expected time*	

RPA-ProMem TEST ITEMS		SCORING FOR ALL TEST FORMS	
	Part 4 (Long-term, Time-based)	*Part 4* (Long-term, Time-based)	
1	Return this postcard on (*date to be posted, 1 week from now*) with your name and the word HAWAII written on the postcard	Postcard sent, correct day, correct information (*score date postcard sent, not date received*)	3
		Postcard sent, incorrect day, correct information	2
2	Return this postcard on (*date to be posted, 1 week from now*) with your name and a description of the weather written on the postcard	Postcard sent, correct day, incorrect information	2
		Postcard sent, incorrect day, incorrect information	1
3	Return this postcard to me on (*date to be posted, 1 week from now*) with your name and a description of what you are having for dinner that night written on the postcard	No postcard sent (*up to 2 weeks*)	0

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Routledge

Validation of the Cambridge Prospective Memory Test (Hong Kong Chinese version) for people with stroke

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This study aimed to develop and evaluate a Hong Kong Chinese version of the Cambridge Prospective Memory Test (CAMPROMPT-HKCV). Thirty-three subjects at least one year post-stroke participated in the study. They were simultaneously rated on version A of the CAMPROMPT-HKCV by two testers to establish its internal consistency and inter-rater reliability. Raters used the parallel versions of the test (A and B), in rating 10 patients within 2 weeks to establish the parallel form reliability. Another 10 were also assessed on the same day using both version A of the CAMPROMPT-HKCV and the Rivermead Behavioural Memory Test–Chinese version (RBMT-CV) to establish concurrent validity. A new group of 40 stroke patients and 44 healthy controls was recruited to establish its sensitivity and specificity. Results indicated that test–retest reliability on time-based, event-based and total scores, and inter-rater reliability for versions A and B of the test were high. Cronbach's alpha of the event-based score was higher than that of the time-based score. The reliability and concurrent validity of the parallel forms were established. There was a significant difference in performance on CAMPROMPT-HKCV (version A) between the stroke group and the healthy control group. ROC

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Rehabilitation of PM

- Retraining approaches
  - repeated practice of simple PM tasks
  - limited generalization
  - increasing self awareness, promoting compensatory strategy use
- Supporting the retrospective components of PM task
  - Errorless learning combined with other memory techniques such as SR, or vanishing cues

- Supporting the executive component of PM tasks
  - Overlapping with executive functions
  - Goal management training (GMT) and using structured group exercise
    - Think about own experiences
    - Discover strategies (stop and think, break down goals into sub-goals, generating to-do list etc.)
    - Use of homework exercise, recording daily success/errors to promote generaliztion

- Supporting mnemonic and executive aspects of PM tasks
  - Memory aids
  - Electronic organizers (Google calendar)
  - Smart phone

Brain Injury, December 2009; 23(13–14): 1017–1026

informa

Virtual reality (VR)-based community living skills training for people with acquired brain injury: A pilot study

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Abstract

Primary objective: The purpose of the present study was to test the usability and effectiveness of a newly-developed virtual reality (VR)-based community living skills training program for people with acquired brain injury (ABI).

Method: A small-sample, pre- and post-quasi-experimental design was adopted to initially study the efficacy of the VR-based training program. Its usability was also investigated through interviewing subjects. Outcomes were documented in terms of subjects' skills acquisition, self-efficacy in applying the learnt skills and the transfer ratio of the learnt skills to the real environment. Global cognitive ability and the functional independence level were also assessed.

Results: Four subjects with ABI (one traumatic brain injury and three stroke subjects) were successfully recruited and received 10 sessions of VR-based community living skills training. All four subjects showed improvement in skills acquisition and memory performance, while three out of four also showed improvement in self-efficacy and demonstrated transfer of skills to the real environment. Usability was initially supported.

Conclusion: Preliminary results suggested positive changes in ABI subjects. The proposed virtual reality (VR) community living skills training software will be further investigated in a randomized controlled trial.

Keywords: *Brain injury, rehabilitation, cognition, virtual reality, community-living*

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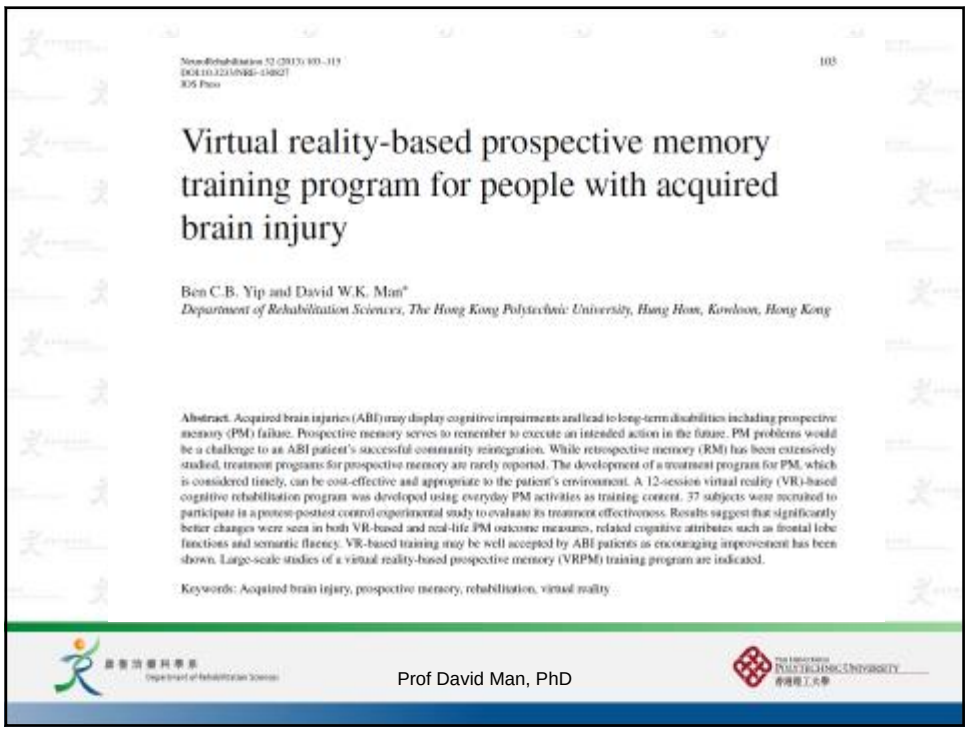

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Virtual reality-based prospective memory training program for people with acquired brain injury

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Abstract. Acquired brain injuries (ABI) may display cognitive impairments and lead to long-term disabilities including prospective memory (PM) failure. Prospective memory serves to remember to execute an intended action in the future. PM problems would be a challenge to an ABI patient's successful community reintegration. While retrospective memory (RM) has been extensively studied, treatment programs for prospective memory are rarely reported. The development of a treatment program for PM, which is considered timely, can be cost-effective and appropriate to the patient's environment. A 12-session virtual reality (VR)-based cognitive rehabilitation program was developed using everyday PM activities as training content. 37 subjects were recruited to participate in a pretest-posttest control experimental study to evaluate its treatment effectiveness. Results suggest that significantly better changes were seen in both VR-based and real-life PM outcome measures, related cognitive attributes such as frontal lobe functions and semantic fluency. VR-based training may be well accepted by ABI patients as encouraging improvement has been shown. Large-scale studies of a virtual reality-based prospective memory (VRPM) training program are indicated.

Keywords: Acquired brain injury, prospective memory, rehabilitation, virtual reality

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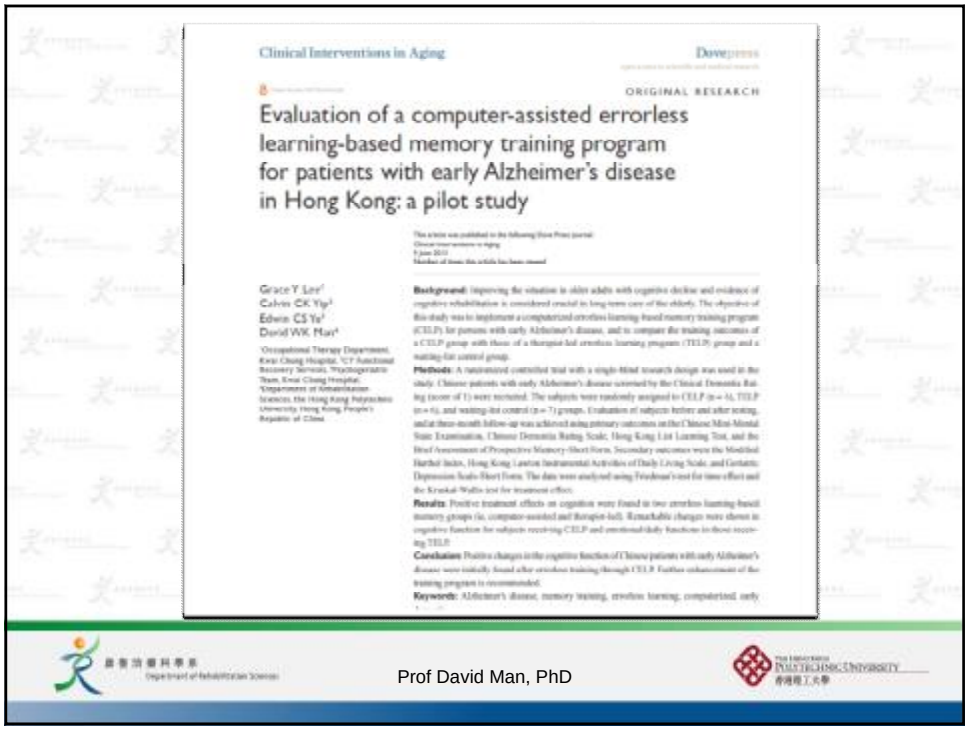
Clinical Interventions in Aging
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ORIGINAL RESEARCH
Evaluation of a computer-assisted errorless learning-based memory training program for patients with early Alzheimer's disease in Hong Kong: a pilot study
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Thank you!
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