The Prospective Memory Concerns Questionnaire: An Investigation of Self-Reported Prospective Memory and Its Relation to Clinical Disorders, Ageing, Naturalistic Prospective Memory, Personality, and Social Desirability

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CERTIFICATE OF AUTHORSHIP

I hereby declare that this submission is my own work and to the best of my knowledge and belief, understand that it contains no material previously published or written by another person, nor material which to a substantial extent has been accepted for the award of any other degree or diploma at Charles Sturt University or any other educational institution, except where due acknowledgement is made in the thesis. Any contribution made to the research by colleagues with whom I have worked at Charles Sturt University or elsewhere during my candidature is fully acknowledged. I agree that this thesis be accessible for the purpose of study and research in accordance with normal conditions established by the Executive Director, Division of Library Services or nominee, for the care, loan and reproduction of theses.

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ABSTRACT

Prospective Memory (PM) involves remembering to carry out an action at a future point in time (McDaniel & Einstein, 2007). Lapses of PM are frequently reported and can have serious negative consequences. This research aimed to develop a brief, self-report measure of PM concerns. This research aimed to investigate self-reported PM and its relation to normal ageing, brain injury, mild cognitive impairment, and dementia. The relationship between self-reported PM and naturalistic PM tasks, and the influences of personality and social desirability traits on self-reported PM were also assessed. A novel approach of combining classical test theory and Rasch methodologies was used for scale development and validation in the three research studies. Therefore, an additional aim was to assess whether this approach resulted in a scale that was similar in structure and content to existing PM scales. In Study 1, 135 scale items were developed. These items were reviewed by individuals who had experience with people with PM impairments, in terms of their relevance and readability. Item analyses in Study 2 assessed the structure, reliability, and validity of the scale; items with poor psychometric properties were subsequently eliminated. In Study 3, participants completed the final version of the questionnaire, the Prospective and Retrospective Memory Questionnaire, the SDS-17, the Australian Personality Inventory, the Addenbrookes Cognitive Exam-Revised as well as event-based, time-based, and 24-hour naturalistic PM tasks. This research resulted in the development of the Prospective Memory Concerns Questionnaire (PMCQ), which contains 42 items and subscales measuring Forgetting Behaviours, Memory Concerns, and Retrieval Cues. The PMCQ has good reliability and validity; normative data for healthy adults aged 18-89 years as well as brain injury and mild cognitive impairment/dementia reference groups were provided. The PMCQ differed from existing PM scales in structure and content. The PMCQ measures a variety of PM dimensions and is intended for use in research and clinical settings in conjunction with other
psychological tests. Clinical individuals (with brain injury, mild cognitive impairment, and dementia) had higher scores (i.e. concerns) than healthy adults on the PMCQ, Forgetting Behaviours, and Memory Concerns scales. They also performed worse than healthy adults on the naturalistic tasks. Age differences were detected with older adults performing better on the naturalistic tasks and reporting fewer concerns than younger adults on the PMCQ and Retrieval Cues scales. These age differences may be attributed to age differences in experience with memory tasks, environmental demands, perceived task importance, or memory strategies used. The PMCQ and naturalistic tasks were unrelated, which raises the question of whether these tasks measure different aspects of PM. Naturalistic PM was not related to personality or social desirability, although PMCQ scores were associated with neuroticism, conscientiousness, extraversion, agreeableness, and social desirability. The relationship between the PMCQ and personality may explain the lack of correlation between self-report and naturalistic PM measures. While some variance in self-report PM measures can be attributed to personality variables, the PMCQ was a unique measure of PM concerns as scores predicted memory concerns after controlling for personality and social desirability.
CHAPTER 1

Introduction to Prospective Memory

Prospective memory (PM) or the “realisation of delayed intentions” (Ellis, 1996, p. 1) can be defined as “remembering to carry out intentions at an appropriate point in the future” (McDaniel & Einstein, 2007, p. 1). Prospective memory is involved in a large proportion of daily activities and is essential for successful functioning at home (e.g. remembering to do chores, pay bills, prepare meals, and in coordinating family routines), at work (e.g. remembering to attend meetings or to send emails), in social settings (e.g. remembering birthdays and meeting friends on time), and in medical settings (e.g. remembering appointments and taking medication as prescribed).

Lapses of PM are frequently reported (Dobbs & Rule, 1987), more so than lapses in retrospective memory (RM) where previously learned information is forgotten (Mateer, Sohlberg, & Crinean, 1987). In addition to being reported more frequently, PM errors are rated as more frustrating than errors in RM (G. Smith, Della Sala, Logie, & Maylor, 2000). A possible reason for these findings is that RM failures have very few negative consequences. For example, forgetting someone’s name is embarrassing but it is not dangerous or life-threatening. Failures of PM on the other hand carry greater personal significance and although these failures are often minor and annoying (e.g. forgetting to buy milk), they do have the potential to cause significant harm. Demonstrating this point, Dismukes (2012) observed that many aviation disasters and medical mistakes (such as surgical instruments being left inside patients) have possibly resulted from PM lapses. In many of these cases, errors were not the result of negligence or carelessness, but instead interruptions, changes in routine, or multitasking that placed excessive demands on a limited-capacity cognitive system (McDaniel & Einstein, 2007).
In social settings, PM plays an integral role in maintaining social relationships. For example, social behaviours such as remembering to meet with a friend or remembering an important birthday or anniversary depend on successful PM (Schnitzspahn, Horn, Bayen, & Kliegel, 2012). Failures of PM may therefore lead to conflict in social relationships (e.g. if an individual forgets a loved one’s birthday the loved one may feel that they are not valued). PM failures may also lead to embarrassment or negative judgements about one’s character (McDaniel & Einstein, 2007). According to Graf (2012), if an individual makes an RM error it is attributed to cognitive decline. However, if an individual makes a PM error, they are considered to be unreliable and the failure is attributed to a character flaw. This in turn may affect the quality of social relationships.

The ability to function independently may also be threatened by PM failures (Foster, McDaniel, Repovš, & Hershey, 2009). Persistent PM failures may result in an individual relying on others to remind them to carry out tasks, thus impacting upon their ability to maintain autonomy. Furthermore, when PM failure is severe, there may be concerns about an individual’s safety and wellbeing to the extent that the risks are too large for the individual to be left alone. For example, if they regularly forget to turn off appliances, perform basic personal care activities such as showering, or if they forget to take medication (Zogg, Woods, Saucedà, Wiebe, & Simoni, 2012).

Difficulties with PM in relation to medication adherence often results in an individual forgetting to take their medication, or taking it twice (or more) as they have forgotten that they have already taken it (Park & Kidder, 1996). Forgetting has been cited as one of the most common reasons for medication non-adherence, particularly for psychotropic drugs such as antidepressants (Bulloch & Patten, 2010). Medication non-adherence has also been observed in several clinical populations, such as people with HIV (Zogg et al., 2010) and schizophrenia (Lam, Lui, Wang, Chan, & Cheung, 2013). PM related medication non-
adherence, particularly in clinical populations, may lead to serious health issues such as relapse and exacerbation of illness, withdrawal or discontinuation symptoms and potentially, death (MacLaughlin et al., 2005; Zogg et al., 2012). These non-adherence health consequences may also have social, occupational, and financial effects. For example, a worsening of illness symptoms may result in the individual withdrawing from social engagements, taking time off work, and having to pay for medical care (MacLaughlin et al., 2005).

With so many potential negative consequences of PM failure, it is essential that the cognitive processes involved in PM and variables that affect PM performance are understood. This knowledge of PM processes and related variables provides a theoretical basis for the development of assessment tools that can be used to measure PM. Such assessment tools that measure PM concerns, performance, and impairments can then be used by researchers and clinicians to plan appropriate interventions that minimise PM failures.

This chapter therefore provides an introduction to PM beginning with a definition of PM, a description of the cognitive processes involved in PM, and a discussion of the main types of PM. This is followed by an outline of tasks designed to measure PM in laboratory and naturalistic research settings, as well as a review of numerous dimensions that have been identified within these tasks as playing a role in PM performance. Hence, this chapter will outline the key PM processes and dimensions that are important for the assessment of PM concerns and performance. In addition, this chapter will introduce the clinical assessment of PM, particularly the assessment of concerns about PM functioning using self-report scales. Clinical assessment tools using objective and self-report methods will be reviewed to provide a framework for the research conducted in this thesis, that is, the development of a self-report PM scale, and an investigation of variables related to the measurement of self-reported PM concerns.
Prospective and Retrospective Memory

Prospective memory refers to situations whereby an individual must remember to carry out an action at a future point in time (McDaniel & Einstein, 2007). According to Ellis (1996), successful completion of a PM task involves five phases. The first is the formation and encoding of the action whereby the content of the intention and retrieval context are placed into memory. For example, when an individual uses the last teabag in the packet they form an intention that they must remember to buy more teabags from the supermarket. The next phase is the retention interval, which is the delay between encoding and retrieval. Following this is the performance interval, or the window of opportunity for the intention to be carried out, that is, the individual is situated in the appropriate retrieval context (i.e. the supermarket). Once the individual recognises the retrieval cue, they complete the fourth phase and execute the intention (i.e. they purchase teabags). The fifth phase then involves an evaluation of the outcome. If the intention was successfully executed, the intention is deactivated to avoid them repeating the task (i.e. buying more teabags). If the intention was not carried out, the individual will assess why this occurred and develop a strategy to fulfil the intention at a later time (e.g. putting teabags on the shopping list for the next visit to the supermarket).

There are several features of PM that differentiate it from RM. Retrospective memory involves the recognition and recollection of previous events or previously learned information, for example, remembering a childhood event or recalling a list of ingredients for a recipe (Einstein & McDaniel, 1990). PM on the other hand is characterised by the retrieval of intentions at a later point in time. These tasks cannot be carried out immediately and therefore a delay of minutes or hours between encoding and retrieval of an intention is required (Graf, 2012; Kvavilashvili & Ellis, 1996). A second distinction between RM and PM is that the delay in a PM task is filled with an ongoing activity (such as watching TV or work-
related tasks), that directs attention away from the intention (McDaniel & Einstein, 2007). During the ongoing activity, initiation and execution of an intention is self-initiated and facilitated by the presence of a retrieval cue. Retrieval cues might include noticing the time on the clock or seeing the supermarket (Ellis, 1996). In RM tasks, retrieval typically occurs following a prompt from an external source, for example, an experimenter asking a participant to recall a previously learned list of words (Graf, 2012).

Although PM and RM are considered to be different entities, PM does contain a retrospective component. When completing a PM task, an individual must remember to carry out the intention at the appropriate time and location—this is the prospective component. However, when retrieving this intention, the individual must also remember the content of the intention and information about the retrieval context—this is the retrospective component (Ellis, 1996; McDaniel & Einstein, 2007). Within this framework, PM errors may occur as a result of prospective or retrospective component errors. For example, an individual may remember to carry out the intention at the appropriate time but forget what it was they were supposed to be doing (a retrospective error). Alternatively, they may completely forget to carry out the intention at all (a prospective error; Kvavilashvili & Ellis, 1996).

**Types of Prospective Memory**

Prospective memory tasks are classified on the basis of the nature of the retrieval cue. The main types of PM are event-based, time-based, and activity-based (McDaniel & Einstein, 2007). In event-based PM, an external cue such as a person, object, or place signals that it is an appropriate time to perform an intended action (e.g. passing on a message to a friend when you see them next; Einstein, McDaniel, Richardson, Guynn, & Cunfer, 1995). Alternatively, time-based PM involves remembering to perform an intended action at a particular time (e.g. remembering to attend a doctor’s appointment at 2:45 p.m.) or after a certain amount of time has elapsed (e.g. taking a cake out of the oven after 15 minutes; Einstein et al., 1995). In both
event-based and time-based PM, the ongoing activity must be interrupted in order to fulfil the intention. Activity-based PM does not have this requirement; instead the signal to carry out the intended action is the initiation or completion of another activity (e.g. remembering to hang out washing once the washing machine finishes its cycle; Kvavilashvili & Ellis, 1996).

Prospective memory tasks not only differ in terms of the type of cues, but also the frequency in which the cues occur. Episodic or irregular tasks are those in which the target event occurs only occasionally (e.g. remembering to return library books or put petrol in the car). Conversely, habitual or regular tasks are routinely carried out and involve a repeated presentation of targets (e.g. brushing teeth each day; Einstein, McDaniel, Smith, & Shaw, 1998; Rendell & Henry, 2009). Occasionally a PM task cannot be carried out at the time the intention is retrieved and the execution of the intention must be postponed. For example, if an individual wishes to pass a message on to a friend but they are on the phone, they must wait until the friend is available before passing on the message. This type of PM is referred to as delay-execute PM (McDaniel, Einstein, Stout, & Morgan, 2003). As PM can be separated into the various task types mentioned in this section, it is important that each of these task types are accounted for when assessing PM performance.

Measurement of Prospective Memory

In order to gain a deeper understanding of the processes involved in PM performance, several research paradigms have been created for use within both laboratory and naturalistic settings. In particular, tasks have been designed to measure event-based, time-based, activity-based, habitual, and delay-execute PM types. The following sections provide an outline of the methods that have been developed to assess PM in both laboratory and naturalistic settings.

Laboratory Assessment of Prospective Memory

Unlike other types of memory, PM has not been studied extensively in the past. Initial PM studies used brief semi-naturalistic methods that resembled PM tasks in everyday life
such as having participants mail postcards on certain days (Meacham & Singer, 1977), or phone the laboratory at a specified time (Maylor, 1990; Moscovitch, 1982). However, these studies were thought to be problematic as researchers were unable to control participant compliance or the use of external aids (Einstein & McDaniel, 1996). As a result, laboratory-based PM tasks were developed to provide greater control over these variables. Furthermore, these tasks allowed for the manipulation of various task characteristics, providing researchers with a better understanding of the role that these characteristics play in PM performance.

A laboratory paradigm was created by Einstein and McDaniel (1990) that incorporated the main features involved in PM. These features included a delay between encoding and retrieval of an intention, an engaging ongoing activity, and the presence of retrieval cues that prompt retrieval of the intention. First, participants were given instructions for an ongoing activity (e.g. a short-term memory task) followed by the instructions for the PM task. This PM task involved participants pressing a specified key on a keyboard when they encountered target words within the ongoing activity. A delay between encoding (i.e. the PM instructions) and retrieval (i.e. the PM task) was then created by having participants perform a distraction task (e.g. free recall). After this delay, participants were presented with the attention demanding ongoing task with embedded PM cues. Performance on the PM task was subsequently measured by the proportion of times participants responded to PM targets (cues) during the ongoing task.

This original event-based laboratory paradigm has been widely used and modified in PM research, with the majority of laboratory-based PM studies using a variation of this paradigm. Einstein et al. (1995) adapted the paradigm to measure time-based PM. In this task, rather than responding to target events, participants were asked to press a key after a certain amount of time had elapsed (e.g. press a key every 10 minutes) or at a specified time. The paradigm has also been modified to measure activity-based, habitual, and delay-execute PM.
The activity-based PM task involved participants carrying out specified activities (e.g. typing digits or turning off a computer) after they completed the ongoing task or a block of trials within the ongoing task (Kvavilashvili, Kornbrot, Mash, Cockburn, & Milne, 2009; Shum, Valentine, & Cutmore, 1999). In the habitual PM task developed by Einstein et al. (1998), participants completed 11 ongoing activity subtasks and had to remember to press a key 30 seconds into each subtask. This habitual paradigm provides insight into performance of repetitive tasks and output monitoring errors. The delay-execute PM paradigm on the other hand allows analyses of situations where participants must delay their responses to targets (Kliegel & Jäger, 2006b) and encounter interruptions (Einstein, McDaniel, Williford, Pagan, & Dismukes, 2003; McDaniel, Einstein, Graham, & Rall, 2004). Finally, a complex PM paradigm was created to measure processes involved in the planning, retention, and execution of multiple intentions (Kliegel, Eschen, & Thöne-Otto, 2004; Kliegel, Mackinlay, & Jäger, 2008).

**Naturalistic Assessment of Prospective Memory**

Laboratory-based paradigms have led to significant breakthroughs in the PM literature. In particular, this method has made it possible to manipulate task characteristics (e.g. length of the retention interval or characteristics of the PM retrieval cue), which has provided an insight into a number of variables that affect PM performance. However, these tasks have been criticised for being artificial and lacking in ecological validity (Philips, Henry, & Martin, 2008). Consequently, there has been a move to create more naturalistic methods that measure everyday PM behaviours, but also permit researchers to control task variables in a manner similar to laboratory-based tasks. For example, Kvavilashvili and Fisher (2007) had participants phone their laboratory at a pre-specified time (time-based) or after receiving a text message (event-based). In this experiment, participant motivation was manipulated by emphasising the importance of the PM task for some participants.
Many studies have also incorporated single-target everyday PM tasks into neuropsychological assessments. For example, participants have been asked to report the time during testing (Troyer & Murphy, 2007), change pen colours when switching between tasks (Dobbs & Rule, 1987), or to write their name on each page of the test (Huppert, Johnson, & Nickson, 2000). This method has the advantage of being cost and time efficient, as the neuropsychological assessment functions as the attention demanding ongoing task (McDaniel & Einstein, 2007). This approach should however be used with caution as performance on the PM task may be confounded by the cognitive demands and costs exacted by the neuropsychological battery and vice versa (e.g. Marsh, Hancock, & Hicks, 2002; Marsh & Hicks, 1998; R. E. Smith, 2003).

Virtual reality is an emerging method for assessing PM in a way that is ecologically valid. Using computer technology, virtual reality programs simulate naturalistic environments that individuals can interact with. In some cases, real-life videos and photos are used to create virtual environments (Knight & Titov, 2009). In virtual reality PM tasks, participants move around virtual environments and complete everyday PM activities such as shopping (Canty et al., 2014; Kinsella, Ong, & Tucker, 2009; Potvin, Rouleau, Audy, Charbonneau, & Giguère, 2011; Titov & Knight, 2001), furniture removal (Brooks, Rose, Potter, Jayawardena, & Morling, 2004), or giving insulin injections (Guimond, Braun, Rouleau, & Godbout, 2008). These methods provide a promising avenue for future PM research as they allow experimenter control over variables and offer a safe, convenient method of realistically assessing PM. However, virtual reality methods may be hampered by technological issues and their limited availability in clinical settings (Knight & Titov, 2009).

**Dimensions of Prospective Memory**

Results across studies in both laboratory and naturalistic settings have been found to be inconsistent in regards to PM performance. It has been concluded that PM performance is
determined by the way it is examined and the task dimensions (McDaniel & Einstein, 2007). Hence, these variables should be taken into consideration when assessing PM concerns or performance. Dimensions implicated in PM performance include retrieval of the PM cue, ongoing task demands, and characteristics of the PM cue. These characteristics include cue focality, cue-action relatedness, cue distinctiveness, salience, specificity, and familiarity. Also involved in successful PM are the length of the retention interval and perceived task importance. Each of these dimensions will be discussed in the following sections.

**Retrieval Processes in Prospective Memory**

The type of cognitive processing engaged when retrieving an intention may be important in determining successful PM performance. However, there is much debate as to what processes are involved in retrieving an intention. One hypothesis is that individuals continuously monitor the environment for PM targets but that this strategic monitoring exacts an attentional cost. The Preparatory Attentional Processes and Memory Processes (PAM) theory (R. E. Smith, 2003; R. E. Smith & Bayen, 2004, 2006) provides a model of the strategic monitoring involved in the PM component of event-based tasks. According to this theory, a capacity consuming preparatory process monitors the environment continuously for PM targets. This strategic monitoring may occur consciously or below the level of awareness. Furthermore, the theory incorporates a RM component that performs the roles of distinguishing between PM targets and non-targets and recalling the intention once a PM target has been located. In this theory, both preparatory and memory processes produce attentional costs. These attentional costs have been demonstrated in several studies, providing support for the PAM theory (R. E. Smith, 2003; R. E. Smith & Bayen, 2004, 2006; R. E. Smith, Hunt, McVay, & McConnell, 2007). These studies reported that there were slower response latencies in performing the ongoing task when individuals were also engaged in a PM task, as opposed to when they completed the ongoing task alone. These slower responses
to the ongoing task are believed to reflect the attentional costs associated with preparatory and memory processes used when responding to PM targets.

The attentional costs of continuously monitoring are assumed to be too large to be maintained for long periods of time (McDaniel & Einstein, 2000, 2007). It is therefore argued that spontaneous retrieval processes must be used at some point (McDaniel & Einstein, 2000). From this perspective, when a PM target is encountered, an automatic associative memory system activates a memory trace that facilitates involuntary retrieval of the intention. Unlike strategic monitoring, spontaneous retrieval of intentions uses minimal cognitive resources. Support for this theory comes from verbal post-test reports in PM studies. Here, individuals reported that they did not use any self-initiated strategic monitoring processes, but instead once they encountered the target the intention “popped into their head” (Einstein & McDaniel, 1990).

A variation of the spontaneous retrieval perspective is the notice plus search model, which proposes that when individuals encounter a PM target they feel a sense of familiarity that causes them to notice it (Einstein & McDaniel, 1996). On a similar note, the discrepancy plus attribution hypothesis (Whittlesea & Williams, 2000, 2001a, 2001b) predicts that individuals evaluate the quality of their processing, which sometimes produces discrepancies. Targets that are unfamiliar are believed to create more unique activations in memory than familiar targets that are retrieved quickly, and these differences in processing produce a discrepancy. This forces the individual to search for the meaning of the discrepancy which is, that the intention needs to be fulfilled (McDaniel & Einstein, 2007). These theories are supported with evidence from studies that have found unfamiliar targets to produce better PM than familiar targets (Einstein & McDaniel, 1990).

The deployment of strategic monitoring or spontaneous retrieval processes may depend on the nature of the task. According to Craik (1986), memory tasks can be ordered in
the degree to which they rely on self-initiated processing or environmental support. PM tasks are considered to require the greatest amount of self-initiation followed by free recall and cued-recall. Alternatively, memory tasks that require little self-initiated processing include procedural (priming) tasks, relearning, and recognition. Craik suggested that in these tasks, complex memory processes are used to a lesser extent as perceptual information and environmental cues that facilitate retrieval are still present.

Similarly, it is assumed that the extent to which spontaneous or strategic processes are used depends on the association between the intention that was encoded and the action to be performed. Highly associated cue-action pairings will result in automatic retrieval whereas cue-action pairings that are weakly related are more demanding and will require the use of strategic monitoring processes. Based on this idea, McDaniel and Einstein (2000) devised the multi-process framework, which posits that individuals use a combination of strategic monitoring and spontaneous retrieval processes in PM. The process that is used in a particular situation will depend on the characteristics of the PM task, ongoing task, and the individual. They argue that individuals use spontaneous retrieval processes more frequently because strategic monitoring is too resource demanding to maintain over long periods of time. The multi-process framework has been used to explain several inconsistent findings in the PM literature, particularly in relation to age differences and the various dimensions of PM.

**Ongoing Task Demands**

The deployment of spontaneous retrieval or strategic monitoring processes for PM target retrieval will depend on the availability of limited cognitive resources. When an ongoing activity has a high cognitive load, there will be fewer cognitive resources available to perform the PM task successfully (McDaniel & Einstein, 2000). This has been demonstrated in several studies whereby PM performance was reduced when a cognitively demanding background task was used or when attention was divided during ongoing tasks.
(Einstein et al., 1998; Einstein, Smith, McDaniel, & Shaw, 1997; Marsh et al., 2002; Marsh & Hicks, 1998; McDaniel, Guynn, Einstein, & Breneiser, 2004; McDaniel, Robinson-Riegler, & Einstein, 1998). It has also been noted that real-life PM failures (such as medical mistakes) are often associated with the reduction in cognitive resources resulting from multitasking or task interruptions (Dismukes, 2012).

Marsh et al. (2002) argued that the effects of a cognitively demanding ongoing task could depend on other characteristics of the PM task. Consistent with this argument, McDaniel, Guynn, et al. (2004) found that dividing attention negatively impacted PM performance when the PM cue and action were not related, but PM performance was unaffected when the cue and action were associated. In addition, studies have varied the number of PM targets in order to increase task difficulty (Einstein 1992, 2000). When more targets were used and the cognitive load was increased, there were greater costs to PM. The characteristics of the PM cue itself may also affect PM performance.

**Characteristics of the Prospective Memory Cue**

**Cue focality.** Prospective memory cues may differ in the extent that they are associated with or embedded in the ongoing activity. PM targets that are focal use the same processing requirements as the ongoing activity. An example of a focal PM cue would be responding to a particular animal word within an animal/non-animal word category judgement task or remembering to edit a word whilst typing a document. Non-focal cues are those in which the processing requirements for responding to the PM target are different to those used in the ongoing activity. For example, responding to a different background colour during an ongoing word category judgement task or remembering to put more paper in the printer when in the middle of typing a document. Non-focal targets are embedded within the ongoing activity, but performing the ongoing activity does not focus on the main features of the PM target (McDaniel & Einstein, 2007).
According to the multi-process framework (McDaniel & Einstein, 2000), as focal cues use similar resources to the ongoing activity, the cue should be retrieved relatively automatically. Alternatively, retrieval of non-focal cues should rely on strategic monitoring to a greater extent as this PM retrieval method uses different processes to those already engaged in the ongoing activity. As non-focal cues require more strategic monitoring, they are expected to exact greater attentional costs. Consistent with these predictions, PM performance using focal cues has been reported to be superior to PM performance with non-focal targets (Ihle, Hering, Mahy, Bisiacchi, & Kliegel, 2013; Kliegel, Jäger, & Phillips, 2008; Uttl, 2011).

Cue-action relatedness. The retrieval of a PM cue is said to involve both data driven processes and conceptually driven processes. Data driven processes use perceptual features of the cue in retrieval whereas conceptually driven processes rely on the semantic meaning of cues for retrieval. A.-L. Cohen, West, and Craik (2001) proposed that the PM component involves data driven processes that facilitate noticing of the target. In contrast, the RM component was argued to rely on conceptual processing in order to identify the significance of the target. These predictions were confirmed in their study as the PM component was more affected by perceptual changes from encoding to retrieval whereas the RM component was impaired when conceptual changes occurred from encoding to retrieval. However, McDaniel et al. (1998) observed a conflicting effect. They found that PM was primarily conceptually driven. Moreover, they suggested that the overlap between processes at encoding and retrieval may be particularly important for successful PM performance.

Following on from this suggestion regarding cue-action relatedness, McDaniel and Einstein (2000) argued that if the process used at encoding is the same as the process involved in retrieval of the intention, the association between the cue and the action should be stronger and the intention should be retrieved more rapidly. Support for this hypothesis has
been found in several studies whereby highly related cue-action associations produced better PM performance than unrelated cue-action pairings (B. Hannon & Daneman, 2007; Marsh, Hicks, Cook, Hansen, & Pallos, 2003; McDaniel et al., 1998; Pereira, Ellis, & Freeman, 2012). In addition, this cue-action relationship at encoding and retrieval was found to have a greater influence on PM performance than any singular encoding or retrieval characteristic assessed (e.g. cue salience and specificity; B. Hannon & Daneman, 2007).

**Cue distinctiveness and salience.** The noticing of PM targets may be enhanced by increasing the distinctiveness or salience of the cue. In daily life, salient and distinctive cues (e.g. leaving keys near the doorway) are commonly used to assist PM. Similarly, superior PM performance has been found in laboratory studies after increasing the perceptual salience of cues. This has been done by highlighting words in bold (McDaniel, Glisky, Rubin, Guynn, & Routhieaux, 1999), italics (Blanco-Campal, Coen, Lawlor, Walsh, & Burke, 2009), displacing letters (A.-L. Cohen, Dixon, Lindsay, & Masson, 2003), and by using different coloured words or participants names as targets (R. E. Smith et al., 2007). In addition, increasing the semantic salience of a target has also been found to enhance PM. For example, Einstein and McDaniel (1990) used rare target words (e.g. monad) that had little meaning for participants and were therefore semantically salient. McDaniel and Einstein (2000) argued that distinctive cues divert attention away from the ongoing task as they are more noticeable, resulting in more efficient responding to PM cues.

**Cue specificity.** Prospective memory targets are often classified as either specific or general. In laboratory-based PM tasks, specific targets are those in which the individual must respond to particular words (e.g. elephant). Conversely, general targets are those in which the individual is given instructions to respond to words that are an exemplar for a particular category (e.g. respond to any animal word). According to Einstein et al. (1995) specific targets should be easier to retrieve than general targets as the individual knows exactly what
target to look for during the task. Consistent with this idea, specific targets have been reported to result in better PM performance than general targets (Cherry et al., 2001; Einstein et al., 1995; S. M. van den Berg, Aarts, Midden, & Verplanken, 2004). Translating these findings to everyday life, it may be easier to retrieve a specific target such as remembering to tell John a funny story at a party as opposed to a general target of remembering to tell the funny story to any number of friends at the party.

**Cue familiarity.** As mentioned previously in the discussion of spontaneous retrieval models, PM cues that are familiar are believed to be retrieved differently to unfamiliar cues and this produces a discrepancy. When evaluated, the significance of this discrepancy is that the individual needs to retrieve the intention (McDaniel & Einstein, 2007). The extent to which a cue is familiar or unfamiliar will therefore effect PM retrieval. For example, Einstein and McDaniel (1990) found that PM was better with unfamiliar cues (e.g. monad) compared to familiar cues (e.g. rake) as individuals are more likely to notice something that is unique rather than something expected. Another method of testing familiarity has involved pre-exposing participants to PM cues. For example, Breneiser and McDaniel (2006) pre-exposed individuals to PM cues which increased individuals’ familiarity with the cues and found that increasing cue familiarity subsequently reduced PM performance. This can be seen in everyday situations where information about a familiar cue (e.g. a staple item on the shopping list) is easily overlooked whereas an unfamiliar cue (e.g. an unusual ingredient for a new recipe) is more easily retrieved.

**Characteristics of the Prospective Memory Task**

**Length of the retention interval.** It is well documented in the RM literature that RM performance declines with increasing retention intervals (Ellis & Freeman, 2008). The effects of delays in PM however have not been studied extensively to date. A few studies have reported that PM remains stable or improves over retention intervals. For example, Einstein,
Holland, McDaniel, and Guynn (1992) found similar PM performance across retention intervals of 15 and 30 minutes. Confirming findings from the RM literature, they found that when the same retention intervals were used to assess RM, performance declined. In addition, Hicks, Marsh, and Russell (2000) reported that PM actually improved over increased retention intervals (up to 15 minutes) but only when the retention interval contained unfilled breaks or intervening activities that required task switching. They suggested that the retention interval and switching between tasks may allow the intention to come to mind more frequently and this could account for the improvements observed in PM performance.

In contrast, declines in PM have been observed over short and extended periods. For example, McBride, Beckner, and Abney (2011) found that PM declined rapidly after a few minutes (1-5 minutes) but the decline was less pronounced after longer periods (up to 20 minutes). Alternatively, McBride, Coane, Drwal, and LaRose (2013) assessed PM retention over a month using a naturalistic PM paradigm. They found that younger adults had quite rapid forgetting rates (similar to those seen in RM) whereas older adults’ PM did decline but not until after 14 days. This contradictory pattern of findings suggests that further research is required to shed light on the effects of the length of retention intervals on PM performance.

**Reminders and strategies.** When carrying out a PM task the use of reminders and external aids (such as notes, diaries, or objects left in one’s line of sight) may assist in remembering to carry out the intention. An effective reminder should facilitate spontaneous retrieval of the intention and reduce the need for an individual to engage in strategic monitoring processes (McDaniel & Einstein, 2000). Consequently, both self-initiated and experimenter-initiated reminders have been found to improve PM performance (Breneiser, 2009; Einstein & McDaniel, 1990; Henry, Rendell, Phillips, Dunlop, & Kliegel, 2012; Marsh, Hicks, & Landau, 1998).
The effectiveness of these reminders may depend on how elaborate they are. For example, Guynn, McDaniel, and Einstein (1998) found that reminders that create an association between the target event and the intended action were more effective than those that referred only to either the target event or intended action alone. Subsequently, Gollwitzer (1999) developed a strategy called “implementation intentions” to assist with PM retrieval. Implementation intentions are statements that create a connection between the target event and action. For example, “when I go to the supermarket tonight, I will remember to buy teabags”. Implementation intentions have been found to improve PM performance in both older adults (Chasteen, Park, & Schwartz, 2001) and younger adults (Breneiser, 2009) and may prove to be an effective strategy to enhance PM performance.

**Task importance.** Whether individuals successfully remember to fulfil an intention may depend on how important they perceive the task to be, or how motivated they are to carry out the task. It seems logical that if individuals consider a task to be important, that they would be motivated to ensure that they completed it. Accordingly, many studies have found that PM performance was improved when tasks were perceived to be important as opposed to unimportant (Altgassen, Kliegel, Brandimonte, & Filippello, 2010; Cicogna & Nigro, 1998; Ihle, Schnitzspahn, Rendell, Luong, & Kliegel, 2012; Kvavilashvili & Fisher, 2007; Marsh et al., 1998; Meacham & Kushner, 1980).

Whether a task is seen to be personally or socially important may also need to be taken into consideration. In tasks that are personally important, completion of the activity will fulfil one's own goals. Conversely, socially important tasks are carried out in order to meet the needs of others or to maintain social relationships. When comparing social and personal importance motivations, PM performance was improved when there was a social incentive (e.g. helping a friend or the experimenter) but personal importance had little effect on PM performance (Altgassen et al., 2010; Brandimonte & Ferrante, 2008; Penningroth, Scott, &
Freuan, 2011). Interestingly, Brandimonte, Ferrante, Bianco, and Grazia Villani (2010) found that receiving personal material incentives for participating in research actually reduced PM performance. Apparently, receiving these incentives conflicted with individuals’ social motivation of participating to assist the researcher, which reduced PM performance.

Whilst many studies have found PM to be improved with emphasised task importance, some studies have not found importance manipulations to affect PM performance. Although PM performance was not improved, importance was found to enhance the activation of intentions in memory (Jeong & Cranney, 2009), individuals’ strategic monitoring (Kliegel, Martin, McDaniel, & Einstein, 2001, 2004), and the use of internal and external memory strategies (Penningroth & Scott, 2013). Hence, when individuals consider a task to be important they are more likely to allocate cognitive resources to the search for PM targets to ensure that they complete the task.

**Clinical Assessment of Prospective Memory**

In clinical settings, the purpose of assessing PM is to measure everyday PM behaviours, specifically, PM failures or impairments that affect individuals’ social, occupational, or independent functioning (e.g. forgetting appointments or medication non-adherence). These PM impairments often are related to or are the result of clinical disorders that affect individuals’ cognitive functioning, for example, brain injury, dementia, schizophrenia, or substance abuse disorders (Thöne-Otto & Walther, 2008). Therefore, the aim of clinical PM assessment is to diagnose such PM impairments and provide information about the nature of impairments so that interventions that minimise the occurrence of PM failures can be implemented (Thöne-Otto & Walther).

In the previous sections, the processes involved in PM, types of PM, and a number of dimensions that have been found to affect PM performance were discussed. These PM processes, types, and dimensions have been assessed in both laboratory and naturalistic tasks.
However, these tasks were designed for use in research settings with the purpose of controlling individual task characteristics and understanding the underlying processes involved in PM. These methods are not practical or appropriate for assessing everyday PM behaviours in clinical settings. Laboratory-based tasks in particular have been criticised for having a limited amount of ecological validity (Philips et al., 2008). Tasks such as Einstein and McDaniel’s (1990) paradigm that involve responding to a PM target on a computer screen cannot be easily generalised to the everyday PM failures that are of interest in clinical settings. In contrast, naturalistic tasks are considered to be more realistic measures of everyday PM as they are usually embedded in everyday activities (Philips et al., 2008). However, they typically only involve a brief, single target task (e.g. a single time-based task requiring the individual to report the time during testing) and therefore provide a limited amount of information about the nature of PM impairments experienced by individuals. Although virtual reality methods allow for the measurement of numerous task dimensions in a more realistic simulated naturalistic environment, they are not currently available for use in general clinical settings (Knight & Titov, 2009). Hence, there is a need for assessment tools that can be used in clinical settings to assess everyday PM behaviours and failures. Such tools should measure the various processes, types, and dimensions involved in PM to assist in the diagnosis of PM impairments. For example, they should be able to provide an indication of whether PM failure is the result of difficulties in encoding, storage, or retrieval.

Several clinical assessment tools have been developed in order to evaluate PM functioning in individuals with and without clinical disorders. This section reviews existing clinical assessment tools, beginning with objective clinical assessment tools. Following this, the assessment of PM using self-report measures is reviewed. Specifically, the importance of subjective reports of cognitive decline is discussed, and existing self-report measures of PM
are evaluated. This precedes an overview of the research to be conducted in this thesis, namely, the development of a self-report scale measuring PM concerns.

Objective Measurement of Prospective Memory

Standardised objective measures of PM have been established for use in clinical and research settings with the aim of providing ecologically valid measurement of actual PM performance. One of the first assessments to include PM was the Rivermead Behavioural Memory Test (RBMT; B. A. Wilson, Cockburn, & Baddeley, 1985). The RBMT incorporates 12 subtests measuring various aspects of memory such as remembering names, picture recognition, delivering a message, and remembering directions. The RBMT contains two PM subtasks that include remembering an appointment, and remembering to ask for a hidden belonging. However, this test is problematic in that only a general memory scale is obtained from the subtask scores rather than an index specifically focused on PM (Cockburn, 1996). Furthermore, the RBMT is useful for assessing moderate to severe memory problems but is less effective in discriminating within mild cases of memory deficits (Makatura et al., 1999).

The Memory for Intentions Screening Test (MIST; Raskin & Buckheit, 1998) assesses PM performance within eight tasks that are carried out whilst completing an ongoing word puzzle task. The eight tasks differ in terms of the delay between the PM instructions and performing the task (2 versus 15 minutes), the type of cue (event-based or time-based), and the response modality (verbal versus physical). An eight item multiple-choice test can be administered at the end of the session to measure recognition of PM targets, for example, “were you meant to ask me when the session ends...?” In addition, a naturalistic 24 hour task requiring participants to phone the clinic is included in the test to assess PM over an extended time period.

A major advantage of the MIST is that it allows PM errors to be evaluated in greater detail. Errors are subdivided into PM errors (e.g. the subject does not give any response), task
substitution errors (e.g. when a subject performs an action for a verbal item or vice versa), loss of content errors (e.g. when a subject recalls that a task needs to be performed at the correct time but cannot recall the task or recalls the incorrect task), loss of time errors (e.g. when the subject recalls the content of the task correctly but performs it at the incorrect time), place losing errors (e.g. the subject performs only part of the task or repeats a previous task), and random error. The MIST has been found to have acceptable psychometric properties (Spearman Brown coefficient = .70, subscale Cronbach's $\alpha = .886$; Woods et al., 2008) and has been used in a variety of clinical populations (Raskin, 2009). However, due to the time needed to set up and administer the tasks, the MIST is not practical in many clinical settings. In addition, although the MIST tasks vary in task type, modality, and the length of the retention interval, they only assess a limited portion of the task types, processes, and dimensions discussed in this chapter.

Another standardised test of PM is the Cambridge Prospective Memory Test (CAMPROMPT; B. A. Wilson, Emslie, Watson, Hawkins, & Evans, 2005). This test includes three time-based tasks (e.g. remind the examiner to call reception in 5 minutes time), and three event-based tasks (e.g. remind the examiner about the location of five hidden objects when a beeper goes off) that are completed during ongoing pencil and paper activities (e.g. word finders). In order to relate to real-world settings, participants may use any memory strategy to help them remember PM tasks. Scoring for the CAMPROMPT is based on the number of prompts from the examiner needed for the person to carry out the task. For example, the person gains six points if they perform the correct response at the right time, four points if a single prompt is needed, two points if two prompts are given, one point if additional prompts are needed, and zero points if they fail to carry out the task following these reminders. The authors of the CAMPROMPT report that the test has acceptable validity and reliability (test retest reliability = .64; B. A. Wilson et al., 2005). However, evidence of
internal consistency reliability and predictive validity of the CAMPROMPT is lacking (Fish, Wilson, & Manly, 2010). The test is limited in that it must be purchased for a fee and is time-consuming to administer, making it expensive and impractical in many assessment settings. Furthermore, like the MIST it is narrow in its scope of measurement as it assesses only a small range of the dimensions involved in PM performance.

Another criticism of the MIST and CAMPROMPT is that they are somewhat artificial, as they do not assess everyday PM behaviours. Rendell and Craik (2000) developed Virtual Week as a more realistic assessment of everyday PM tasks. Virtual Week is a board game marked with times of the day whereby participants move around the board and carry out PM tasks at the appropriate time or after encountering a particular event. On each circuit of the board (one virtual day), participants choose event cards that represent PM activities. These are either regular tasks that are carried out every day (e.g. taking antibiotics with breakfast and dinner or taking asthma medication at 11 a.m. and 9 p.m. daily), or irregular (e.g. filling the car with petrol or returning library books). An additional time check task is included whereby participants must perform a lung test at certain times during each virtual day. A review of Virtual Week indicated that the test has good reliability and validity, and is sensitive to PM deficits in normal ageing and in several clinical groups (Rendell & Henry, 2009). Although Virtual Week assesses a variety of PM task characteristics, it is impractical in many clinical settings due to the time needed for individuals to carry out the tasks. In addition, it has been primarily used in research and is not widely available for clinical use.

**Self-Reported Measurement of Prospective Memory**

Rather than having individuals complete PM tasks, another common method of assessing PM in clinical and research settings is to have participants subjectively report their memory successes, failures, and concerns. Subjective cognitive decline (SCD) refers to a self-perceived decline or impairment of cognitive capacities, especially memory abilities such
as PM (Jessen, Amariglio, et al., 2014). Studies using individuals’ subjective reports of memory performance have found that PM lapses are frequently reported (Dobbs & Rule, 1987). Moreover, these lapses cause a considerable amount of frustration and concern for individuals and their significant others (G. Smith et al., 2000).

There are many advantages of using self-report measures to assess PM. First, self-report measures are readily available in the public domain. They are cheap, quick, and simple to administer providing a cost-effective method of assessment (Chau, Lee, Fleming, Roche, & Shum, 2007). Another benefit is that self-report questionnaires can provide information about a person’s memory which may not be detected by other objective clinical measures, or may not be evident to observers (Shum, Fleming, & Neulinger, 2002). For example, an individual’s failure to remember to tell someone a story cannot be overtly noticed by observers, or measured using objective tools. Instead, this failure is only known to others if the individual reports its occurrence.

Reports of SCD reflect concerns about memory or cognitive ability, but these concerns do not necessarily manifest when objective neuropsychological testing is used (Steinberg et al., 2013). Nevertheless, there is a growing body of research suggesting that SCD (especially reports of memory decline) is associated with cognitive impairment (Amariglio, Townsend, Grodstein, Sperling, & Rentz, 2011; Steinberg et al., 2013), preclinical Alzheimer’s disease (see Jessen, Amariglio, et al., 2014 for a review), and progression to dementia (Jessen, Wolfsgruber, et al., 2014; Modrego & Gazulla, 2013; Waldorff, Siersma, Vogel, & Waldemar, 2012).

Although not all individuals with cognitive impairments report SCD (Jessen, Wolfsgruber, et al., 2014), reports of SCD particularly in older adults should not be ignored as they may assist in identifying individuals who require further cognitive examination (Amariglio et al., 2011). In addition, SCD may help identify individuals in preclinical stages
of dementia who may be good candidates for clinical dementia trials. These individuals do not yet exhibit the neuronal damage and cognitive impairment seen in those with mild cognitive impairment (MCI) and prodromal Alzheimer’s disease (Jessen, Amariglio, et al., 2014). Furthermore, individual or informant reports of SCD are one of the criteria used for MCI and dementia diagnosis, and therefore are an important part of cognitive assessments.

Self-reported PM plays an important role in the assessment and rehabilitation of cognitive impairments such as those seen in individuals with brain injury, MCI or dementia (Fleming et al., 2008). Regardless of whether self-reported PM is an accurate reflection of an individual’s memory or not, self-reports provide an insight into the individual’s beliefs about their memory ability. These beliefs will influence the individual’s behaviour and therefore should be taken into consideration (R. Hannon, Adams, Harrington, Fries-Dias, & Gipson, 1995; Shum et al., 2002). For example, individuals who do not perceive a memory problem will be resistant to treatment and will not utilise compensatory strategies (Roche, Fleming, & Shum, 2002). Even when the self-perceived memory problems are not the main issue for rehabilitation, the self-reported areas of concern may be a good starting point for treatment as the patient will be less resistant to treatment if their concerns are being taken seriously (Roche et al.). Hence, self-reported PM may provide valuable information about individuals’ everyday PM behaviours, beliefs, and concerns. Thus, a number of self-report measures have been developed for the clinical assessment of PM.

Existing self-report prospective memory scales. Early clinical assessment scales measured self-reported PM failures within general memory and cognitive scales such as the Everyday Memory Questionnaire (EMQ; Sunderland, Harris, & Gleave, 1984) and the Cognitive Failures Questionnaire (CFQ; Broadbent, Cooper, Fitzgerald, & Parkes, 1982). The EMQ contains 28 items measuring the frequency of forgetting on everyday tasks such as losing things around the house or remembering a change in daily routines. The CFQ is a 25
item questionnaire that measures the relative frequency of everyday cognitive failures including memory, psychomotor, and attention slips. On both of these measures, ratings from all items are summed to form an overall scale score to indicate a broad spectrum of everyday memory or cognitive failures. General scales such as these provide minimal information about PM functioning as total scores obtained encompass more than just PM as only a handful of items in the questionnaires actually measure PM (Chau et al., 2007; Crawford, Smith, Maylor, Della Sala, & Logie, 2003).

In order to assess self-reported PM exclusively, the Prospective Memory Questionnaire (PMQ; R. Hannon et al., 1995) was developed. This scale contains 52 items that assess long-term episodic PM (e.g. forgetting to return books to the library on the due date), short-term habitual PM (e.g. forgetting to put a stamp on a letter before mailing it), internally-cued PM (e.g. forgetting the content of the message mid-sentence) and techniques used to assist PM (e.g. use of rehearsal and imagery). Whilst this scale measures the frequency of forgetting, it has been criticised for not assessing the various functions of PM or reasons for why people forget or remember in PM tasks (Roche, Moody, Szabo, Fleming, & Shum, 2007). Information about the processes and dimensions involved in PM failures is important, as this information will assist clinicians in developing more targeted interventions.

In contrast, The Prospective and Retrospective Memory Questionnaire (PRMQ; G. Smith et al., 2000) measures both PM and RM failures. This questionnaire consists of 16 items measuring prospective versus retrospective memory, self-cued versus environmentally-cued, and short-term versus long-term memory dimensions. Examples of PRMQ items include “do you fail to recognise a place you have visited before” and “do you forget to tell someone something you had meant to mention a few minutes ago”. This questionnaire provides a carer/informant version and was developed for use in individuals with Alzheimer’s disease. However, like the PMQ this questionnaire does not specifically assess the
dimensions of PM or reasons why people succeed (or do not succeed) in PM tasks, limiting its utility in clinical settings.

Another self-report measure of PM is the Comprehensive Assessment of Prospective Memory (CAPM; Waugh, 1999). The CAPM is comprised of three sections: Section A measures the frequency of PM failure in instrumental activities of daily living (e.g. household chores) and basic activities of daily living (e.g. personal care), Section B assesses the respondent’s perceived amount of concern, whilst Section C asks for reasons why the person is successful or unsuccessful in PM tasks. This section was based on Ellis’ (1996) PM model with items designed to measure PM failures that occur during encoding, the retention interval, the performance interval, task execution, and the evaluation of outcomes. This measure provides a relatively thorough analysis of the functions of PM but it does not incorporate a number of the PM types or dimensions discussed earlier in this chapter.

The PMQ, PRMQ, and CAPM are all useful for assessing individuals’ perceptions of their memory ability and concerns about PM failures. They each assess the frequency of forgetting behaviours, which provides information about individuals’ perceived PM ability. The PMQ contains subscales based on some PM task types and dimensions, namely length of the retention interval, habitual versus episodic task types, nature of the retrieval cue (internal versus external), and techniques used to remember PM tasks. The CAPM on the other hand measures the processes involved in PM using Ellis’ (1996) model as a guideline. Although they measure a few key PM characteristics, the major drawback of these scales is that they do not assess the numerous PM processes, task types, and dimensions outlined in the literature reviewed in this chapter. For example, items in these scales do not assess cue focality, salience, or cue-action relatedness. Hence, there is currently a gap in the area of self-reported PM whereby tasks, processes, and dimensions of PM require further exploration.
Study Aims and Rationale

As no existing scales provide a wide-ranging assessment of PM process, types, and dimensions, there is arguably a need for a scale to measure these important aspects of PM. It has been suggested by McDaniel and Einstein (2007) that any new clinical assessment tool should assess the different processes and task characteristics involved in PM. Moreover, Shum et al. (2002) argued that future PM self-report measures need to be theoretically based. Therefore, the primary aim of this thesis was to develop a brief, self-report scale that measures individuals’ perceptions of and concerns about their PM ability. This self-report measure was to be called the Prospective Memory Concerns Questionnaire (PMCQ). The PMCQ was intended to be theoretically based in its design with items created to assess the wide range of PM types, processes, and dimensions outlined in the review of the literature within this chapter. These included:

- processes involved during formation and encoding of intentions, the retention interval, the performance interval, intervention execution, and evaluation of outcomes;
- the prospective and retrospective component of PM;
- time-based, event-based, activity-based, episodic, habitual, delay-execute, and complex PM task types;
- strategic monitoring and spontaneous retrieval processes;
- cognitive demands of the ongoing task and divided attention;
- characteristics of the PM cue such as cue focality, cue-action relatedness, cue distinctiveness and salience, cue specificity, and cue familiarity;
- length of the retention interval;
- the use of reminders and strategies;
- task importance.
It was important that the proposed PMCQ scale was developed using a theory driven approach. This theoretical approach was to be used not only for the writing of individual items, but also for the construction of the scale overall, for example, in item analyses involved in selecting items for the scale. Existing self-report measures of PM have been developed primarily using techniques derived from Classical Test Theory (CTT), for example, factor analysis was used during the development of the CAPM (Waugh, 1999). It was intended that CTT would also be used for the development of the PMCQ scale in this thesis. Another test theory that has been used in a variety of disciplines for the construction and analysis of measures is Item Response Theory (IRT; Belvedere & de Morton, 2010). Although the methods employed in CTT and IRT differ considerably, several studies have used the two test theories in conjunction with one another (Mâsse, Heesch, Eason, & Wilson, 2006; Pan et al., 2011). These studies demonstrated that the method of combining CTT and IRT was advantageous in scale construction as it provided a more in-depth evaluation of scale items. Therefore, in this thesis, the technique of using both CTT and IRT was employed for the construction and analysis of the PMCQ. This research is innovative in that it is the first study conducted in the PM field to utilise IRT for scale development or evaluation. A detailed discussion of the methodology employed in this thesis is provided in Chapter 3.

This approach to scale development (i.e. a combination of CTT and IRT) differs considerably from the methods used to develop existing self-report PM scales. Therefore, the second thesis aim was to investigate whether the scale development techniques used in this research would result in a scale that was similar in content and structure to existing self-report PM scales that used different scale development procedures. The Prospective and Retrospective Memory Questionnaire (PRMQ; G. Smith et al., 2000) is the most commonly cited self-report measure of PM and was therefore used in this research to be compared with the scale developed in this thesis. It was expected that the scale developed in this research
would differ from the PRMQ and be a unique self-report PM measure. However, it was also anticipated that the two scales, both being designed to measure PM, would measure the same PM construct and demonstrate convergent validity.

It was intended that the PMCQ—to be developed in this research—be used in both research and clinical settings to assess subjective perceptions of PM ability and concerns about PM failures. Furthermore, the scale was to be designed in a way so that it could be used to assist in the planning of rehabilitation or implementation of PM compensation strategies. In order for the PMCQ to be used for these purposes, it was important that the scale was reliable and valid. Therefore, the psychometric properties of the PMCQ scale developed in this research were to be investigated. Of particular interest was the internal consistency reliability of the scale to determine whether the individual scale items were consistently measuring the PM construct. In addition, the content, construct, convergent, divergent, and predictive validity of the PMCQ were to be evaluated to ascertain whether the scale was an appropriate measure of PM.

It was also important for the PMCQ to be standardised in this research, as normative data provide a benchmark of PMCQ scores for future scale users to compare their performance on the scale with. In this research, normative data for the PMCQ was to be obtained for both males and females across the adult lifespan. This would allow the PMCQ to be used in clinical settings to identify PM impairments and in research settings to investigate individual differences in PM.

In order to provide further information about the utility of the PMCQ and the self-report method of assessing PM, an aim of this study was to investigate the relationship between self-reported PM and a number of variables that might be expected to play a role in the assessment of PM using self-report scales. This included an investigation of:
• self-reported PM and naturalistic PM performance in individuals diagnosed with cognitive impairments, namely acquired brain injury (ABI), MCI, and dementia;
• the effects of normal ageing on self-reported PM and naturalistic PM performance;
• the relationship between self-reported PM and naturalistic PM performance;
• the relationship between personality, self-reported PM, and naturalistic PM performance;
• the relationship between social desirability, self-reported PM, and naturalistic PM performance.

Thesis Overview

This chapter has provided an introduction to PM, outlining the key processes involved in PM, the main types of PM, laboratory and naturalistic research methods, and dimensions that have been found to affect PM performance. In addition, this chapter reviewed objective and self-report measures that have been used to assess PM in clinical settings, which provided a framework for the aims of the current research. Chapter 2 provides a review of the literature relating to individual differences in PM. In particular, it will review literature relating to the five areas of investigation listed in the dot points above. Chapter 2 also provides a summary of the research aims.

Chapter 3 gives an overview of the project and processes involved in the development of the PMCQ. Specifically, the steps involved in the construction of the PMCQ are outlined. A discussion of the methodologies employed in this research is also provided. This includes an overview of CTT and IRT, how they were applied in this research, and a rationale for their use in this thesis.

Chapter 4 reports on the method and results of Study 1, a pilot study conducted as a part of the scale development process. Chapter 5 includes the method and results of a Pre-Test study that was carried out to trial the PMCQ. Chapter 5 also reports on the procedures
and results of Study 2, which comprised an item analysis and further development of the PMCQ. Chapter 6 outlines the procedures and results of the validation of the final version of the PMCQ. Chapter 6 also presents the normative data for the PMCQ and delivers the findings of analyses investigating variables relating to the self-reported measurement of PM. This included the relationship between self-reported PM and clinical disorders, ageing, naturalistic PM tasks, personality, and social desirability. Chapter 7 provides a general discussion of the overall research findings and implications of these findings. Study limitations, avenues for future research, and thesis conclusions are also provided.
CHAPTER 2

Variables Associated with the Measurement of Self-Reported Prospective Memory

As outlined in Chapter 1, an aim of this thesis was to investigate the relationship between self-reported PM and variables that might be expected to be related to self-reported PM. This chapter gives a background and rationale for the investigation of these relationships through a review of the literature. This literature review will begin with an overview of research investigating PM in clinical populations. The nature of ABI and research examining PM and ABI will be evaluated. This will be followed by a discussion of MCI, dementia, and research that has been conducted on PM in these populations. Next, a review of the literature on PM and ageing will be presented. In addition, research investigating the relationship between self-reported and naturalistic PM will be discussed. Finally, a review of literature that has investigated the relationships between PM, personality, and social desirability will be provided.

Prospective Memory in Clinical Disorders

Prospective memory is seen to be multi-componential, involving an array of cognitive processes rather than a singular structural and functional entity (Carlesimo & Costa, 2011). It is generally accepted that executive functioning processes are implicated in the performance of PM tasks (Burgess et al., 2008). Executive functioning refers to a broad range of higher order cognitive processes such as planning, task initiation, switching between tasks, and monitoring task performance (Salthouse, Atkinson, & Berish, 2003). These executive functions are believed to be subserved by frontal regions of the brain (Bisiacchi, 1996; Glisky, 1996; West, 1996). This relationship between PM, executive processes, and frontal brain functioning has been observed in studies using experimental (McDaniel et al., 1999), functional neuroimaging (Burgess, Gonen-Yaacovi, & Volle, 2011), and electrophysiological methods (West, 2011).
Damage to the frontal regions of the brain is associated with a variety of clinical disorders including ABI, some types of dementia, schizophrenia, multiple sclerosis, HIV, and Parkinson’s disease (Malloy, Cohen, Jenkins, & Paul, 2006). As there is a relationship between these frontal brain regions, executive functioning, and PM performance, it is expected that individuals with cognitive impairments resulting from these disorders will experience impairments in PM (Kliegel, Jäger, Altgassen, & Shum, 2008). In line with this prediction, PM impairments have been documented in a number of clinical groups including those with Parkinson’s disease (A. Costa, Peppe, Caltagirone, & Carlesimo, 2008; Foster et al., 2009; Whittington, Podd, & Stewart-Williams, 2006), schizophrenia (Altgassen, Kliegel, Rendell, Henry, & Zöllig, 2008; Kumar, Nizamie, & Jahan, 2008; Shum, Ungvari, Tang, & Leung, 2004; Y. Wang et al., 2009), multiple sclerosis (Bravin, Kinsella, Ong, & Vowels, 2000; Rendell et al., 2012; Rendell, Jensen, & Henry, 2007), and HIV (Carey et al., 2006; Woods et al., 2007). The vast majority of clinical studies have however focused on PM impairments experienced by individuals with ABI, MCI and dementia (particularly of the Alzheimer’s type) as these individuals appear to be most at risk and affected by PM impairments. Consequently, the current research will also focus on PM in relation to ABI, MCI, and dementia. The following sections will provide an overview of brain injury, MCI, and dementia; and will review the literature investigating PM within these clinical groups.

**Acquired Brain Injury**

Acquired brain injury refers to damage to the brain that occurs any time after birth. Common causes of ABI include stroke, encephalitis, haemorrhages, hypoxia, tumours, and infection (Brain Injury Australia, n.d.). Traumatic brain injury (TBI) is a subtype of ABI caused by an external force to the head resulting in the brain becoming bruised, swollen, stretched, or torn. These injuries are typically caused by motor vehicle accidents, falls, gunshot wounds, assaults, and sporting accidents (Ponsford, Sloan, & Snow, 2013). There is
a lack of current data on the incidence and prevalence of ABI and estimates vary largely depending on the definitions and methods used in making estimates. Nevertheless, a report issued by the Australian Institute of Health and Welfare (Fortune & Wen, 1999), estimated that the incidence of ABI in Australia is 149 per 100,000 per annum, and that 338,700 Australians (1.9% of the population) had a disability resulting from an ABI.

Acquired brain injuries are commonly associated with sensorimotor disabilities such as paralysis, vision problems, speech impairments, difficulties in swallowing, and impaired balance and coordination. In addition, individuals with ABI often exhibit cognitive and behavioural symptoms. These may include fatigue, flatness of affect, a lack of initiative, impulsivity, irrationality, inappropriate social behaviours, difficulties with attention and information processing speed, and impaired planning and problem-solving abilities.

Impairments in learning and memory (including PM) are also commonly seen in individuals with ABI (Ponsford et al., 2013). The nature of impairments experienced by individuals with ABI will depend on the brain regions injured. For example, damage to the temporal and frontal lobes of the brain has been reported to result in deficits in RM and executive functioning respectively (Malloy et al., 2006). As PM involves both of these functions it can be expected that individuals with ABI would be more vulnerable to PM impairments (Fleming et al., 2008; Mathias & Mansfield, 2005).

**Prospective memory performance in acquired brain injury.** For those with an ABI, PM failures can be embarrassing, frustrating, and life-threatening. Individuals and significant others of those with ABI identify PM failure as a barrier to functional independence, more so than other types of memory problems (Radford, Lah, Say, & Miller, 2011; Shum et al., 2002). Frequent PM failures may result in a loss of independence for individuals with ABI as they must rely on others to prompt them to undertake essential tasks (Fleming et al., 2009). As PM failure has significant consequences for individuals with ABI,
an understanding of PM functioning in ABI is essential for creating assessment tools that can be used to identify deficits. These tools can then be used to assist in the implementation of appropriate compensation strategies and to determine the amount of care and support required for the individual (Fleming et al., 2008).

A number of studies have investigated the relationship between PM and ABI using laboratory, naturalistic, clinical, and virtual reality measures. These studies found that in comparison to healthy controls, PM performance was impaired in individuals with TBI (Canty et al., 2014; R. Hannon et al., 1995; Henry et al., 2007; Mathias & Mansfield, 2005; Shum et al., 1999) and ABI resulting from other causes (Brooks et al., 2004; Groot, Wilson, Evans, & Watson, 2002; Radford et al., 2011; Raskin, Buckheit, & Waxman, 2012). All of these studies except the study conducted by Brooks et al. (2004) found impairments in both time-based and event-based tasks. Impairments in activity-based PM have also been reported, although individuals with TBI were seemingly less impaired on activity-based tasks than on time-based and event-based tasks (Shum et al., 1999). In the above studies, individuals with ABI were more impaired on time-based tasks compared to event-based tasks. In contrast, in their meta-analysis of PM and TBI, Shum, Levin, and Chan (2011) did not find significant differences between time-based and event-based conditions. However, they did suggest that the ongoing task demands were lower in time-based compared to event-based conditions and this may have led to an underestimation of PM deficits on time-based tasks.

A possible explanation for the difficulties exhibited by individuals with ABI on time-based tasks is that these individuals cannot rely on environmental cues as they would in event-based tasks. Instead, time-based tasks require strategic monitoring of time cues and self-initiated retrieval of intentions. These processes are believed to be associated with executive functioning, which is assumedly impaired in individuals with ABI (Kliegel, Jäger, Altgassen, et al., 2008). Supporting this notion, several studies have reported a link between
PM and executive functioning processes in individuals with ABI (Fleming et al., 2008; Kinsella et al., 2009). For example, Mioni, Stablum, McClintock, and Cantagallo (2012) found that accuracy on time-based tasks was associated with intact updating abilities and working memory processes, both of which are related to executive functioning. Using the complex PM paradigm, Kliegel, Eschen, et al. (2004) found that individuals with TBI were impaired on intention formation, intention reinstatement, and intention execution compared to healthy younger controls. Whilst these executive functions were impaired, RM retrieval processes in this task remained intact. In stroke patients with predominantly frontal lesions, Kim, Craik, Luo, and Ween (2009) found executive functioning to be impaired in regards to self-initiation and cognitive control, but not other components. They argued that the extent to which executive functioning processes are compromised may depend on the characteristics of the PM task used, for example, whether strategic monitoring or automatic retrieval processes are involved in retrieving the PM cue.

In their meta-analysis, Shum et al. (2011) reported that in addition to executive functioning, RM processes were also associated with PM performance in individuals with closed head injuries. However, whilst RM may be involved in PM in individuals with ABI, Henry et al. (2007) argued that RM is not the major cause of impairments experienced by these individuals in PM tasks. They reported that PM difficulties still emerged when the RM demands associated with the PM task were reduced and when ongoing task demands were matched for controls and individuals with ABI. Furthermore, studies have found that although individuals with ABI had difficulty in remembering to fulfil intentions, they were still able to recall the PM instructions following the PM task (Kliegel, Eschen, et al., 2004; Mioni et al., 2012; Raskin et al., 2012). These findings considered together suggest that PM failure in ABI is not primarily the result of forgetting the PM instructions (the RM
component). Instead, PM failure reflects an inability to retrieve the intention from memory (the PM component).

Although both executive functioning and RM are involved in PM performance, they do not fully account for deficits experienced in individuals with ABI. A number of other factors such as the task dimensions identified in Chapter 1 are likely to contribute to PM performance in ABI. Task importance/motivation was one of the dimensions associated with PM performance. In individuals with ABI, motivation has been implicated in PM performance (Brooks et al., 2004). This was demonstrated in a series of studies conducted by McCauley and colleagues (McCauley, McDaniel, Pedroza, Chapman, & Levin, 2009; McCauley et al., 2010; McCauley et al., 2011), whereby children and adolescents with TBI were given either high motivation (points in reward for dollar bills) or low motivation (points in reward for pennies) to perform a PM task. Individuals with mild and moderate TBI performed better in the high motivation condition compared to the low motivation condition. However, motivation did not result in improvements in those with severe TBI. Hence, there is a need to further investigate the role of the various PM dimensions that may affect PM performance in individuals with ABI.

There are several issues that have been identified in relation to the measurement of PM in individuals with ABI. Issues highlighted by Mathias and Mansfield (2005) included sample characteristics, sources of recruitment, and differing task demands. One issue raised was that studies in this area typically have used small, heterogeneous samples. Samples regularly consist of individuals with ABIs of various aetiologies, often combining individuals with TBI with those resulting from other causes. The severity and location of brain injury also differs across studies and in some cases is not reported at all. This makes it difficult to generalise findings across studies. Differing task characteristics and demands across studies also limits the generalisability of findings across different settings. Another issue noted by
Matthias and Mansfield was that some studies have recruited individuals on the basis of having memory impairments. This recruitment bias may lead to different results to studies that did not recruit on the basis of memory impairment. Hence, larger studies that can assess PM across ABI subtypes and severity and task characteristics are needed in order to fully understand the effects of PM on those with ABI. Where this is not practical (such as in the current research), it is still important to assess the effects of PM in ABI samples and to provide maximum detail about participants so that these characteristics can be taken into consideration when interpreting results. In the current research, the relationship between ABI and PM performance (as measured using naturalistic PM tasks) was to be investigated to provide further insight into ABI related PM impairments.

**Self-reported prospective memory and acquired brain injury.** Similar to the findings of laboratory and naturalistic PM research, informant reports using the CAPM indicate that individuals with ABI experience a greater frequency of PM failures than healthy controls. In addition, these informants have reported that individuals with TBI also rely on memory aids more so than healthy controls (Radford et al., 2011; Roche et al., 2007). However, in these studies individuals with ABI did not report having more PM failures or needing more memory aids than controls. Similarly, R. Hannon et al. (1995) found no differences between individuals with ABI and controls on self-reported strategy use on the PMQ. However, they did find that individuals with ABI reported poorer performance than younger adults on the Short Term Habitual subscale of the PMQ. Together, these findings suggest that individuals with ABI may benefit from compensatory aids more than other individuals yet despite this they do not make additional use of them. Furthermore, these scales do not appear to detect differences between healthy adults and individuals with ABI. This may be due to a lack of awareness of impairments in individuals with ABI.
Successfully carrying out PM tasks in everyday life requires knowing if one will be able to remember to perform the intention and when memory aids will be needed (Fleming et al., 2008; Knight, Harnett, & Titov, 2005). A common issue following ABI is that self-awareness of memory ability is impaired, leaving individuals with a lack of insight into the effects of their impairments (Roche et al., 2002). Self-awareness may be affected to varying degrees; individuals may not be aware of deficits at all, they may not realise how deficits affect day-to-day functioning, or they may lack the ability to understand how to compensate for these deficits. For example, an individual may forget that they have actually had memory lapses. Alternatively, they may report their premorbid memory performance as they lack insight into how the ABI has affected their memory (Roche et al., 2002). Man, Fleming, Hohaus, and Shum (2011) note that whilst this lack of awareness in individuals with ABI may affect the validity of memory self-reports, not all individuals with ABI will demonstrate these issues.

A method to overcome the issue of awareness in ABI is to use informant reports of memory ability. When studies have compared self-reported PM failure of individuals with ABI to informant reports from their significant others, ABI individuals tend to underestimate the extent of their deficits. Alternatively, when self-reports of healthy controls are compared to informant reports from their significant others, these individuals tend to overestimate PM failures experienced (Roche et al., 2002; Roche et al., 2007). This pattern of findings could be explained by the fact that healthy people do not usually report their everyday memory failures to significant others whereas the behaviour of individuals with ABI is typically monitored by significant others and PM failures are likely to be noticed by these informants (Roche et al., 2002; Roche et al., 2007). Alternatively, these informant reports may be inaccurate and influenced by bias caused by stress or caregiver burden (Roche et al., 2007).
As mentioned in Chapter 1, even when self-report and informant reports of PM are not 100% accurate measures of PM performance, perceptions of PM ability and concerns about PM failure provide valuable clinical information in the assessment of PM in ABI. Individuals’ beliefs and concerns about their memory ability can be used as a starting point for treatment planning (Roche et al., 2002). Despite the clinical utility of self-report measures in assessing ABI, little research has actually been conducted to investigate the relationship between self-reported PM and ABI. Therefore, in the current study the relationship between self-reported PM and ABI was to be investigated. Despite previous studies not being able to detect PM impairments in self-report scales such as the CAPM and PMQ, it was of interest to this study to assess whether impairments could be detected using the PMCQ.

**Dementia**

Another clinical disorder that is commonly associated with impairments in PM is dementia. Dementia is a major global health issue with over 36 million people estimated to be living with dementia worldwide in 2010 (Alzheimer’s Disease International, 2013). In Australia, approximately 270,000 individuals were believed to be living with dementia in 2011. It is estimated that by the year 2050 this number will increase to over 900,000 (Deloitte Access Economics, 2011). Thus, dementia will become a growing cause of disability in Australia. This will result in significant costs to the health care system and will place a greater burden upon caregivers (Australian Institute of Health and Welfare, 2012).

Dementia refers to a range of disorders associated with cognitive decline and a reduction in the ability to function independently. In the most recent edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-V; American Psychiatric Association, 2013), dementia has been replaced with the term “neurocognitive disorder” in order to provide a broader scope for diagnosis. In this thesis however, the term “dementia” will be used to maintain continuity with terms used in the PM literature.
Dementia is typically characterised by impairments in memory and other cognitive functions. Impairments in memory are often one of the earliest indicators of dementia, with individuals demonstrating RM failures such as forgetting conversations or PM failures such as forgetting where they have placed common objects (Rabin, Wishart, Fields, & Saykin, 2006). However, the nature of cognitive decline will vary depending on the type of dementia. Alzheimer’s disease is the most common form of dementia and is characterised by a gradual onset of cognitive and behavioural symptoms, particularly in the memory domain (Access Economics, 2009). Another common subtype of dementia is Frontotemporal dementia, which involves behavioural symptoms (e.g. apathy or disinhibition) or language symptoms such as difficulty with speech production or comprehension (American Psychiatric Association, 2013). Alternatively, dementia with Lewy bodies features attention difficulties, hallucinations and often concurrent rapid eye movement sleep behaviour disorder. Vascular dementia is another common aetiological subtype associated with changes in personality, psychomotor ability, and executive functioning. Vascular dementia is diagnosed in individuals who have a history of cerebrovascular disease. Further subtypes of dementia include dementia resulting from HIV infection, Prion disease, Parkinson’s disease, Huntington’s disease, substance use, or other medical conditions (American Psychiatric Association).

The DSM-V (American Psychiatric Association, 2013) and the National Institute on Ageing-Alzheimer’s Association workgroup (NIA-AA; McKhann et al., 2011) provide several criteria for diagnosing dementia. These include cognitive and behavioural symptoms that significantly affect social or occupational functioning. The symptoms represent a decline from previous levels of functioning and are not the result of any other psychiatric or neurological disorders. Depending on the subtype of dementia, symptoms include impairments in the domains of attention, memory, executive functioning, language, perceptual motor ability, personality, and social cognition. Neither the DSM-V nor the NIA-
AA workgroup criteria specify neuropsychological instruments or cut-off scores to be used in diagnosis. However, the DSM-V notes that performance two standard deviations below age-appropriate norms on a neuropsychological test is typically used in the diagnosis of dementia (American Psychiatric Association, 2013). In making a diagnosis of dementia, a combination of patient history and neuropsychological testing should be used. Each method provides differential information that will assist in making clinical decisions, for example, an individual with a high IQ may score well on neuropsychological tests but a patient history interview may reveal that this performance is below their previous level of functioning or premorbid IQ level (Petersen, 2004).

Before the onset of many dementias (particularly Alzheimer’s disease) there is often a decline in cognitive functioning (Jones, Livner, & Bäckman, 2006). This may manifest in lapses in memory, attention, or other cognitive domains that are mild and have minimal impact upon daily functioning. For example, an individual may report taking more time to complete tasks (Petersen et al., 2001). There is now a focus on diagnosing dementia during these early stages as effective drug treatments that may minimise neurological damage are available (Duchek, Balota, & Cortese, 2006; Petersen, 2007).

**Mild Cognitive Impairment**

Mild cognitive impairment is conceptualised as an intermediate stage between normal ageing and mild dementia, although this continuum is arbitrary (Petersen et al., 2001). In the DSM-V, the diagnostic category of “mild neurocognitive disorder” has been added to cover impairments observed in this transitional stage (American Psychiatric Association, 2013). However, the term MCI will be used in this thesis to maintain consistency with the PM literature.

Individuals with MCI have slight impairments in one or more cognitive domains but impairments do not significantly affect social or occupational functioning as is experienced in
The criteria typically used for the diagnosis of MCI include: a subjective cognitive complaint from the patient which is corroborated by an informant, cognitive impairments confirmed by neuropsychological testing, intellectual functioning which is comparable to age-appropriate standards, minimal impairment in activities of daily living, and the individual does not have a diagnosis of dementia (Albert et al., 2011; American Psychiatric Association, 2013; Petersen, 2004, 2007). As with the diagnosis of dementia, MCI is diagnosed on the basis of neuropsychological assessment and patient history. There are no neuropsychological tests or cut-off scores specified for use in diagnosis, however typically test scores that are 1.5 standard deviations below age norms are considered to be indicative of MCI (American Psychiatric Association; Petersen et al., 2001).

There are several subtypes of MCI that provide further information about cognitive impairments. MCI is classified as either amnestic, whereby the individual is primarily impaired in the memory domain, or non-amnestic where the individual is impaired in domains other than memory (e.g. language, executive functioning, or visuospatial skills). In addition, in single-domain MCI, only one cognitive domain is impaired, whereas in multiple-domain MCI more than one cognitive area is affected (Petersen, 2004, 2007, 2011).

The aetiology of MCI provides important information about the course and progression of the disease. MCI may result from neuronal degeneration, vascular factors (such as a history of strokes or transient ischaemic attacks), psychiatric causes (including a history of depression, anxiety, or other mood disorders), or coexisting medical disorders such as diabetes, small vessel disease, or heart disease (Albert et al., 2011). MCI is considered to be heterogeneous as different aetiologies lead to various outcomes. For example, MCI that is amnestic and degenerative will most likely progress to Alzheimer’s disease. Other aetiologies and subtypes may lead to other types of dementia. Alternatively, some individuals with MCI may never progress to dementia at all (Petersen, 2007; Petersen et al., 2001).
In the Sydney Memory and Ageing Study (Brodaty et al., 2013), the progression of MCI into dementia over a 2-year period was assessed. 4.8% of individuals with MCI at baseline progressed to dementia at the 2-year follow-up. The progression rate of healthy individuals to dementia over this 2-year period was 1.2%. These rates were found to be similar to previous community studies. Despite reasonably consistent findings suggesting that MCI progresses into dementia, Petersen (2004) identified several methodological issues that make predictions difficult. For example, MCI samples are typically heterogeneous including individuals with amnestic and non-amnestic MCI of differing aetiologies and severity. In addition, studies measuring progression from MCI to dementia have mostly analysed short-term progression rates. Hence, there is a need for long-term studies to determine the full course of progression from MCI to dementia (Petersen, 2011).

Several diagnostic markers have been identified in relation to the progression from MCI to dementia (especially Alzheimer’s disease). Amyloid beta deposits, cortical atrophy, and cerebrospinal tau protein levels are all potential biomarkers of dementia but are not widely available in clinical settings (American Psychiatric Association, 2013). The genetic allele apolipoprotein E4 has been linked to the rapid onset of Alzheimer’s disease and is considered to be a risk factor for the disease (Albert et al., 2011; Petersen, 2004, 2007, 2011).

The E4 apolipoprotein allele has also been linked to PM performance. In a study conducted by Driscoll, McDaniel, and Guynn (2005), individuals who carried the E4 allele performed successfully on fewer PM trials compared to individuals who did not carry the allele. In another study where individuals with Alzheimer’s disease were compared to healthy controls on an event-based task, the presence of the E4 allele was correlated with PM performance but only in very early onset dementia. Surprisingly, in healthy adults the presence of the allele was associated with increased PM performance and with the increasing age of individuals the allele appeared to lose its potency as a risk factor (Duchek et al., 2006).
These findings suggest that PM performance may be associated with the E4 allele and furthermore may play a role in MCI and dementia.

The Relationship between Prospective Memory, Dementia, and Mild Cognitive Impairment

One of the hallmark symptoms of both MCI and dementia is memory impairment. Episodic memory or RM is a well-established indicator of both of these disorders and is widely used in the neuropsychological assessment and diagnosis of MCI and dementia (American Psychiatric Association, 2013; McKhann et al., 2011; Petersen, 2004, 2007, 2011; Rabin et al., 2012; Rabin et al., 2006). Similarly, impairments in executive functioning are seen as an indicator of the onset of MCI and dementia (Rabin et al., 2012). Individuals with frontotemporal, Lewy body, and vascular dementia subtypes are particularly prone to executive dysfunction as these aetiologies are associated with damage to the frontal regions of the brain (American Psychiatric Association, 2013; Malloy et al., 2006; Rabin et al., 2006). As PM reportedly involves RM processes (Ellis, 1996; McDaniel & Einstein, 2007) and frontally mediated executive functioning processes (Burgess et al., 2011; McDaniel et al., 1999; West, 2011), both of which are associated with MCI and dementia, it is assumed that PM is also impaired in individuals with MCI and dementia (Kliegel, Jäger, Altgassen, et al., 2008). Hence, a number of studies have been carried out to determine whether PM impairments exist in dementia and MCI.

Prospective memory performance in dementia. As Alzheimer’s disease is the most common form of dementia, almost all studies comparing individuals with dementia to healthy controls have used individuals from this subgroup. These studies have consistently found that PM was impaired in individuals with dementia. When compared to older and younger healthy adults, individuals with dementia were found to perform poorly on both laboratory event-based (Duchek et al., 2006; Gao, Cheung, Chan, Chu, & Lee, 2013) and time-based tasks
Poor performance on these tasks was manifested through slower and fewer accurate responses to PM targets. PM impairments have also been found in individuals with Alzheimer’s disease in naturalistic settings. For example, Huppert, Johnson, and Nickson (2000) reported that only 8% of individuals with probable dementia successfully performed a PM task despite the mild severity of dementia in this group.

The impact of differing task characteristics has been assessed to some extent in relation to individuals with dementia. In the study conducted by Maylor et al. (2002), individuals with Alzheimer’s disease performed comparatively on event-based and time-based tasks. However, this effect has not been found in the other laboratory studies listed above. In all of these laboratory studies, individuals with Alzheimer’s were not disproportionately impaired on the PM component compared to the RM component. This finding was also reported in naturalistic settings whereby Livner, Laukka, Karlsson, and Backman (2009) found that individuals with both Alzheimer’s and vascular dementia were impaired on PM and RM components equally. Thus it appears that in dementia, PM impairments are observed regardless of task type and that the impairments on the PM and RM components of the task are similar.

Prospective memory performance in mild cognitive impairment. Consistent with the findings of PM impairments in dementia, studies investigating PM in individuals with MCI have repeatedly shown that individuals with MCI perform poorly on PM tasks when compared to healthy controls matched for education and age. These findings emerged across a variety of PM assessment methods including the CAMPROMPT (Delprado et al., 2012), Virtual Week (Will et al., 2009), the MIST (Karantzoulis, Troyer, & Rich, 2009), the Royal Prince Alfred Prospective Memory Test (Rabin et al., 2012), laboratory-based tasks such as remembering to press a key on encountering a particular stimulus (Blanco-Campal et al., 2009; A. Costa et al., 2010; A. Costa, Perri, et al., 2011; Tam & Schmitter-Edgecombe,
2013), and naturalistic tasks such as remembering to call the experimenter (Jones et al., 2006). Comparing the various subtypes of MCI to healthy controls, Wang, Guo, Zhao, and Hong (2012) found that PM performance was most impaired in amnestic MCI, followed by non-amnestic MCI and healthy controls.

The majority of studies investigating MCI and PM have focused on task characteristics that result in impairments in PM performance. These characteristics have included salience and specificity of PM targets (Blanco-Campal et al., 2009) and importance placed upon the ongoing task as opposed to the PM task (Tam & Schmitter-Edgecombe, 2013). In terms of the task types, some studies have found MCI patients to perform better on event-based tasks compared to time-based tasks (A. Costa et al., 2010; Delprado et al., 2012; Karantzoulis et al., 2009) whilst other studies have found the opposite effect (B. Wang et al., 2012). Although, this opposing effect was only found for individuals with non-amnestic MCI, this suggests that performance on these tasks may be affected differently for different subtypes of MCI. However, task difficulty could also potentially account for these effects (A. Costa, Caltagirone, & Carlesimo, 2011; Rabin et al., 2014).

Performance on the prospective and retrospective components of PM has also been assessed in individuals with MCI. Some studies have found the PM and RM components to be equally impaired in individuals with MCI (Jones et al., 2006)—which is consistent with findings of studies using individuals with dementia—whereas other studies have found better performance in MCI on the RM component compared to the PM component (A. Costa et al., 2010). Alternatively, Delprado et al. (2012) found greater impairments on the RM component than on the PM component. They suggested that these inconsistent findings across studies may be attributed to differences in aetiologies across samples (e.g. impairments in RM as opposed to executive functioning).
The use of memory aids is another factor that may affect PM performance in individuals with MCI. Delprado, Kinsella, Ong, and Pike (2013) found that individuals with MCI used less effective memory strategies than healthy controls, for example, they were more likely to receive reminders from others, which is considered less reliable than other strategies. Conversely, Thompson, Henry, Withall, Rendell, and Brodaty (2011) found that individuals with MCI benefited from the use of external memory aids. In addition, Ozgis, Rendell, and Henry (2009) tested memory strategies on individuals with MCI using time-based Virtual Week tasks. They found that the impairments observed in the MCI group were minimised when spaced retrieval memory strategies were used to the point where differences between the MCI and control groups were eliminated. As memory aids and compensation strategies have the potential to help individuals with MCI, Costa, Carlesimo, and Caltagrione (2012) argued that PM should be involved in clinical assessment and intervention planning.

Overall, the effects found in these MCI studies must be considered with caution. A. Costa, Caltagirone, et al. (2011) noted in their review of MCI studies that the PM paradigms and task characteristics used were extremely varied, which may affect the reliability of comparisons across studies. They also warned that the study samples were heterogeneous with studies using a mixture of amnestic, non-amnestic, single and multiple domain MCI participants. Another issue identified in this review was that the sample sizes used in the reviewed studies were small, ranging from 10-48 with an average of 25 participants. These issues will be discussed in Chapter 7 in detail in relation to the current research.

Comparisons of prospective memory performance in dementia and mild cognitive impairment. There have been few studies to date comparing individuals with dementia and MCI on PM tasks. E. van den berg, Kant, and Postma (2012) conducted a meta-analysis on studies measuring PM performance in individuals with MCI and dementia in the laboratory (seven studies) and in naturalistic settings (six studies). They found large deficits
in PM performance in individuals with dementia compared to controls and in individuals with MCI compared to controls. However, individuals with MCI and dementia did not differ on PM performance. In addition, within the MCI and the dementia groups, performance did not differ between time-based versus event-based tasks or PM versus RM components.

A study conducted by Troyer and Murphy (2007), found that individuals with dementia and individuals with amnestic-MCI were both more impaired on time-based and event-based tasks than healthy controls. Contrary to the finding of E. van den berg et al. (2012), this study also found that individuals with MCI outperformed those with dementia on the PM tasks. Whilst those with Alzheimer’s showed equivalent time-based and event-based scores in this study, individuals with MCI had greater impairment on the time-based task compared to the event-based task. These findings indicate that MCI and dementia may be differentially impaired on PM tasks.

Two studies conducted by Thompson and colleagues compared three groups of individuals (dementia, mixed-aetiology MCI, and healthy control) on PM tasks in laboratory (Thompson, Henry, Rendell, Withall, & Brodaty, 2010) and naturalistic settings (Thompson et al., 2011). In the laboratory, individuals with dementia showed the greatest amount of impairments on the Virtual Week task, whilst the healthy controls showed the least amount of impairment. Those with MCI performed worse than controls but were less impaired than those with dementia (Thompson et al., 2010). In naturalistic settings whereby participants were asked to switch on electronic organisers at specified times over two days, individuals with dementia performed worse than controls. Unlike the findings observed in the laboratory study, the MCI group performed comparatively to the control group in the naturalistic task. In this task, individuals were able to use external aids and were given a business card as a prompt (Thompson et al., 2011). As mentioned in the previous section, individuals with MCI may be able to compensate for PM deficits with the use of external memory strategies.
However, the results of this study suggest that individuals with dementia do not seem to benefit from such aids.

Although few studies have compared individuals with dementia, MCI, and healthy controls, it appears that those with dementia and MCI both experience some difficulty on PM tasks. These findings have clinical importance as PM impairments could potentially be used in a similar manner to RM and executive functioning declines as an early marker of MCI of dementia onset. It is argued that PM relies on more complex cognitive processes than RM and therefore PM impairments may be more apparent in the early stages of MCI dementia (Rabin et al., 2014). In line with this argument, several studies have reported that PM was able to predict MCI and dementia in its early stages and indicated that PM could be a better predictor of these conditions than episodic memory (Blanco-Campal et al., 2009; Duchek et al., 2006; Jones et al., 2006). As mentioned in Chapter 1, self-reports of cognitive decline may also have utility in predicting MCI and dementia.

**Self-reported prospective memory in dementia and mild cognitive impairment.**

In Chapter 1, it was noted that SCD (including reports of memory decline) has been found to be related to the progression to cognitive impairment (Amariglio et al., 2011; Steinberg et al., 2013) and dementia (Jessen, Amariglio, et al., 2014; Modrego & Gazulla, 2013; Waldorff et al., 2012). In addition, Reisberg, Shulman, Torossian, Leng, and Zhu (2010) found that not only were individuals with SCD more likely to progress to dementia or MCI than those without SCD, the progression of cognitive decline in these individuals was more rapid than those without cognitive complaints. SCD has also been related to performance on PM tasks. For example, Rabin et al. (2014) found that individuals with SCD performed worse on long-term subtasks of the Royal Prince Alfred Prospective Memory Test. Hence, SCD, particularly self-reported PM decline, may have clinical utility in the assessment and treatment of individuals with MCI and dementia.
Only one known study has compared those with MCI, dementia, and healthy controls on self-reported PM performance. Eschen, Martin, Schreiter-Gasser, and Kliegel (2009) found that the three groups did not differ in the number of failures reported on the PM or RM components on the PRMQ. They did however find that all groups reported more PM failures than RM failures. More importantly, this difference between PM and RM reports was able to distinguish the Alzheimer’s group from those with MCI and healthy controls.

There are no known studies that have investigated self-reported PM in individuals with dementia and only one study of self-reported PM in MCI. In this study, Tam and Schmitter-Edgecombe (2013) found that individuals with MCI reported more PM failures than controls, however there was no relationship between the self-reported failures and laboratory-based PM in MCI (compared to controls). This lack of correlation was suggested to reflect an impaired awareness of deficits in individuals with MCI, although with so few studies available, further research is required in order to clarify these relationships. Consequently, this research aimed to investigate self-reported PM in individuals with MCI and dementia. It was also of interest in this research to investigate PM performance (as measured by naturalistic PM tasks) in individuals with MCI and dementia. The current research is the first to include both participants with ABI and those with MCI and dementia. Although not a main objective, this research assessed differences between individuals with ABI and those with MCI and dementia.

**Prospective Memory in Normal Ageing**

The previous section provided an overview of PM impairments in clinical disorders such as ABI, dementia, and MCI. However, PM is also believed to decline in healthy adults as a function of normal ageing. It has been widely reported that ageing is associated with declines in memory, particularly working memory and episodic memory (for a review of age-related memory decline see Naveh-Benjamin & Ohta, 2012). As these memory processes are
involved in PM tasks, it would be expected that age differences also occur on PM tasks. Furthermore, Craik (1986) argued that age-related declines on memory tasks will depend on the amount of environmental support provided within the task. As mentioned in Chapter 1, memory tasks such as priming, relearning, and recognition require low amounts of self-initiation processes. In these tasks, environmental prompts are readily available and so these tasks are considered to be less affected by ageing. In contrast, tasks such as cued recall, free recall, and PM involved higher amounts of self-initiation and are therefore expected to result in greater age-related declines (Craik, 1986).

A large portion of the research conducted on PM has focused on the relationship between age and PM. However, the findings have been mixed. In laboratory settings there is a trend towards younger adults outperforming older adults (A.-L. Cohen et al., 2003; A.-L. Cohen et al., 2001; Martin, Kliigel, & McDaniel, 2003; Maylor, 1993, 1996a, 1998; Maylor et al., 2002; Park, Hertzog, Kidder, Morrell, & Mayhorn, 1997; Schnitzspahn, Stahl, Zeintl, Kaller, & Kliigel, 2013; R. E. Smith, Horn, & Bayen, 2012; West, 2001; West & Craik, 1999) whilst other studies have not found age effects (Einstein & McDaniel, 1990; Einstein et al., 1995; Jäger & Kliigel, 2008; Reese & Cherry, 2002; Vogels, Dekker, Brouwer, & de Jong, 2002). A meta-analysis conducted by Kliigel, Jäger, and Phillips (2008) found a medium to large effect size indicating deficits in older adults compared to younger adults in event-based PM. In many of the studies that did not find age effects, the cognitive demands of the ongoing task were reduced for older adults as it was expected that they would have fewer cognitive resources available (Einstein & McDaniel, 1990; Reese & Cherry, 2002). However, in some studies where the background task was equated for older adults to match younger adults, the PM impairments in older adults remained (Cherry et al., 2001; Maylor, 1996a; Reese-Melancon, 2013). Thus, manipulating the demands of the background task may not be sufficient to eliminate age differences in event-based PM (Maylor, 1998).
In contrast to laboratory settings, older adults have been found to perform at a similar level to younger adults or in some cases better than younger adults in naturalistic settings (Bailey, Henry, Rendell, Philips, & Kliegel, 2010; Cuttler & Graf, 2007; Kvavilashvili, Cockburn, & Kornbrot, 2013; Kvavilashvili & Fisher, 2007; McBride et al., 2013; Shum, Cahill, Hohaus, O’Gorman, & Chan, 2013). This contrast between laboratory and naturalistic settings is referred to as the “age prospective memory paradox” (Philips et al., 2008; Rendell & Craik, 2000). This paradox was demonstrated in a meta-analysis conducted by Henry, MacLeod, Philips, and Crawford (2004), where younger adults were found in a number of studies to perform better on both event-based and time-based tasks in laboratory settings, whilst older adults performed better on these tasks in naturalistic settings.

There are several possible explanations for these findings that have been explored. For example, Bailey et al. (2010) suggested that it may not be the setting responsible for these age effects, but instead some other task characteristic. They found that when individuals completed naturalistic tasks in naturalistic settings, older adults’ performance was superior. However, when the task was more similar to laboratory tasks younger adults performed better despite the task still being carried out in the individual’s natural environment.

It has been argued that in naturalistic settings, older adults have a greater knowledge of their own memory ability due to a lifetime of experience with memory tasks, and therefore will make use of compensatory strategies to overcome memory failures (Henry et al., 2004; Maylor, 1996b; Philips et al., 2008). Supporting this claim are the findings of Shum et al. (2013) who observed that when planning strategies were banned from naturalistic event-based and time-based tasks, younger adults outperformed older adults. However, when participants were able to engage in planning strategies these age differences disappeared. It therefore appears that older adults make better use of planning strategies in naturalistic
environments. In laboratory settings where planning strategies are typically not permitted, older adults perform worse.

A different explanation for the paradoxical findings in laboratory and naturalistic settings relates to perceived task importance and participant motivation. Philips et al. (2008) argued that the level of motivation to perform the PM task may differ between younger and older adults. They noted that in research settings younger adults are typically university students who take part in studies for the purpose of gaining course credit. In contrast, older adults participate on a more voluntary basis. Furthermore, there is a generational difference in terms of politeness and completing tasks in a timely manner as older adults tend to gravitate towards more socially and emotionally meaningful interactions (Carstensen, Mikels, & Mather, 2006). This idea was supported in a study where the manipulation of social importance improved older adults PM but young adults did not differ across conditions (Altgassen et al., 2010). In addition, older adults have been reported to have overall higher levels of intrinsic motivation than younger adults when performing PM tasks in naturalistic settings (Kvavilashvili & Fisher, 2007). Further supporting this notion, Ihle et al. (2012) found that older adults had superior performance in naturalistic PM tasks that had low, medium, and high levels of importance. Conversely, younger adults only performed as well as older adults when the task was considered very important. Thus, older adults may have greater intrinsic levels of motivation in PM tasks but manipulations of importance may only affect younger adults.

The effects of ageing have not only been found to differ across laboratory and naturalistic tasks, but also on event-based as opposed to time-based tasks. Due to the greater demands of self-initiated processing in time-based tasks, it is assumed that older adults will perform more poorly than younger adults on time-based tasks compared to event-based tasks. These effects have been found in numerous studies (Einstein et al., 1995; Jäger & Kliegel,
2008; Maylor et al., 2002; Park et al., 1997). However, in contrast, d’Ydewalle, Luwel, and Brunfaut (1999) and Gonneaud et al. (2011) found that time-based PM performance was better than event-based PM in older adults. The meta-analysis conducted by Henry et al. (2004) found that in the laboratory, age deficits were greater for time-based compared to event-based tasks, although these findings were not statistically significant. They reported that the age effects associated with event-based PM were partially related to task demands as tasks that were more demanding resulted in larger deficits than less demanding tasks. In relation to age effects on time-based PM, performance has been linked to perceived task importance (Kliegel et al., 2001). In studies where age effects were greater on time-based tasks, older adults were also slower to respond to targets than younger adults, and monitored the clock less than younger adults (Einstein et al., 1995; Park et al., 1997).

Age differences are also expected to vary depending whether the task is focal or non-focal. Three meta-analyses (Ihle et al., 2013; Kliegel, Jäger, & Phillips, 2008; Uttl, 2011) revealed greater age differences in non-focal conditions compared to focal conditions although this effect did not reach significance in the Uttl (2011) study. The authors of these meta-analyses argued that the processing involved in non-focal tasks to monitor the environment is much greater than that needed for the focal processing of targets. This result was not due to targets in non-focal conditions appearing in peripheral as opposed to central vision (Kliegel, Jäger, & Phillips, 2008). However, the order that the PM and ongoing tasks were specified to be completed did play a role, with age differences occurring when order was specified as opposed to being unspecified (Ihle et al., 2013).

In addition to time and event-based tasks, older adults have been found have poorer performance than younger adults in delay-execute tasks (Einstein, McDaniel, Manzi, Cochran, & Baker, 2000) and habitual tasks (Einstein et al., 1998). It appears that older adults have difficulty with even a brief delay, as they are unable to maintain intentions in working
memory. In habitual tasks, older adults have been found to make a greater number of repetition errors compared to omission errors; if they cannot remember whether the task was performed they are biased towards ensuring that the task is completed and therefore carry it out twice (McDaniel, Bugg, Ramuschkat, Kliegel, & Einstein, 2009; Skladzien, 2010).

The ageing studies reviewed above have assessed PM by comparing differences in performance in groups of younger and older adults. Another approach to assessing the relationship between PM and ageing is to measure the development of PM across the lifespan. Using this approach, two studies have assessed PM in individuals of various ages, ranging from childhood to old-age (Mattli, Zöllig, & West, 2011; Zöllig et al., 2007). These studies both found that PM performance increased with age until early adulthood before slowly declining with increasing age. This trajectory resembled an inverted U-shape pattern with peak PM performance occurring in early to mid-adulthood. Both of these studies monitored cognitive processes using event-related potentials. It was concluded in these studies that the PM failures exhibited by younger versus older participants might be the result of the failure of different processes, suggesting that the processes involved in PM may change across the lifespan.

One area that has not received much attention is the relationship between age and self-reported PM. In the few studies that have investigated this relationship, some have found no differences between younger and older adults on the PMQ (R. Hannon et al., 1995) or the PRMQ (Crawford et al., 2003; Piauilino et al., 2010; G. Smith et al., 2000). However, similar to the findings of age differences on naturalistic PM tasks, other studies have found that older adults reported less PM problems than younger adults on the PRMQ (Hsu & Hua, 2011; Rönnlund, Mäntylä, & Nilsson, 2008) and the CAPM (Chan, Qing, Wu, & Shum, 2010; Chau et al., 2007). Hence, the effects of ageing on self-reported PM require further clarification.
Therefore, an aim of this research was to investigate the effects of ageing on self-reported PM, as measured by the PMCQ developed in this thesis. As the findings of age differences on self-reported PM are mixed, the goal of this research was to identify whether any age differences in self-reported PM exist, and if they do exist, the direction of these age differences (i.e. do younger or older adults report more memory concerns, and do younger or older adults experience more PM deficits?).

Furthermore, as the findings relating to the effects of ageing on PM performance are also mixed, an additional research aim was to investigate whether age has an effect on PM performance, and if so, the direction of this effect. In this research, naturalistic PM tasks were to be used to measure PM performance as the inclusion of a laboratory PM task was impractical and beyond the scope of this research. The detection of age-related declines in PM may have important clinical implications. If age-related declines are found on the PMCQ, this may suggest that the scale has some utility in assessing PM declines associated with normal ageing. From a broader perspective, this would increase the validity of the use of self-report PM scales in the assessment of PM in healthy adults.

The Relationship between Self-Reported Prospective Memory and Naturalistic Prospective Memory Performance

It is apparent from the literature reviewed in the previous sections that the declines in PM performance found in individuals with ABI, dementia, MCI, and in normal ageing using laboratory, naturalistic, and objective clinical PM tasks have not always been mirrored in self-reported PM. As a result, a number of studies have assessed the relationship between self-report measures of PM and performance on laboratory, naturalistic, and clinical PM tasks to determine whether these instruments do indeed measure the same PM construct. These studies have mostly reported weak relationships between self-report measures and “actual” PM performance. For example, only a small correlation between the PRMQ and laboratory
PM task performance has been found (Kliegel & Jäger, 2006a). Furthermore, R. Hannon et al. (1995) found a small correlation between the PMQ and laboratory-based PM, but an even smaller relationship between the PMQ and a naturalistic PM task. Similarly, Uttl and Kibreab (2011) found a weak relationship between self-report and laboratory measures of PM, and a lesser correlation between self-report measures and naturalistic PM.

In individuals with ABI, the correlations between self-reported PM and performance on PM tasks have also been low (Fleming et al., 2009; R. Hannon et al., 1995; Kim et al., 2009; Man et al., 2011; Raskin et al., 2012). This finding has been reported in a study comparing self-reports on the CAPM with performance on the MIST and CAMPROMPT (Fleming et al., 2009), and a study comparing performance on the CAMPROMPT with self-reported PM on the Brief Assessment of PM—a short version of the CAPM (Man et al., 2011). A similar finding has been reported in individuals with MCI. Tam and Schmitter-Edgecombe (2013) found that neither MCI self-reports nor informant reports correlated significantly with performance on an event-based PM task. Informant reports of healthy adults also did not correlate with PM performance in this study. This was contrary to the significant correlation obtained in healthy adults whereby PM performance was related to their self-reported memory problems. It should be noted that in this study, the Memory Functioning Questionnaire (Gilewski & Zelinski, 1988) was used as a measure of self-reported PM, despite it measuring multiple memory domains rather than PM alone.

The reason for the low correlation between self-report PM measures and laboratory, naturalistic, and clinical measures of PM performance remains uncertain. Man et al. (2011) proposed several explanations including that self-report measures may be affected by individuals’ lack of awareness of their PM ability. This may particularly be the case in clinical populations such as in those with ABI, MCI, and dementia where a lack of awareness into impairments might be an issue. Alternatively, they suggested that self-report and
laboratory, naturalistic, and clinical measures of PM may differ in terms of the aspects of PM that they measure. For example, self-report measures may reflect everyday PM behaviours that take place over a longer time frame whereas laboratory, naturalistic, and clinical tasks assess more immediate and specific PM functions. Whilst an analysis of factors that affect the relationship between self-report and other measures of PM is beyond the scope of this thesis, an aim of this research was to investigate the correlation between self-reported and naturalistic PM. Specifically, this research was to assess whether the PMCQ correlates significantly with the naturalistic PM tasks.

The Relationship Between Personality and Prospective Memory

The Five-Factor Model of Personality

The five-factor model of personality is one of the most commonly used personality classification systems. This taxonomy has a hierarchical structure with five second-order factors or dimensions. These dimensions are openness to experience, conscientiousness, extraversion, neuroticism, and agreeableness. Each of these dimensions can then be defined by a narrow range of primary traits that load on to the higher order dimensions (Matthews, Deary, & Whiteman, 2003). P. T. Costa, Jr and McCrae (1992) outlined some of the primary traits that define the five dimensions as follows: those high in openness to experience tend to be intellectually curious, flexible, and imaginative; individuals that are conscientiousness are generally hard-working and organised; extraversion is characterised by an inclination towards being outgoing, sociable, and joyful; neuroticism is related to psychological distress, anxiety, and depression; and those high in agreeableness are typically trusting and cooperative.

Personality, Self-Reported Prospective Memory, and Naturalistic Prospective Memory

As previously stated, PM is believed to be multifaceted and affected by numerous variables. One variable that has been associated with self-reported PM is personality (Uttl & Kibreab, 2011), yet few studies have measured this relationship. One of the first studies to
test this relationship was conducted by Heffernan and Ling (2001) who found that extraverts reported having less PM failures on the PMQ than introverts. They suggested that extraverts, when compared to introverts, are engaged in more social and future oriented activities. As these activities require planning, extroverts have more opportunity to enhance their PM skills. A similar finding was reported by Steinberg et al. (2013) using the PRMQ, however relationships between extraversion and PM have not been reported elsewhere (Cuttler & Graf, 2007; Gondo et al., 2010; Uttl & Kibreab, 2011).

Associations between PM and conscientiousness have been observed more consistently across studies. Individuals high in conscientiousness have reported having fewer memory concerns on self-report measures of PM and also were found to perform better on laboratory and naturalistic PM tasks (Cuttler & Graf, 2007; Gondo et al., 2010; Steinberg et al., 2013; Uttl & Kibreab, 2011). A study conducted by Arana, Meilan, and Perez (2008) observed that “global self-control” and “rule-consciousness” personality traits, which are considered to be primary traits of conscientiousness, predicted PM performance. It has been suggested that people high in conscientiousness tend to concentrate more on making future plans and might be more invested in completing PM tasks successfully (Cuttler & Graf). In the study conducted by Gondo et al. (2010), PM lapses were associated with both conscientiousness and neuroticism, however once the RM scores were deducted from the PM scores to allow for analyses of the PM component alone, only conscientiousness remained significant in younger adults. The authors argued that higher overall conscientiousness scores in older adults may explain the lack of significant findings in these individuals.

Neuroticism has also been linked to PM in several studies. Individuals with high neuroticism scores have been found to report more PM failures on self-report measures (Gondo et al., 2010; Steinberg et al., 2013; Uttl & Kibreab, 2011). In naturalistic settings, relationships between neuroticism and PM performance have not been found (Cuttler & Graf;
Uttl & Kibreab). However, in laboratory settings the findings are mixed. Similar to the self-report findings, Uttl and Kibreab reported a negative relationship between PM success and neuroticism. Alternatively, Cuttler and Graf (2007) found better PM performance in individuals with high neuroticism scores. They suggested that neurotic individuals may monitor their PM performance to a greater extent.

In regards to agreeableness, Uttl and Kibreab (2011) found that agreeableness was related to improved PM performance in the laboratory, but it was unrelated to naturalistic performance or self-reported PM. None of the other aforementioned personality studies have reported an association between agreeableness and PM. Similarly, only one of these personality studies has found openness to experience to be related to PM. Gondo et al. (2010) found a relationship between self-reported PM and openness to experience, but only in older adults and only when the RM component was removed from the PM score. Salthouse, Berish, and Siedlecki (2004) found conflicting results in that openness to experience was associated with all cognitive factors measured (including executive functioning, verbal fluency, and vocabulary), but was not related to PM.

Salthouse et al. (2004) argued that PM does not have a unique relationship with personality when compared to other cognitive factors. However, others suggest that the effects of personality on PM may depend on task characteristics, such as whether the intention is generated by the individual or experimenter, task difficulty, and the extent to which social interaction is present in the task (Arana et al., 2008; Cuttler & Graf, 2007). For example, Gondo et al. (2010) suggest that conscientiousness could be particularly important for tasks such as remembering appointments where social interaction and time constraints are present. With so few studies available regarding the relationship between self-report, laboratory, and naturalistic measures of PM and personality, further research is required in order to uncover these effects. In addition, the differential effects of personality on self-
reported and naturalistic PM should be investigated. Therefore, an aim of the current research was to investigate the relationship between the five-factors of personality, self-reported PM, and naturalistic PM performance. Moreover, if relationships between measures of PM and personality were discovered, an additional objective of this research would be to assess whether self-reported PM concerns were merely an artefact of these significant personality variables. That is, do scores on the PMCQ assess PM concerns above and beyond what is predicted by personality factors? If the PMCQ were to predict memory concerns above the variance accounted for by personality factors, this would provide evidence for the validity of self-report PM measures such as the PMCQ.

The Relationship Between Prospective Memory and Social Desirability

Social Desirability Bias

Social desirability bias refers to the tendency for individuals to portray themselves in a positive light. Crowne and Marlowe (1960) proposed that this response bias may be the result of an individual’s need for social acceptance or to avoid criticism. Paulhus (1984) on the other hand argued that socially desirable responding could be broken down into two components. He suggested that socially desirable responding could result from impression management (i.e. intentional faking behaviour), or from self-deception whereby the individual actually believes that their responses are true. Social desirability bias is an issue particularly in self-report scales where participants may distort responses by “faking good” or “faking bad”. Furthermore, instruments measuring competency and sensitive issues are especially prone to such responses (Loo & Loewen, 2004; Loo & Thorpe, 2000; Seol, 2007).

Social desirability bias poses a threat to the validity of self-report measures as it is unclear whether an individual’s responses to items reflect the construct of interest (e.g. memory concerns), or whether they are an artefact of social desirability bias. In order to ascertain whether socially desirable responding is taking place it is recommended that a
social desirability scale, designed to identify individuals high in socially desirable responding, is administered in conjunction with the scale of interest (Blake, Valdiserri, Neuendorf, & Nemeth, 2006; Van de Mortel, 2008). Socially desirable responses can then be treated in three ways. The first method involves eliminating high-scoring individuals on the social desirability scale (as their responses on the scale of interest are likely to be biased), although this method is not favoured. The second method involves using statistical procedures such as factor analyses to determine whether items on the social desirability scale and scale of interest load on to the same factors. Statistical correction of social desirability may also be carried out by adjusting the scores of individuals that score higher on the social desirability scale. The third method is to simply report the correlation between the social desirability scale and the scale of interest, acknowledging that social desirability bias may be contributing to variance on the scale of interest (Leite & Beretvas, 2005; Nederhof, 1985).

Social Desirability in Self-Reported and Naturalistic Prospective Memory

As self-report PM scales assess both competency in everyday PM tasks and sensitive issues such as perceived memory decline, it is possible that these measures (including the PMCQ) may be confounded by the effects of social desirability. Individuals may feel anxious about reporting memory failures or concerns, as memory decline has negative connotations such as the onset of old age or dementia. Hence, they may downplay memory failures or over-exaggerate their memory ability on PM self-report measures to avoid negative evaluations (i.e. impression management). Alternatively, individuals may demonstrate self-deception whereby they lack insight into their PM ability and report having less memory failures than they actually have.

Whilst social desirability bias is mentioned in passing in the PM literature, surprisingly, no research has been published looking specifically at the effects of social desirability on self-reported PM. Cuttler and Graf (2007) found no relationships between
social desirability and naturalistic or laboratory measures of PM, however, they did not assess social desirability in self-reported PM. As social desirability bias may affect the validity of self-report measures (including the PMCQ) an aim of this research was to explore the relationship between self-reported PM and social desirability. More importantly, for the validation of the PMCQ it was important to determine that PMCQ scores were not merely an artefact of social desirability.

**Conclusion and Thesis Aims**

In chapters 1 and 2, a review of the PM literature was provided. As chapter 1 outlined, PM performance is determined by the way it is examined and the characteristics of the tasks used (McDaniel & Einstein, 2007). This was evident throughout chapter 2 in the literature reviewed as the use of varied methodologies resulted in inconclusive findings regarding PM performance. For example, there were inconsistencies in findings relating to PM performance in individuals with ABI (Matthias & Mansfield, 2005; Shum et al., 2011), dementia (Maylor et al., 2002), and MCI (A. Costa, Caltagirone et al., 2011) due to the various methods employed in studies. Similarly, the mixed findings in relation to PM in normal ageing are largely attributable to the differences in the nature of PM tasks used across studies (Bailey et al., 2010; Henry et al., 2004; Kliegel et al., 2008; Philips et al., 2008). In addition, this chapter demonstrated that there is a lack of consensus about the relationship between personality and PM, partly due to the studies in this area using a range of different self-report, laboratory, and naturalistic measures (Arana et al., 2008; Cuttler & Graf, 2007).

The low correlations between self-report measures of PM and other "objective" PM measures (such as laboratory and naturalistic PM tasks) used in the literature reviewed were also highlighted in this chapter. For example, Kliegel and Jäger (2006) found only a small correlation between the PRMQ and laboratory tasks whilst Fleming et al. (2009) made comparisons between the CAPM, MIST, and CAMPROMPT and found low correlations
between the self-report and objective measures. Whilst these repeated findings of low
correlations between self-report and objective measures of PM might suggest that self-report
scales are not effective measures of actual PM performance, it should be noted that these
studies investigating correlations between self-report and objective measures were also
affected by variations in task characteristics. Man et al. (2011) argue that the self-report
measures of PM may differ from laboratory, naturalistic, and clinical measures of PM in
terms of what aspects of PM they measure (e.g. short-term versus long-term behaviours).
Therefore, the low correlations between these tasks may be due to the disparity in task
dimensions rather than being indicative of a lack of relationship between self-report PM and
objective PM.

Thus, it can be concluded from the literature reviewed in chapters 1 and 2 that the PM
construct is multifaceted. Furthermore, when assessing PM, the various dimensions and
characteristics of PM tasks (such as those summarised on page 28) and influences of factors
such as personality and social desirability need to be taken into consideration. Hence, this
review of the PM literature led to the development of three thesis aims. These aims were:

**Aim One**

The primary thesis aim was to develop a brief, self-report scale that measures
individuals’ perceptions of and concerns about their PM ability. This self-report measure was
to be called the Prospective Memory Concerns Questionnaire (PMCQ). The PMCQ was
intended to be theoretically based in its design with items created to assess the wide range of
PM types, processes, and dimensions outlined in Chapter 1. The development of the PMCQ
was to be carried out in Study 1 and 2. As part of this aim, the psychometric properties of the
final version of the PMCQ were to be assessed in order to determine the utility of the scale in
clinical and research settings. Furthermore, normative data was to be obtained for the PMCQ.
for healthy adults across the lifespan. The validation and standardisation of the final PMCQ were to take place in Study 3.

**Aim Two**

The PMCQ was to be developed using a combination of CTT and IRT techniques, an approach that is novel to the development of PM self-report scales. Therefore, the second thesis aim was to investigate whether the scale development techniques employed in this research would result in a scale that was similar in content and structure to existing self-report PM measures that used different scale development procedures. This investigation was to take place in Study 3.

**Aim Three**

The final thesis aim was to investigate the relationship between PM and a number of variables that may be involved in the measurement of PM using self-report measures. This would include an investigation of: self-reported PM and naturalistic PM performance in individuals diagnosed with ABI, MCI, and dementia; the effects of normal ageing on self-reported PM and naturalistic PM performance; the relationship between self-reported PM and naturalistic PM performance; the relationship between personality, self-reported PM, and naturalistic PM performance; and the relationship between social desirability, self-reported PM, and naturalistic PM performance. This aim was to be achieved in Study 3 using the final version of the PMCQ developed in this thesis as a measure of self-reported PM and a series of naturalistic PM tasks. Hypotheses relating to the aforementioned relationships are provided in the introduction to Study 3 in Chapter 6.
CHAPTER 3

Project Overview: Scale Development and Test Theories

This chapter provides an overview of the scale development process and test theories employed in this research. The research was to be carried out across three studies in order to achieve the three thesis aims. The first aim of developing, validating, and standardising the PMCQ was to be achieved progressively across the three research studies. Study 1 was designed for the purpose of developing an item pool for the proposed scale. Study 2 was to be carried out to develop the final version of the PMCQ. Study 3 was to be conducted in order to validate and standardise the final version of the PMCQ. The third aim of investigating issues relating to the self-report measurement of PM was also to be carried out in Study 3, in conjunction with the validation of the PMCQ.

As mentioned previously, the development of the PMCQ scale was to be carried out using a combination of CTT and IRT. The second thesis aim was to investigate whether the PMCQ, developed using this approach was consistent with existing self-report PM measures that were developed using different techniques. This chapter therefore provides a description of the scale development process undertaken in this thesis. Furthermore, this chapter will provide an outline of CTT and IRT, presenting a rationale for their inclusion in this research.

Scale Development Process

In the development of psychological and educational scales there are several steps frequently used which are discussed in texts such as Crocker and Algina (2006), DeVellis (2003) and Downing and Haladyna (2006). These steps align with the Standards for Educational and Psychological Testing (American Educational Research Association, American Psychological Association, & National Council on Measurement in Education, 1999). These steps were followed in the current research in developing the PMCQ. Figure 1 illustrates how these steps were distributed across the three studies in this research.
Step 1: Item Development

Item development in this research began with the development of test specifications (i.e. the consideration of construct definitions, the use of psychometric models, target populations, and intended uses of the test). Next, an item pool consisting of a large number of items that were representative of the construct was developed. Common methods for writing items that sample behaviours from the construct include reviewing the literature, direct observation of behaviour, and expert opinion (Crocker & Algina, 2006). In this study, an extensive literature review of PM books, journal articles, and existing scales was carried out in order to define the PM construct, inform test specifications, and to write items that measured both cognitive and behavioural aspects of PM.

Step 2: Expert Review of Item Pool

Following item development, items underwent an expert review in order to establish their content validity and to identify any flaws within the items. This review involved recruiting a group of experts that were familiar with and had experience with the target population (Standard 3.5; American Educational Research Association et al., 1999, pp. 43-44). In Study 1, the draft PMCQ items were reviewed by a group of people (e.g. health professionals such as nurses or carers) that were expected to have regular contact with people.
with suspected PM impairments. This group were asked to use their knowledge and experience with everyday PM impairments in reviewing the items.

An expert review of items typically assesses the relevance of items in measuring the construct, the level of readability of items, and any technical and grammatical errors with items (Crocker & Algina, 2006; DeVellis, 2003). The expert review in this study involved participants rating items on how relevant they were in measuring PM (i.e. their construct validity) and also how readable (i.e. easy to understand) they were for someone with a mild level of cognitive impairment. Items that were considered to have met these criteria were retained for further analysis in Study 2.

Step 3: Item Trial/Pre-Test

It is recommended that items undergo a preliminary item trial before being tested on a large sample. For example, Crocker and Algina (2006) suggest that a scale should be pre-tested on a small number of participants (as few as 15-30) in order to assess response distributions and ensure that items are performing as expected. Pre-testing also allows the scale developer to receive participant feedback on whether the instructions are easy to understand, the time taken to complete the scale, and if there are any errors in the scale. In Study 2 of this research, a pre-test of the draft PMCQ items was carried out in order to gain feedback from participants on scale items and instructions.

Step 4: Item Analysis

Subsequent to item trials, scale items underwent an item analysis. In an item analysis, items are administered to a large sample and this data is used to examine the psychometric properties of items. Indices such as item difficulty, reliability, discrimination, and model fit are typically examined during an item analysis. Items that perform poorly in these analyses are eliminated, although item content should also be factored into these decisions (Livingston, 2006; Osterlind, 1989). In Study 2, an item analysis was conducted using a
combination of the CTT and IRT methods discussed later in this chapter. Items retained following these analyses formed the final version of the PMCQ.

**Step 5: Scale Validation**

Once the final form of the PMCQ was established, a validation study that included an examination of reliability was carried out (American Educational Research Association et al., 1999; Crocker & Algina, 2006). Validity is defined by Messick (1995, p. 742) as “an evaluative summary of both the evidence for and the actual -- as well as potential -- consequences of score interpretation and use”. Messick identified six aspects of validity that are important for psychological measurement. These include content (relevance and representativeness of items), substantive (empirical evidence that theory is represented in observations), structure (fidelity of scoring items to the construct of interest), generalisability across populations and settings, evidence of convergent and divergent validity, as well as the consequences and implications of score interpretations. In the current research, each of these aspects of validity was assessed for the PMCQ. The content validity of the PMCQ was assessed during the expert review in Study 1, whilst the main validation study took place in Study 3. Many of the validation analyses in Study 3 overlapped with the investigations of variables relating to self-reported PM. Thus, these analyses not only provided evidence to support the validity of the PMCQ, they also provided implications for PM researchers and future users of self-report PM scales.

**Step 6: Standardisation**

The final step in the scale development process was standardisation of the scale. This involved developing normative data for the healthy adult sample providing a benchmark for future scale score comparisons. This is important for diagnostic purposes as judgements can be made about an individual’s performance on the scale based on comparisons to the normative data (Crocker & Algina, 2006). In Study 3, the PMCQ was standardised using a
large sample consisting of people from the general population. In addition, two reference
groups were recruited: one consisting of individuals with ABI, and another group of
individuals diagnosed with either MCI or dementia. The recruitment of these three groups
allowed for the comparison of scores across the groups in this research.

**Classical Test Theory and Item Response Theory**

Throughout the scale development process and investigations of self-reported PM in
this thesis, CTT and IRT approaches were used. More specifically, the one parameter model
of IRT—the Rasch model—was used.

**Classical Test Theory**

Classical test theory is derived from the concept that many phenomena are not
directly observable, for example, memory ability. As a result, measurement instruments (such
as the PMCQ in this thesis) are developed to provide estimates of these unobservable
phenomena.

In CTT, the true score model assumes that an observed score on a scale results from
the combination of a true score and error. This relationship is expressed in the following
equation:

\[ x = t + e \]

whereby \( x \) represents the observed score, \( t \) is the true score or the quantity of the latent
variable (e.g. the true level of memory concerns), and \( e \) represents the error associated with
items (that is, extraneous variables other than the latent variable that contribute to the
observed score, for example environmental factors). In this model, a good scale is considered
to be reliable when observed scores share their variance with the true score (DeVellis, 2006).

CTT therefore includes a variety of statistical techniques based on the principles of reliability
that estimate how well these measurement instruments actually measure the true score on the
variable of interest (DeVellis, 2006).
Furthermore, in CTT, good scales demonstrate unidimensionality and have high inter-item correlations. Scale dimensionality can be assessed through factor analytical methods whilst internal consistency reliability analyses are used to determine inter-item correlations (DeVellis, 2006). This research utilises several of these CTT techniques including factor analysis, internal consistency reliability, and discriminant analysis. The following sections outline each of these methods and provide a rationale for their use in this research.

**Factor analysis and principal component analysis.** Factor analysis is a CTT technique that was used in the development and validation of the PMCQ for data reduction and analysis of scale structure. These functions are carried out using either exploratory (EFA) or confirmatory (CFA) factor analysis methods. In EFA, the researcher is interested in identifying “factors” within the scale. Factors represent underlying constructs within the data and therefore include groups of variables that are highly correlated with one another and are independent of other subsets of variables (Tabachnick & Fidell, 2012). The aim of EFA is to explain the maximum amount of variance in the data using the least number of factors (Nunnally & Bernstein, 1994). EFA is also used in scale construction for reducing the number of items in a scale. Using this method, items that do not load highly onto factors are considered to be poor measures of the construct and are therefore eliminated from the scale (Tabachnick & Fidell). In this research, a procedure similar to EFA called principal component analysis (PCA) was used in the item analysis within Study 2 to assess scale structure and more importantly, for data reduction.

Tabachnick and Fidell (2012) argued that PCA should be used rather than EFA for data reduction purposes. Unlike EFA where factors are obtained, PCA involves the extraction of “components”. The aim of PCA is to extract the maximum amount of variance from the data into each component. The first principal component extracted from the dataset without factor rotation provides a linear combination of variables that account for the most variance.
in the data. The second component includes a linear combination of observed variables that account for the most variance within the residual data, and includes bidirectional loadings. Subsequent components continue to extract maximum variance from remaining variables. These are orthogonal to components already extracted. Therefore, the first component will explain the most variance in the data whilst the final component will explain the least amount of variance in the data (Tabachnick & Fidell).

In PCA (and EFA), analyses are data driven, as the researcher does not have existing hypotheses about what will be found in the data. CFA on the other hand is used to test assumptions about relationships within the data. CFA provides analyses of the goodness of fit of data to the predicted model (Kline, 1994; Nunnally & Bernstein, 1994). A CFA was used in Study 3 to test the validity of the PMCQ developed in Study 2. Specifically, this analysis was used to ascertain whether the model achieved in the PCA during scale development in Study 2 could be reproduced in a different subset of participants.

**Internal consistency.** The reliability of the PMCQ was assessed for internal consistency using Cronbach’s alpha. This was done during scale development in Study 2 and for the final version of the PMCQ in Study 3. According to Nunnally and Bernstein (1994, p. 251) Cronbach’s alpha provides “estimates of reliability based on the average correlation among items within a test”. That is, Cronbach’s alpha assesses the extent to which scale items—or a subscale of items (created through a factor analysis of items)—measure the same construct. A low alpha may indicate that items are not measuring a single construct well and that item-specific variance is high. If this is the case, the scale may be too short or items may need to undergo further refinement (Cortina, 1993; Nunnally & Bernstein, 1994).

**Discriminant analysis.** *Discriminant analysis* (DA) is a procedure used to predict or classify participants’ membership to a group (e.g. clinical versus nonclinical) based on their scale scores. Where groups are predefined (e.g. by age or other sample characteristics), DA
can test how well items classify individuals into these groups. This is done by specifying the proportion of cases correctly classified, and this percentage should be substantially larger than the proportion expected by chance alone. Hence, if there are two equally sized groups, 50% of cases should be correctly classified by chance as a result of random assignment of cases (Tabachnick & Fidell, 2012). In this research, DA was used in Study 2 and 3 to assess how effective the PMCQ was at discriminating between individuals believed to have PM ability in the normal range (i.e. nonclinical participants) and those expected to have poor PM ability (i.e. participants diagnosed with an ABI, MCI, or dementia).

**Utility of Classical Test Theory in Scale Construction and Validation**

Classical test theory was used in this study as it has been extensively used in scale construction and validation. In fact, the majority of existing measures (including PM measures) are based on the principles of CTT (Hambleton & Jones, 1993). These methods are widely understood with most generic statistical programmes equipped to perform CTT analyses. This means that CTT is readily available for scale development and validation (DeVellis, 2006; Hambleton & Jones). As most instruments are created and assessed using CTT, it was imperative that this research incorporate these measures to allow for simple interpretation of the PMCQ scores and for comparison with existing measures.

Classical test theory places an emphasis on data at a scale level rather than item level, therefore individual items that are less than perfect are not considered to be problematic unless there is an issue with the overall scale functioning. Problems with individual items can be overcome by including a greater number of similar items to improve the overall reliability of the scale (DeVellis, 2006). Therefore, in this research, CTT statistics (e.g. means, variance, and error statistics) were used in the development and validation of the PMCQ for the purpose of gaining an insight into the distribution of items on the scale. Furthermore, these CTT statistics were to be used for the development of normative data.
The development of normative data is useful for the development and validation of the PMCQ for several reasons. First, normative data provides information as to how an individual has performed in relation to other individuals within the sample on the scale. This is important as an overall scale score sometimes lacks meaning without knowledge of how this score relates to the distribution of scores (Nunnally & Bernstein, 1994). Second, the use of normative data allows for the comparison of individuals based on age, gender, and clinical group membership. This will facilitate research into group differences and will assist in decisions about individuals’ PM ability (Nunnally & Bernstein). However, CTT is often criticised due to the fact that item responses and person scores are not separable, that is, item responses are dependent on the sample that has been used in scale construction (Fan, 1998). However, as long as the normative sample is representative of the population being targeted, comparisons between different samples can be made (Nunnally & Bernstein).

In this research, CTT was also used in the validation of the PMCQ. Construct validity was to be established through an examination of scale structure in a PCA in Study 2 and CFA in Study 3. Discriminant analyses in Study 2 and 3 were conducted to assess predictive validity, that is, the effectiveness of the PMCQ in classifying individuals’ membership to the nonclinical versus the clinical groups. Finally, convergent and divergent validity were explored in Study 3 through an analysis of correlations with existing scales measuring similar (convergent) and different constructs (divergent) to those measured by the PMCQ. Although CTT is typically used on its own, it can be used in conjunction with the Rasch model to provide a more detailed analysis of scales (Mâsse et al., 2006; Pan et al., 2011). In this research, both CTT and the Rasch model were used in analyses of the PMCQ.

**The Rasch Model**

The Rasch model is a one parameter model of IRT that has been increasingly used for scale development and validation in a variety of disciplines. The Rasch model has been used
in healthcare settings for the development and validation of a number of clinical measures (Belvedere & de Morton, 2010; da Rocha, Chachamovich, Pio de Almeida Fleck, & Tennant, 2013; Hagquist, Bruce, & Gustavsson, 2009). However, the Rasch model has not been used in the PM field and so this research is the first known study to develop a PM scale using this method.

The Rasch model is based on the premise that there is a greater probability of easy items rather than difficult items being answered correctly by all individuals. In addition, individuals with higher levels of ability should answer a greater number of items correctly than those with lower levels of ability (Bond & Fox, 2007). Translated into the context of the PMCQ developed in this research, easy memory tasks are more likely to be endorsed by respondents as being remembered than difficult memory tasks. Furthermore, difficult memory tasks are more likely to be endorsed as being remembered by individuals with high levels of memory ability than those with low levels of memory ability. As a result, the Rasch model mathematically predicts how individuals should respond to an item based on their ability level on a latent trait (Nunnally & Bernstein, 1994).

Person ability is an estimate of the amount of latent trait (i.e. PM concerns) possessed by an individual based on their item response patterns. Conversely, item difficulty relates to how many individuals endorse an item on a scale. In order to calculate person ability and item difficulty the Rasch model uses a logarithmic transformation using the following formula for dichotomous data:

$$\log \left( \frac{P(\text{Success})}{P(\text{Failure})} \right) = \text{ability} - \text{difficulty}$$

This formula converts ordinal raw data into logits. Logits are the metric used in the Rasch model and these form a common interval scale along which both items and persons are placed. The logit scale has an arbitrary origin and unit of measurement. Zero is typically used
to indicate the origin (and is usually taken to be the mean of the item scores), whilst interval sizes are derived from person and item response probabilities on a test (Bond & Fox, 2007).

**The rating scale model.** The general Rasch model described above is used for dichotomous data whereby distinctions are made between passing and failing an item. The *Rasch-Andrich rating scale model* is an extension of this general Rasch model that allows for analysis of Likert or rating scales where there are more than two categories. The point at which there is a 50/50 probability of choosing one category (e.g. strongly agree) over an adjacent category (e.g. agree) is called a “threshold”. Therefore, in a scale with four response categories there will be three thresholds. Threshold values are calculated for all items within a scale and each threshold within an item is given a difficulty estimate. These threshold difficulty estimates are provided in addition to an overall item difficulty measure (Bond & Fox, 2007; Embretson & Reise, 2000; Wright & Mok, 2004). The Rasch-Andrich rating scale estimates are provided using the following formula:

$$\log \frac{P_{nik}}{P_{ni} (k-1)} = Bn - Di - Fk$$

Where:

- $P_{nik}$ is the probability of person $n$, on item $i$, choosing category $k$
- $P_{ni} (k-1)$ is the probability of person $n$, on item $i$, choosing category $k - 1$
- $Bn$ is the ability level of person $n$
- $Di$ is the difficulty estimate of item $i$
- $Fk$ is the threshold whereby the probability of choosing category $k$ is greater than the probability of choosing $k - 1$

The Rasch-Andrich rating scale model requires that each item in a scale contains the same number of response categories and that a single set of threshold values are provided for all items within a scale (Bond & Fox, 2007). These requirements can reduce flexibility in scale development and so the partial credit model was primarily used in this research.
**The partial credit model (PCM).** The PCM was developed by Geoff Masters (1982) for items where it is not appropriate to score a response as either right or wrong and there may be some partially correct response alternatives (Masters, 1988). In the PCM, items are modelled to contain several steps or response options whereby one step should be completed before the next step is used (Masters, 1982, 1988). For example, a person endorsing the category *always* would be expected to have surpassed the point of endorsing the lesser categories *often*, *sometimes*, and *never*. Response options within the PCM are not considered to be equal and so each item is modelled to have its own response structure (Linacre, 2009a). This can be seen within the PCM formula:

\[ \log \frac{P_{nik}}{P_{ni \ (k-1)}} = B_n - D_{ij} \]

Where:
- \(P_{nik}\) is the probability of person \(n\), on item \(i\), choosing category \(k\)
- \(P_{ni \ (k-1)}\) is the probability of person \(n\), on item \(i\), choosing category \(k-1\)
- \(B_n\) is the ability level of person \(n\)
- \(D_{ij}\) is the threshold estimate \(j\) for each individual item \(i\)

In the PCM formula, the parameter \(D_{ij}\) provides individual threshold estimates for each item whereas in the Rasch-Andrich rating scale model the parameter \(F_k\) provides a single threshold estimate for all items in scale.

In applying the PCM to the PMCQ rating scale data, the number of response categories is free to vary from item to item. For example, some items may have three response categories whereas others may have four. This is advantageous as a response category may be used for some items but not others (Bond & Fox, 2007). A second benefit of the PCM is that individual threshold estimates are provided for each item and so distances
between response categories are also free to vary across items (Bond & Fox, 2007; Masters, 1982). This is important as some response categories may be more difficult to endorse in one item compared to other items. For example, it may be more difficult to endorse the category always for an item such as “I forget to turn the stove or iron off” as opposed to an item measuring a lower difficulty level such as “I have trouble remembering names of people or places”. Allowing individual items to have a unique response structure gives a more realistic picture of how individuals respond to items.

**Specifications of the Rasch model.** There are a number of specifications of the Rasch model that needed to be taken into consideration in this research, one of which was specific objectivity. This is the idea that person ability and item difficulty are independent of one another. This is in contrast to CTT where item difficulty is calculated using the proportion of persons who correctly answer the item, which in turn is reliant upon the test takers’ ability (Nunnally & Bernstein, 1994). Therefore, specific objectivity permits analyses of item difficulty on the PMCQ that are not confounded by person ability measures and vice versa.

Similarly, local independence specifies that an item measure should not be influenced by other item measures once the latent trait has been removed. This means that PMCQ items should be correlated as a result of the underlying variable (i.e. PM concerns), and not by another dimension not accounted for by the trait measured by this underlying Rasch variable (Baghaei, 2007; Embretson & Reise, 2000; Wright, 1996). The violation of local independence may indicate multidimensionality where there are dimensions other than PM failures underlying the relationship between items.

Unidimensionality is another specification of the Rasch model. Unidimensionality, the assumption that a scale should consist of a single latent trait, is critical in establishing the content validity of a scale (Bond & Fox, 2007; Embretson & Reise, 2000). In the current
research, this means that the PMCQ should solely measure the PM construct. In this research, unidimensionality was investigated with the Rasch model using fit statistics and principal component analyses of residuals (PCAR).

**Analysis of fit.** Information about whether the scale is unidimensional and whether the data adhere to the predicted model was provided in this research using fit statistics. Fit statistics are calculated for both persons and items. These identify either persons or items that do not perform as expected by the measurement model. For example, a person with high levels of PM ability reporting memory failures on easy items (or tasks). Two types of fit statistics were tested: infit which is weighted towards the performance of persons close to the item measure, and outfit which is not weighted and focuses on outlying measures. Because infit statistics are more sensitive to persons located near an item's difficulty level, they were to be given priority in interpretation (Bond & Fox, 2007).

Fit statistics are reported in either unstandardised or standardised forms. Unstandardised fit statistics, which were used in this research, are reported as mean squares (i.e. the average value of the squared residuals for that item). These are presented as chi square statistics divided by their degrees of freedom. Mean square statistics have a mean of +1.0 and range from 0 to positive infinity (Wright & Linacre, 1994). A mean square of 1.30 indicates that there is 30% more variation in the data than expected and that the responses are too unpredictable. Conversely, a mean square of 0.75 suggests that there is 25% less variation in the data than predicted. This may mean that items are redundant in the information that they provide about the dimension (Bond & Fox, 2007). It is recommended that mean square fit statistics should fall within 0.75 and 1.30 for a typical multiple-choice test, and between 0.5 and 1.7 for clinical decisions (Wright & Linacre, 1994). The standardised fit statistic is reported as a $t$ statistic, which has a mean of 0 and a standard deviation of 1.0. Standardised fit statistics are considered significant (and therefore misfitting) at the $p < .05$ level if they are
± 1.96, however the range of ± 2.0 is generally accepted in diagnosing misfit (Linacre, 2009a; Wright & Linacre, 1994).

These item fit statistics were also used in this research in relation to the Rasch-Andrich rating scale model and PCM. However, these statistics can be interpreted in the same fashion as in the general Rasch model; Wright and Linacre (1994) suggest that for rating scales, mean square fit statistics should be within the range of 0.6 to 1.4. In this research, the more restricted criteria of 0.7–1.3 were used in Study 2 to inform decisions of item retention and deletion. In Study 3, as poorly performing items were to have been eliminated, the criteria of 0.6–1.4 were used to assess the fit of items in the final version of the PMCQ.

**Principal component analysis of residuals (PCAR).** The aim in the Rasch model is to have a unidimensional scale where all of the information in the data is explained by the latent variable. Any unexplained variance in the data (i.e. residuals), where the empirical data do not fit the predicted model is attributed to other dimensions or random noise. In this research, PCAR was used in Study 2 and 3 to detect secondary dimensions in the PMCQ that may explain variance in the data (i.e. multidimensionality; Linacre, 1998, 2003; E. V. Smith, Jr, 2004a).

In PCAR, the first dimension is the Rasch component that is already removed from the analysis. Therefore, the PCAR looks at contrasts in remaining residuals rather than observations in the original data. Eigenvalues above 2.0 in the second contrast (and subsequent contrasts) suggest that the residual variance carries the strength of more than two items, and therefore is above noise level (Linacre, 2009a). If the second contrast is below this level then unidimensionality is assumed. However, if the second contrast is above noise level a dimension other than the Rasch measure may be present and, further analysis of response patterns is warranted (Linacre, 1998, 2003; E. V. Smith, Jr, 2004a).
**Differential test functioning.** Differential test functioning (DTF) is another method that was used in this research to assess scale validity and the generalisability of the PMCQ across groups. Differential item or test functioning occurs when two people with the same ability level score differently on an item as a result of a variable other than the construct of interest (e.g. sample characteristics such as age or gender; Belvedere & de Morton, 2010; da Rocha et al., 2013). The DTF in this research was used to detect items that function differently across clinical and nonclinical groups, for example, items that are more difficult for clinical individuals to endorse than nonclinical individuals (Bond & Fox, 2007). Estimates of item difficulty and person ability for the two groups were plotted against one another on a common logit scale allowing for the comparison of the two groups. Therefore, in clinical settings DTF can be used to ensure the quality of the PMCQ for making decisions based on scale scores (Belvedere & de Morton, 2010).

**Utility of the Rasch Model in Test Construction and Validation**

The Rasch model provides several useful tools for assessing scale validity. These tools were used in this research to ensure that the PMCQ, its items, and item categories performed as intended. The conversion of data into logits allows the functioning of persons and items to be assessed both statistically (using person and item measures) and graphically (using Wright maps). This means that person and item functioning can be assessed in great detail.

In CTT, individuals with the same total score are believed to have the same ability level (Nunnally & Bernstein, 1994). Furthermore, all items in CTT are assumed to carry equal weightings in forming a total score. However, this may mean that items with higher levels of difficulty (or levels of an attribute) are considered equal to items of lesser difficulty. Da Rocha (2013) illustrated this point using an example of depression scales, whereby items measuring suicidal ideation are given equal weighting to items measuring inattention.
However, these should not be considered equal as suicidal ideation indicates a higher intensity of depression than inattention. In Rasch analysis, item and person statistics are separated, and therefore not reliant on one another (E. V. Smith, Jr, 2004b). This means that individual persons and items are weighted based on scale responses.

The separation of person and item scores facilitates the assessment of which items are more difficult, which persons have higher PM ability levels, and how well the PMCQ matches item difficulty to person ability (Bond & Fox, 2007). The scale should measure the full range of the distributions for person ability and item difficulty in order to be representative (E. V. Smith, Jr, 2004b). The hierarchy of PMCQ items on the logit scale can be assessed to detect if there are gaps. If there are large differences between estimates within the distribution then the scale is not precisely measuring items or persons in that area. At this point more items may need to be added to the scale in order to fill these gaps and increase the representativeness of the scale (Baghaei, 2008). Similarly, scale validity can be tested by assessing how well the person and item hierarchies match the hypothetical prediction of how persons and items should be ordered (E. V. Smith, Jr, 2004b; Wright & Masters, 1982).

The validity of the PMCQ was also assessed in terms of whether individuals are using the rating scale as intended. This is achieved using category probability curves and average measures. These provide information on whether all response categories are being used appropriately. For example, are all categories used and do people of higher ability endorse higher categories (Bond & Fox, 2007; Linacre, 1999)? Categories that do not function as intended may indicate that categories are being over or under endorsed or that thresholds between categories are disordered. These categories require further analysis and may need to be collapsed into adjacent categories (Bond & Fox, 2007).
Combining Classical Test Theory and the Rasch Model

Both CTT and the Rasch model provide a variety of tools for scale development and validation. Whilst these theories are quite distinct, they can be used in conjunction with one another. Combining CTT and Rasch methods allows for a more comprehensive analysis of scales. This has been shown in several studies whereby CTT and Rasch methods were found to complement each other (e.g. Mâsse et al., 2006; Pan et al., 2011).

A key difference between CTT and the Rasch model is that CTT analyses focus on data at scale level, whilst the Rasch model emphasises analysis at item level. Incorporating both methods into the development and validation of the PMCQ enables scale items to be evaluated in greater depth (Mâsse et al., 2006). Using CTT, items were to be assessed in terms of how well they contributed to the overall functioning of the total scale. For example, factor analysis and internal consistency reliability methods assess how well individual items contributed to the measurement of the overall PM construct. Normative data (i.e. descriptive statistics) for the PMCQ allows for an analysis of how individuals perform in relation to other individuals on the scale. These statistics are well understood, and PMCQ scores can also be compared with findings from studies that use similar samples. One issue with statistics derived from CTT is that they are sample dependent, and this is where the addition of Rasch analyses (which are “test free” measures) to an analysis is beneficial (Fan, 1998).

Using Rasch analysis, items can be assessed independent of the sample that was used to develop them. Unlike CTT, analyses using Rasch are targeted at the item level, which gives greater flexibility and provides in-depth methods of analysing individual items (Hambleton & Jones, 1993; M. Wilson, Allen, & Corser Li, 2006). In the current research, the distribution or hierarchy of items and persons on the PMCQ were analysed using Wright maps. Furthermore, these analyses indicate whether items are too easy or difficult for respondents and whether there were any gaps in the hierarchy where items are not targeted to
the ability of individuals. In addition, the Rasch analyses of the PMCQ assessed how individuals responded to each item, and how individuals used the rating scale response categories (M. Wilson et al., 2006).

Both CTT and Rasch methods provide tools to evaluate the validity of scales. Using CTT, strong correlations between the PMCQ and other PM scales indicated convergent validity, whilst weak correlations between the scale and scales measuring different constructs indicated divergent validity (Nunnally & Bernstein, 1994). In addition, DA was used to assess predictive validity, that is, how effective the PMCQ is in classifying individuals as belonging to the clinical or nonclinical group (Pan et al., 2011; Tabachnick & Fidell, 2012).

The CTT validation tools can be used in unison with measures to assess validity within the Rasch framework. Construct validity of the PMCQ was to be established within the Rasch model through the assessment of item fit. That is, the PMCQ was considered to be valid if the PMCQ scale items fit the model proposed by the Rasch analysis (Pan et al., 2011). A comparison of how well the item hierarchy obtained in the Rasch analysis matched the expected hierarchy of items would also provide evidence of validity. In addition, PCAR assessed the dimensionality of the PMCQ subscales. Finally, DTF identified items that perform differently for clinical versus nonclinical individuals.

The use of CTT and Rasch approaches in the PMCQ allows for a more targeted approach to the identification and treatment of PM impairments. Using CTT, information about an individual’s overall performance on the scale can be ascertained. More importantly, how well the individual performs in relation to other individuals on the scale can also be established. Comparisons with normative data will identify if the individual’s performance on the scale falls within the normal range or whether the individual’s score indicates the existence of PM impairments.
Using Rasch methods, a clearer picture of which areas of PM the individual is experiencing impairments can be obtained. An analysis of the hierarchy and difficulty of items endorsed by the individual provides an indication of what types of memory behaviours the individual is having difficulty with. For example, the individual may report difficulty with items measuring the retrieval of PM cues and so interventions can be targeted to improving PM retrieval. Hence, utilising the psychometric properties of both CTT and Rasch gives researchers a more comprehensive approach to scale development, validation, and score interpretation. However, there is a limitation of using both CTT and Rasch methods. Namely, CTT requires high item correlations for the development of scale factors, whereas Rasch analyses do not rely on item correlations. Therefore, differing decisions about whether an item should be retained, eliminated, or modified may be made on the basis of these methods. Table 1 summarises how these CTT and Rasch procedures were combined in this research.
Table 1

*Summary of CTT and Rasch Procedures Used in This Research*

<table>
<thead>
<tr>
<th>Purpose</th>
<th>CTT</th>
<th>Rasch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comparisons of performance on scale</td>
<td>Normative data</td>
<td>Person and item hierarchies (Wright maps)</td>
</tr>
<tr>
<td>Convergent and divergent validity</td>
<td>Correlations with the other scales</td>
<td></td>
</tr>
<tr>
<td>Predictive validity</td>
<td>Discriminant analysis</td>
<td>Differential test functioning</td>
</tr>
<tr>
<td></td>
<td>ANOVAs</td>
<td></td>
</tr>
<tr>
<td>Construct validity</td>
<td>Principal component analysis</td>
<td>Item hierarchy model fit</td>
</tr>
<tr>
<td></td>
<td>Confirmatory factor analysis</td>
<td>Principal component analysis of residuals</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fit statistics</td>
</tr>
<tr>
<td>Reliability</td>
<td>Internal consistency (Cronbach’s alpha)</td>
<td></td>
</tr>
<tr>
<td>Rating scale functioning</td>
<td></td>
<td>Category probability curves</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Average measures</td>
</tr>
</tbody>
</table>
Chapter Summary

This chapter outlined the methodology used in this thesis. First, the six steps involved in the process of developing the PMQ were discussed. These steps were item development, expert review of items, item trials or pre-testing of items, item analysis, scale validation, and scale standardisation. A rationale for their use of these steps was also provided.

Second, the data analytical techniques derived from CTT that were used in this thesis were examined which included: PCA, CFA, internal consistency reliability, and DA. The use of CTT in scale development and validation is advantageous as it is widely used and understood and allows for simple comparisons of individuals across studies.

These CTT techniques were complemented by the Rasch model in this thesis. This Rasch analysis calculated separate person ability and item difficulty estimates using a logarithmic transformation placing these two parameters on a common interval scale. The partial credit Rasch model was used to assess the functioning of the PMQ rating scale. The specifications of the Rasch model (i.e. specific objectivity, local independence, and unidimensionality) were outlined and techniques including fit statistics, PCAR, and DTF were also discussed.

Using a combination of CTT and Rasch methodologies in this thesis allowed for the PMQ to be evaluated at both test and item level. CTT analyses were targeted at the test level, providing information about overall scale structure, distribution of individual scores, and reliability and validity of the PMQ. Conversely, Rasch methods focused on individual items in the data analysis, providing an in-depth analysis of item and rating scale category functioning. Item fit statistics and DTF also assessed the validity of scale items. This method of development and validation, which evaluates the scale at both the scale and item level, allowed for a more comprehensive analysis of the PMQ items and individuals’ performance on the scale.
CHAPTER 4

Study 1: Scale Development

Study 1 was carried out in order to partially meet the first thesis aim of developing the PMCQ. Specifically, the purpose of this study was to complete the first two steps of the scale development process outlined in Chapter 3, item development and the expert review of the item pool. Hence, the aim of Study 1 was to develop a pool of items that were believed to assess various aspects of PM for inclusion in the pilot version of the PMCQ. In addition, Study 1 aimed to establish the content validity of items in the pilot PMCQ, that is, the relevance of the pilot items in measuring PM. To achieve this aim, the pilot items were to be reviewed by an expert sample that had experience with people suffering from PM impairments. The information obtained in the expert review regarding item relevance would also be used for reducing the large number of items in the item pool to a smaller amount for subsequent item analyses in Study 2. As the development of the PMCQ was an exploratory endeavour no specific hypotheses were generated about the items that would be derived from this process or the items that would make up the final version of the scale. However, it was intended that the items would be based on theory and previous research and would therefore represent the various components of PM, types of PM, dimensions of PM tasks, and other factors that influence PM performance that were outlined in the literature review in chapters 1 and 2.

Another important consideration for the final version of the PMCQ was that items were readable and easy to understand. This was particularly important for people with mild levels of cognitive impairment such as those with ABI who often demonstrate impairments in abstract thinking (i.e. the ability to generalise from specific examples; Ponsford et al., 2013) or individuals with MCI, or mild dementia who may have difficulty with language comprehension and deciphering contextually ambiguous words (American Psychiatric
Therefore, a third study aim was to assess the usability of items in the pilot PMCQ in terms of how easily individuals with mild levels of cognitive impairments would be able to read and understand the items. This would then inform the refinement of item wording to increase item readability. Due to the difficulty of recruiting individuals with cognitive impairments throughout this research, it was not possible to assess the usability of the items directly using this population. In the absence of direct self-report data from cognitively impaired individuals, a frequently used technique is to use proxy reports from health professionals, carers, and family members who interact regularly with these cognitive impaired individuals in order to gather information about observed impairments (Jorm, 2003; Snow, Cook, Lin, Morgan, & Magaziner, 2005). Hence, in this study the usability of PMCQ items was to be assessed by the expert sample as these individuals were assumed to interact regularly with individuals with cognitive impairments. Evaluating usability in this way is argued to be appropriate as these experts who have regular contact with cognitively impaired individuals are consequently familiar with problems experienced by these individuals on a day-to-day basis, their motivation levels, maturity and intelligence levels, and ability to read and understand written information (Oakland & Lane, 2004).

In summary, this chapter outlines the steps taken in the development of PMCQ items, followed by an overview of the method and results of Study 1, and the expert review of items in the pilot PMCQ. Finally, this chapter will discuss the steps taken to eliminate items from the item pool and refine the wording of the remaining items.
Method

Item Pool Development

A pool of items that were believed to measure PM was developed in conjunction with a review of the PM literature. Items were written to measure key components of PM, such as the RM component of PM, encoding, storage, and retrieval processes. Items were also written to assess the various types of PM including event-based, time-based, activity-based, delay execute, habitual, and complex PM. In addition, items were created to capture task specific dimensions of PM. These included the salience of cues, distinctiveness of cues, cue specificity, cue focality, interference effects, task complexity, planning processes, attention, meta-memory, time monitoring, content of intentions, context at encoding and retrieval, length of retention interval, importance of intentions, motivation, personality, mood, anxiety, and strategies used to assist in PM performance. Furthermore, a few items and examples were loosely based on content from an existing scale, the Memory Functioning Questionnaire (Gilewski & Zelinski, 1988). In total, 340 items were developed for the initial item pool.

The item pool was too large for all items to be included in the expert review study and so a qualitative analysis of items was carried out to reduce the number of items. The researcher sorted the 340 items into groups and qualitatively analysed the content of the items within each group. Items were thematically placed into groups on a content basis with groups relating to the theoretical components, PM types, and variables mentioned above. For each group, items that were repetitive and contained similar content to other items in the group were removed. In many cases, pairs of items were almost identical but were worded in either a positive or negative direction (e.g. one was worded “I remember” whilst the other was worded “I forget”). To ensure that a wide variety of PM dimensions were covered in the PMCQ, at least one item per item group was retained. Items that were considered to best represent each item group were kept whilst those that did not were deleted. After removing
these items, 135 items remained in the item pool and these items were used in the expert review study pilot questionnaire.

**Participants**

The participants were 32 females and 6 males aged between 21 and 86 years ($M = 44.97$, $SD = 15.23$) recruited on the basis that they had experience with people who were suspected to have PM problems. The sample consisted of carers, nurses, psychologists, other health-care specialists, and friends and relatives of people with PM impairments. A summary of the relationships participants had with people who have suspected PM impairments is provided in Table 2.

Table 2

**Participants’ Relationship to People with Prospective Memory Impairments**

<table>
<thead>
<tr>
<th>Relationship</th>
<th>$n$</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carer</td>
<td>5</td>
<td>13.2</td>
</tr>
<tr>
<td>Nurse</td>
<td>17</td>
<td>44.7</td>
</tr>
<tr>
<td>Psychologist</td>
<td>2</td>
<td>5.3</td>
</tr>
<tr>
<td>Friend</td>
<td>1</td>
<td>2.6</td>
</tr>
<tr>
<td>Family</td>
<td>4</td>
<td>10.5</td>
</tr>
<tr>
<td>Other</td>
<td>4</td>
<td>10.5</td>
</tr>
<tr>
<td>Combination</td>
<td>5</td>
<td>13.2</td>
</tr>
</tbody>
</table>

As can be seen in Table 2, the sample was comprised of several health professionals with the largest category being nurses. Those classified under “other” specified their roles as a social worker, an aged care assessment team member, a community service worker, and a nursing service manager. In the family category, participants’ relationships to PM impaired persons included: two grandsons, one daughter, and one wife. In some cases, participants
performed a combination of roles. Hence, the “combination” category included a daughter/caseworker, a daughter/nurse, and three participants who listed themselves as both carer and spouse (two wives and one husband).

The amount of time participants reported having spent with people with suspected PM impairments ranged from six months to 42 years ($M = 12.5, SD = 10.03$). Table 3 shows the frequency of contact participants reported having with people with suspected PM problems.

Table 3

<table>
<thead>
<tr>
<th>Frequency</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Once a year</td>
<td>1</td>
<td>2.6</td>
</tr>
<tr>
<td>Several times a year</td>
<td>2</td>
<td>5.3</td>
</tr>
<tr>
<td>Up to 3 hours a month</td>
<td>1</td>
<td>2.6</td>
</tr>
<tr>
<td>3 to 12 hours a month</td>
<td>2</td>
<td>5.3</td>
</tr>
<tr>
<td>More than 12 hours a month</td>
<td>1</td>
<td>2.6</td>
</tr>
<tr>
<td>Up to 3 hours a week</td>
<td>4</td>
<td>10.5</td>
</tr>
<tr>
<td>3 to 12 hours a week</td>
<td>3</td>
<td>7.9</td>
</tr>
<tr>
<td>More than 12 hours a week</td>
<td>6</td>
<td>15.8</td>
</tr>
<tr>
<td>Up to 3 hours every day</td>
<td>1</td>
<td>2.6</td>
</tr>
<tr>
<td>3 to 12 hours every day</td>
<td>8</td>
<td>21.1</td>
</tr>
<tr>
<td>More than 12 hours every day</td>
<td>6</td>
<td>15.8</td>
</tr>
</tbody>
</table>

As shown in Table 3, all participants who disclosed their frequency of contact reported that they had contact with someone who had suspected PM difficulties at least once a year. The majority of participants reported that they had contact with people with suspected PM difficulties on a weekly basis. Three participants (7.9%) did not disclose frequency of contact. However, two of these participants were nurses and one was a spouse of a person
with suspected PM problems. It is therefore assumed that these participants would be in contact with those with PM impairments to some extent. Thus, the pilot sample appeared to all have some experience with people suffering from suspected PM difficulties. Moreover many participants demonstrated a great deal of experience in this area.

**Measures**

**Demographic items.** Participants were asked to disclose their age, gender, their relationship to persons with PM impairments, the frequency of their contact with individuals with PM impairments, and the number of years’ experience they had with individuals with PM impairments.

**Pilot questionnaire.** The pilot PMCQ contained the 135 items believed to measure dimensions of PM from the item development process discussed earlier in this chapter. The pilot questionnaire and instructions are included in Appendix A. In the questionnaire instructions, participants were informed that the questionnaire contained “a series of items that are being considered for inclusion in a self-report test of prospective memory” and that participants should indicate whether these items were suitable for such a measure.

To indicate whether items were suitable, participants were asked to rate each of the 135 items on two scales: Relevance, and Readability. The Relevance scale was developed to assess face and content validity of the proposed items. On the Relevance scale, participants were asked how relevant each item was for measuring the PM problems experienced in their everyday life (with family members or in their workplace). Participants reported relevance using a 4-point rating scale with the anchors: 1 (*not at all relevant*), 2 (*not very relevant*), 3 (*somewhat relevant*), and 4 (*definitely relevant*). These scale anchors were used to avoid neutral or undecided responses ensuring that participants provided information as to whether an item was either relevant or not relevant. Participants were asked to circle the number on the scale that corresponded to their response for each of the items.
In addition to item relevance, participants were asked to rate items on their usability and readability. The Readability scale was developed to ensure that items were worded unambiguously. Therefore, the Readability scale asked participants whether someone with a mild cognitive impairment (such as a mild brain injury or mild dementia) would be able to read and understand each of the items. Like the Relevance scale, a 4-point scale was used to avoid neutral responses. The 4-point rating scale for readability contained the following labels: 1 (not at all readable), 2 (may have great difficulty), 3 (may have a little difficulty), and 4 (definitely readable). Again, participants were asked to circle the number on the scale that corresponded to their response for each item.

**Procedure**

Ethics approval for this study was obtained from the Greater Western Area Health Service Human Research Ethics Committee. Participants were recruited through several health organisations located in Central Western New South Wales, Australia. Organisations approached to recruit nursing staff included a private nursing service and two units at a regional mental health facility. Participants who specialised in dementia care were also recruited through a regional Aged Care Assessment Team. For these organisations, the service director was asked to invite staff and members of the organisation to participate in the study. These service directors distributed the research information sheet (Appendix B) and pilot questionnaires to staff during staff meetings and invited them to complete the questionnaires in their own time. Staff members were instructed to return questionnaires to a specified questionnaire box in the staffroom, which was to be collected by the researcher.

Psychologists from a regional branch of the Australian Psychological Society (APS) were also recruited. The branch chairperson sent a research information sheet by email to branch members. Those interested were asked to respond by email for questionnaires to be
sent to them. These questionnaires were to be returned using a reply paid envelope supplied with the questionnaire.

Participants who were carers, relatives, and friends of people with suspected PM impairments were identified through a local aged care and disability support organisation. Care staff, relatives, and friends of people with PM impairments were given a research information sheet and invited by the service director during staff and client meetings to take a questionnaire and complete it in their own time. These participants were asked to return the questionnaire to the specified questionnaire box located in the staffroom or to return the questionnaire using the reply paid envelope supplied with each questionnaire.

For all participants, the return of completed questionnaires by mail or by the questionnaire boxes was deemed to be informed consent. Through the organisations listed above, 116 questionnaires were distributed to participants. A response rate of 32.8% was obtained with 38 completed questionnaires returned.

Analyses

Analyses were conducted to identify items from the pilot questionnaire that were considered by the expert sample to be most relevant and readable. Items deemed to be the least effective in measuring PM were to be eliminated, whilst items that were deemed to be lacking in readability were to be reworded. A combination of CTT and IRT techniques were used in this study. Specifically, descriptive statistics (CTT) were calculated to assess the distribution of relevance and readability scores for each item. A Rasch analysis (IRT) was carried out to examine the hierarchy of items ordered based on their relevance ratings.

Descriptive statistics. IBM SPSS Statistics Version 20 was used to compute descriptive statistics. Means and standard deviations were calculated to determine the average ratings on both the Relevance and Readability scales for each of the 135 pilot items. Minimum and maximum scores were also obtained for each item on both the Relevance and
Readability scales. These minimum and maximum scores were used to assess whether all four response options were used, and also to measure the range of responses selected by participants. Frequency statistics and percentages were calculated to review how many participants chose each response option, for example, how many participants circled 1 (not at all relevant), as opposed to the other three options. These frequency scores were calculated for all of the 135 items on both the Relevance and Readability scales. In addition to calculating scores for all of the individual items, overall means, standard deviations, minimum and maximum scores, and frequencies were calculated for both the Relevance and Readability scales.

**Rasch analysis.** Winsteps Version 3.70.0.2 (Linacre, 2009a) was used to conduct a Rasch analysis on the Relevance scale. This Rasch analysis was used solely for the purpose of creating an item hierarchy for the Relevance scale that ranked items from those rated the most relevant to items rated the least relevant.

**Results**

This section begins with an overview of the characteristics of the Relevance scale. This includes the descriptive statistics for the overall Relevance scale and the Rasch analysis depicting the hierarchy of items on the scale. The characteristics of the Readability scale are then reported, followed by an explanation of how items were removed from the scale and a description of the rewording of scale items.

**Scale Characteristics**

**Relevance scale.** The mean score for the items overall on the Relevance scale was 2.84 (SD = .31) from a possible range of 1 to 4. The average number of participants who endorsed items as either somewhat or definitely relevant was 65.2% (SD = 13.34). Figure 2 presents a Wright Map produced by the Rasch analysis depicting the ratings of items on the Relevance scale. In this figure, the item hierarchy (item measures) is on the right-hand side of
the central line with the items rated most relevant at the top of the scale progressing down to the items rated least relevant at the bottom of the scale. The left side of the figure depicts participants’ ratings of item relevance (person measures) with individuals who rated items as relevant most often located at the top. The numbers on the far left hand side of the figure represent the logit measurement scale for the person and item measures. On the central line, M represents the mean person or item measure (in logits), S depicts one standard deviation from the mean and T shows two standard deviations from the mean.

Figure 2. Wright map depicting the expert review ratings of item relevance and individuals’ endorsement of relevance.
As shown in Figure 2 the item rated the most relevant in measuring PM was Item 25 “I am more likely to remember to do something if there is something to remind me (e.g. object, person)”. This item had an item measure of .92 logits ($SE = .25$). The average Relevance scale rating for Item 25 was $M = 3.54$ ($SD = .69$) indicating that this item was perceived to be somewhat to definitely relevant. Moreover, this item was rated as either 3 (somewhat relevant) or 4 (definitely relevant) by 94.6% of the participants. At the other end of the scale, the item with the lowest relevance rating was Item 103 “If a person is asked to do something by their friend and they forget to do it, they are a bad person”. This item had an item measure of -1.52 logits ($SE = .22$), and a mean relevance rating of 1.83 ($SD = .86$). Only 22.9% of participants rated this item as 3 (somewhat relevant) or 4 (definitely relevant).

**Readability scale.** The mean score for the items in total on the Readability scale was 3.17 ($SD = .26$) out of a possible score of 4. This suggests that overall individuals with mild cognitive impairments were expected by the expert review sample to have had a little difficulty reading the items. The item rated the easiest to read was Item 101 “I believe that people’s memory gets worse with old age” ($M = 3.63$, $SD = .81$) with 85.7% of participants scoring this item as either 3 (may have a little difficulty) or 4 (definitely readable). Conversely, the most difficult to read was Item 78 “Sometimes I see objects, people, or places which remind me that there is something I need to do, even though the task I need to do has nothing to do with what I’m looking at” ($M = 2.33$, $SD = 1.02$). Only 36.4% of participants rated this item as either 3 (may have a little difficulty) or 4 (definitely readable).

**Removal of Items from Scale**

Only the Relevance scale was used in determining which of the 135 pilot PMCQ items to retain or remove, as the data from this scale reflected item content validity. The Readability scale did not reflect item content validity; therefore it was not used in decisions.
of item retention and removal. Instead, the Readability scale informed the subsequent rewording of items retained in the scale.

Item removal began with ranking items rated as most relevant to least relevant. More specifically, items were sorted on the basis of the percentage of participants who endorsed categories 3 or 4 on the Relevance scale (i.e. the percentage of participants who rated the items as *somewhat* or *definitely* relevant). Items were sorted from the highest percentage of participants endorsing the two “relevant” categories to the lowest percentage of participants endorsing the item as relevant. Items in the bottom third of the list were highlighted as being potential items to remove. These items had less than 64.7% of participants rating the items as *somewhat* or *definitely* relevant. The items were also sorted using the Rasch analysis, which placed items on a continuum ranging from highest endorsement of relevance to lowest amount of endorsement on the Relevance scale. Similar to the relevance percentages, items in the bottom third of the Rasch logit scale (i.e. items that had the lowest amount of endorsement on the Relevance scale) were flagged as items that could potentially be deleted.

It should be noted that no items were removed solely on the basis of the relevance percentage or the Rasch analysis.

Whilst ratings of relevance were taken into account, a qualitative analysis of content took place when removing items. Items were sorted into groups based on their content (e.g. items measuring PM task importance). Item content was then cross-referenced with relevance ratings to identify the most relevant items for each item group so that at least one item from each item group was retained. In cases where two items from the same item group measured similar content, the item with the lower relevance rating was eliminated. Many items with lower rankings on both the Rasch and percentage continuums appeared to measure constructs other than PM ability. For example, many lower ranking items assessed perceived social consequences of PM failure rather than actual memory ability. As many of the higher ranking
items targeted PM ability, the lower ranking “social consequence” items were eliminated to make the scale more ability focused. Following these analyses, 78 items from the pilot questionnaire were retained. Appendix C contains a list of items that were eliminated from the item pool along with the descriptive statistics and Rasch measures for each of these items.

Rewording Scale Items

Subsequent to the removal of items using the Relevance scale, the Readability scale was used to guide the rewording of the 78 retained items. Mean scores on the Readability scale in particular were used to assess item readability. This scale was not the only criteria used in the decision-making process. For example, it was decided after item development that the final version of the PMCQ would contain response options measuring frequency, that is, participants would respond to the PM items using the anchors 1 (Never), 2 (Sometimes), 3 (Often), and 4 (Always). To maintain consistency in the scale these frequency terms could no longer be included within any of the individual items. Therefore, these frequency words were removed from items, for example, in Item 13 “I often walk into a room and forget why I went there” the word “often” was removed.

Mean scores on the Readability scale were used to indicate items that might have required rewording. Items with average readability scores above 3.0 (i.e. may have a little difficulty or definitely readable) were deemed to have adequate readability and so minimal changes were made to these items. Items with mean readability scores below 3.0 were rewritten or edited in order to improve clarity. In most cases these changes were minor. Examples within items were removed if they did not assist in conveying item meaning. For example, in Item 36 “If I do not finish what I am doing (e.g. cleaning, typing a letter), I will remember to go back and finish it later” the example in brackets was deleted. Other changes included reversing the wording of items to change the subject of the sentence, rephrasing
items to include simpler wording, and removing words that were redundant and simply added length to the items.

It was not possible for reworded items to be returned to the expert review sample for changes to be evaluated. However, the reworded items were presented to two clinical psychologists who had experience with individuals with PM impairments. Both of these reviewers accepted the changes made in the rewording of items. Hence, at the conclusion of Study 1, 66 items were reworded for use in the Study 2 questionnaire. Relevance and Readability descriptive statistics and Rasch measures for the reworded items are presented in Appendix D. Furthermore, changes made to these items are shown in Appendix E. Appendix F contains a list of items retained in this study that were not reworded along with their respective Relevance and Readability descriptive statistics and Rasch measures.

Conclusion

The aim of Study 1 was to develop a pool of questionnaire items that were believed to assess PM concerns and failures. These items were to be used in achieving the overall thesis aim of constructing the PMCQ. Hence, in this study an item pool of 340 items was developed in conjunction with a review of the PM literature. The item pool was then reduced to 135 items for the pilot PMCQ by removing items that were similar to other items and redundant.

Study 1 was also carried out with the aims of establishing the content validity of the pilot questionnaire and also assessing the readability of the scale items. Hence, an expert review study involving individuals that had experience with people with suspected PM impairments was carried out. The expert sample rated the 135 pilot questionnaire items on their relevance in measuring PM (i.e. content validity) and their readability (i.e. whether an individual with a mild cognitive impairment would be able to understand the items). Items considered to be the least effective in measuring PM were then eliminated. The elimination of items was based on Relevance scale ratings and qualitative analyses of item content.
Readability scale ratings were then used to inform the rewording of the remaining scale items. Following item removal and rewording a total of 57 items were eliminated from the pilot questionnaire. Therefore, 78 of the items from the pilot questionnaire were retained. Of these 78 items, 66 items were modified in the rewording stage, whilst no changes were made to the remaining 12 items that were retained.

In conclusion, this study involved the completion of the first two scale development steps outlined in Chapter 3, Item Development and Expert Review. A total of 78 items were retained following this study for further analysis and development of the final version of the PMCQ. These 78 items were to be used in the Pre-Test and Item Analysis scale development steps carried out in Study 2. Chapter 5 will report on the Pre-Test and Item Analysis studies.
CHAPTER 5

Pre-Test, Study 2, and Item Analysis

This chapter reports on the third and fourth scale development steps discussed in Chapter 3, item pre-testing and item analysis. These scale development steps contribute towards the overall thesis aim of developing the PMCQ. As outlined in Chapter 3, before a scale is administered to a large sample it is advisable to pre-test items on a small sample (Crocker & Algina, 2006). Hence, this chapter reports on a pre-test study that was conducted with the purpose of assessing the 78 item PMCQ developed in Study 1. The pre-test was carried out to examine ceiling and floor effects, whether the full rating scale was used, whether instructions were easy to follow, and to ensure that the scale contained no content, spelling, typographical, or formatting issues. Any issues identified in this pre-test could then be rectified before the questionnaire was administered to a large sample in Study 2.

Subsequently, this chapter reports on the methodology and results of the item analysis conducted in Study 2. The aim of the item analysis in this study was to investigate the psychometric properties of the 78 item draft PMCQ, specifically the scale’s structure, reliability, and validity. These analyses would then inform decisions regarding the development of the final version of the PMCQ. As the PMCQ was designed to measure "concerns" about PM rather than objective PM performance, the scale was conceptualised to be a brief measure that could be used by clinicians to assess whether individuals were concerned about their PM ability. For example, the scale may be used by a general practitioner to assess an individual who presents with concerns about their memory. If the individual scores highly on the scale, the clinician may refer the individual to a specialist for a comprehensive neuropsychological assessment. Hence, in order for the scale to be utilised in this way, it needed to take a short amount of time to complete. It was also essential that the scale was not too time-consuming or difficult to complete for cognitively-impaired
individuals such as the elderly or those with ABI, MCI, or dementia who may be affected by fatigue, apathy, and selective attention impairments (American Psychiatric Association, 2013; Ponsford et al., 2013). Krosnick and Fabrigar (1997) noted that when the cognitive demands of a questionnaire become excessive, individuals are more likely to engage in satisficing behaviours that reduce the reliability of responses. Therefore, it was important that the PMCQ did not place excessive demands on individuals and was an appropriate length in order for it to be used as a brief measure of PM. Hence, the target number of items for the final version of the PMCQ was approximately 40, as this was considered to be an appropriate length to meet these needs. Whilst being brief, this scale length would still allow the scale to assess a wide range of PM functions and dimensions effectively. Thus, a second aim of Study 2 was to reduce the scale length from 78 items to approximately 40 for the final version of the PMCQ.

**Pre-Test**

A pre-test was conducted on the 78 item PMCQ scale that was developed in study 1. For this pre-test, a convenience sample consisting of 14 female and 7 male friends and relatives of the researchers aged between 19 and 91 years ($M = 45.43$, $SD = 22.06$) was recruited. These individuals were asked to complete the questionnaire booklet that was to be used in study 2 as well as a questionnaire feedback sheet (Appendix G). The feedback sheet asked participants for their opinion on whether the instructions were easy to follow, whether the questions were easy to understand, and if the format and layout was easy to use. Participants were also invited to provide any other suggestions for improvement.

The data from the PMCQ items in this pre-test did not reveal any issues with item polarity, item fit, or ceiling and floor effects. Although not all item response categories were endorsed by the sample on some items, these items measured severe memory failures and so it was expected that the nonclinical pre-test sample would report having severe memory
failures. In terms of participant feedback, no significant alterations to items were suggested. Therefore, no changes to the PMCQ items, instructions, or format were made following the pre-test. Participants in this Pre-Test study fit the eligibility criteria for participants in the non-referred group for Study 2. Thus, data from the Pre-Test participants was added to the dataset for the non-referred group in Study 2.

**Study 2**

The Pre-Test indicated that the questionnaire booklet and PMCQ were free from any major issues. Therefore, the aim of Study 2 was to conduct an item analysis on the PMCQ, assessing the scale’s structure, reliability, and validity. In order to establish the validity of the PMCQ an objective of this study was to assess whether the PMCQ items could distinguish between people with PM at a normal level for one’s age from those at greater risk of having impaired PM ability. To test this, two samples were recruited. As individuals with ABI (Brooks et al., 2004; R. Hannon et al., 1995; Mathias & Mansfield, 2005), MCI, and dementia (Tam & Schmitter-Edgecombe, 2013; Thompson et al., 2010; Thompson et al., 2011; E. van den Berg et al., 2012) have been found to have impaired PM ability compared to healthy controls, a group of individuals with a diagnosis of ABI, MCI, or dementia were recruited as a clinically-referred sample that was expected to have impaired PM. This referred group was to be compared with a sample of non-referred adults who had not been diagnosed with ABI, MCI, or dementia and were believed to have PM ability that fell within the normal range for their age. These participant groups are described in detail in the following section.

**Participants**

There were 153 participants, of which 57 were male, 94 were female, and two who did not disclose their gender. The average age of participants was 52.15 ($SD = 20.49$, range = 19-91). This study included two participant groups: a non-referred group, and a referred group. The characteristics of these groups are presented in the following sections.
Non-referred group. Participants in the non-referred group were believed to have PM ability that was normal relative to their age peers. Thus, participants in this sample were assumed to be healthy adults. The 21 participants recruited in the Pre-Test for Study 2 (discussed earlier in this chapter) were included in the current non-referred sample. As a result, the non-referred group consisted of 134 participants aged between 19 and 91 years ($M = 51.04$, $SD = 20.86$). The non-referred group comprised of 80 females and 52 males as well as two participants who did not disclose their gender. Participants were asked to report their highest level of completed education. These responses are shown in Table 4.

Table 4

Highest Level of Education Reported by Participants in the Non-Referred Group

<table>
<thead>
<tr>
<th>Level of education</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower than Year 10</td>
<td>9</td>
</tr>
<tr>
<td>Year 10/High School Certificate/Intermediate Certificate</td>
<td>30</td>
</tr>
<tr>
<td>Year 12/Higher School Certificate/Leaving Certificate</td>
<td>15</td>
</tr>
<tr>
<td>TAFE/Diploma</td>
<td>30</td>
</tr>
<tr>
<td>Undergraduate university (Bachelor Degree)</td>
<td>32</td>
</tr>
<tr>
<td>Postgraduate university (Masters or Doctorate)</td>
<td>12</td>
</tr>
<tr>
<td>Other</td>
<td>5</td>
</tr>
</tbody>
</table>

Note: $n = 1$ participant did not report their highest level of education.

Referred group. In addition to the non-referred group, a clinically-referred group was recruited. Participants were recruited to the referred group as a result of either sustaining an ABI or developing a MCI or dementia. Individuals in this group were anticipated to have PM impairments as a consequence of these clinical diagnoses. Whilst no explicit diagnosis of PM impairment was made for these individuals, impairments were expected on the basis of clinical observations made by the recruiting medical specialists and because of the nature of
impairments experienced by the clinically-referred group. Due to recruitment issues, only a small number of participants with MCI or dementia were recruited. Therefore, participants with MCI and dementia were combined for analyses as the individual groups were too small to analyse separately. The referred group was subsequently subdivided into a brain injury sample \((n = 12)\) and a MCI/dementia sample \((n = 7)\) on the basis of participants’ clinical diagnoses.

The combined referred group consisted of 19 participants of which 14 (73.7\%) were females. This group did not differ significantly from the non-referred group on the basis of gender, \(\chi^2(1, N = 153) = 1.21, p = .272, \phi = .09\). In terms of age, participants in the referred group were aged between 32 and 88 years \((M = 59.89, SD = 16.13)\). Again, the referred and non-referred groups did not differ significantly in age, \(t(149) = -1.77, p = 0.78, d = 0.47\). It is however acknowledged that the sample sizes of the groups reduced the likelihood of detecting a significant difference at this level of effect size. As some cells had values below 5, Fisher’s exact test was used to analyse group differences in education. This analysis found that the referred and non-referred groups again did not significantly differ on education level, \(\chi^2(6, N = 153) = 8.18, p = .165, \phi_c = .26\). Although no significant differences were found in regards to gender, age, or education when comparing the non-referred group with the referred group, some differences did emerge when the referred group was split into the brain injury and MCI/dementia subgroups. These differences are discussed in the following section.

**Subgroup comparisons.** First, age differences between the brain injury subgroup, MCI/dementia subgroup, and the non-referred group were assessed. Levene’s test of homogeneity of variances revealed that the group variances were unequal, \(F = 8.87, p < .001\) and so the Welch test and Games-Howell post-hoc test were employed. Differences between the three group means were unequal, \(F(2, 15.93) = 23.64, p < .001\), and post-hoc comparisons revealed that the MCI/dementia group \((M = 75.57, SD = 8.24)\) were significantly older than
both the non-referred group ($M = 51.04, SD = 20.86$) and brain injury samples ($M = 50.75, SD = 11.89, p < .001$). However, these differences would be expected due to the fact that MCI and dementia are conditions that occur mostly in older age groups.

Comparisons of gender were also made across the non-referred group, brain injury, and MCI/dementia groups. Due to small cell counts within the brain injury, and MCI/dementia samples, Fisher’s exact test was used in analyses of gender and education. These analyses revealed that the three groups did not significantly differ in terms of gender, $\chi^2(2, N = 153) = 1.10, p = .64, \varphi = .09$. Finally, the brain injury, MCI/dementia, and non-referred groups were analysed for differences in the highest level of education completed. The highest levels of education completed by both the brain injury and MCI/dementia samples are shown in Table 5 (the highest level of education completed in the non-referred group was shown in Table 4). Again, no significant differences were found between the three groups, $\chi^2(2, N = 153) = 16.02, p = .07, \varphi_c = 26$. Further information about the characteristics of the brain injury and MCI/dementia subsamples is provided in the following sections.

### Table 5

| Highest Level of Education Reported by Participants in the Clinically-Referred Group |
|----------------------------------|-----------------|-----------------|
| Level of education               | Brain injury    | MCI/dementia    |
| Lower than Year 10               | 0               | 2               |
| Year 10/High School Certificate/Intermediate Certificate | 0 | 2 |
| Year 12/Higher School Certificate/Leaving Certificate | 1 | 1 |
| TAFE/Diploma                     | 8               | 2               |
| Undergraduate university (Bachelor Degree) | 3 | 0 |
| Postgraduate university (Masters or Doctorate) | 0 | 0 |
| Other                            | 0               | 0               |
**Brain injury subgroup.** The brain injury subgroup consisted of 9 females and 3 males that were aged 32 to 67 years ($M = 50.75$, $SD = 11.89$). In terms of the types of brain injury sustained by participants in this group, eight participants had a TBI caused by external forces such as motor vehicle accidents or gunshot wounds. The remaining four participants had an ABI as a result of herpes simplex viral encephalitis, Hashimoto’s encephalitis, a communicating artery aneurysm, and intracerebral (right thalamic) bleeds. The average time since individuals sustained their injury (ABI or TBI) was 1581.08 days or approximately 4.5 years ($SD = 1351$ days/3 years and 8 months), ranging from 5 months to 14 years. These individuals spent an average of 101.67 days in hospital ($SD = 115.35$, range = 10–386) and 118.80 days in inpatient rehabilitation ($SD = 118.42$, range = 20–310).

For participants with TBIs, severity of injury was judged on the basis of the length of post-traumatic amnesia (PTA) as well as scores on the Glasgow Coma Scale (GCS). The longer an individual is affected by PTA, the more severe the TBI is believed to be. For example, a mild TBI is classified as a PTA of less than 24 hours, a moderate TBI is considered a PTA of 1–7 days, a severe TBI is diagnosed with 1–4 weeks of PTA, and a very severe TBI is diagnosed when PTA lasts over 4 weeks (Ponsford et al., 2013). The GCS (Teasdale & Jennett, 1974) measures conscious states by assessing motor, verbal, and eye opening responses. This scale is typically used to measure injury severity at the scene of injury and on admission to hospital. Scores on GCS range from 3-15 whereby a score of 3–8 indicates a severe injury, a score of 9–12 a moderate injury, and 13-15 a mild injury. However, Teasdale (1995) argues that a GCS score of 15 should be distinguished from scores of 13 and 14 and should instead be classified as a minor injury.

Based on the PTA criteria above, one participant in the current sample would be classified as having a mild TBI, three as having a severe TBI, and four a very severe TBI. Overall, the average length of PTA experienced by participants in the brain injury group was
45.94 days ($SD = 57.72$, range $= < 24$ hours to 6 months, $n = 8$). Similarly, GCS scores indicated that brain injuries in this group were mostly severe. GCS scores ranged from 3–14 ($M = 9.63$, $SD = 4.75$, $n = 8$) at the scene of injury, and 3-15 ($M = 8.88$, $SD = 3.83$, $n = 8$) on hospital admission. At the scene of injury, three individuals’ scores would be classified as severe, two as moderate, and three as having a mild TBI. On arrival at hospital, four individuals’ scores would class them as having a severe TBI, whilst one would be considered to have a moderate TBI, one a mild TBI, and one a minor TBI.

**Mild cognitive impairment/dementia subgroup.** Participants in the MCI/dementia subsample of the referred group were 2 males and 5 females. The average age of participants in this subsample was 75.57 years ($SD = 8.24$, range $= 65$–88 years). The MCI/dementia subsample included four people who were diagnosed with MCI—information regarding the subtype of MCI for these individuals was unavailable. Of the remaining three participants, two had been diagnosed with Alzheimer’s disease and one with Parkinsonian type dementia. To treat their conditions, one of the participants diagnosed with Alzheimer’s disease had been prescribed Aricept, whilst one participant with MCI was prescribed SSRIs. No other participants in the subsample had been prescribed medication for their cognitive impairments. All but one participant completed the Mini Mental State Exam (MMSE) with a clinical specialist within 6 months of taking part in the study. The MMSE assesses cognitive skills and is widely used to assist in the diagnosis of cognitive impairment and dementia. Scores on the MMSE range from 0–30 with scores below 24 considered to indicate cognitive impairment or dementia, and scores within 24 to 26 indicating MCI (Crum, Anthony, Bassatt, & Folstein, 1993; Pasquier, 1999). The MCI/dementia subgroup had MMSE scores consistent with diagnoses of MCI or dementia, ranging from 23 to 27 ($M = 25.67$, $SD = 1.51$). Although one individual scored 27 (6 months prior to participation), they were later diagnosed with MCI by the referring physician prior to participating in this study.
Measures

Participants were given a questionnaire booklet containing demographic questions that included participants’ age, gender, and highest level of completed education as well as the PMCQ draft scale.

**PMCQ draft scale.** The draft version of the PMCQ used in this study contained the 78 items derived from Study 1. A list of the 78 scale items is provided in Table 7 in the Results section of this study. Participants were asked to respond to each of these items using a 4-point rating scale. Scores on this scale could range from 0–234 with higher scores indicating greater PM impairment. The item response scale included the following response options: 0 (*Never*), 1 (*Sometimes*), 2 (*Often*) and 3 (*Always*). This 4-point rating scale measured the frequency of memory concerns and so differed from the scale used in Study 1 that assessed readability and relevance characteristics of items.

The four response options used in this study were included for several reasons. First, four response categories were chosen rather than a larger number of categories in order to provide clarity of meaning and brevity (Krosnick & Fabrigar, 1997). This was particularly important as the PMCQ was designed for use in clinical populations where fatigue and attention levels can be problematic in test administration (Ponsford et al., 2013). Whilst increasing the number of response options provides response precision with a finer distinction between response categories, it also increases the difficulty of responding to items. For individuals with ABI, MCI, and dementia that may experience abstract reasoning difficulties, including additional response categories would make it more difficult for these individuals to decipher category meanings. This would increase the likelihood that they would engage in satisficing responding behaviours that use less cognitive resources, for example, choosing the first adequate response rather than reading all response options (Krosnick & Alwin, 1987; Krosnick & Fabrigar, 1997).
Second, an even numbered rating scale was used rather than a scale with 3 or 5 response options in order to avoid participants giving “middle of the road” answers. In some cases the use of a neutral response is warranted, for example, when participants are undecided or impartial in their opinions. However, participants may automatically use the neutral option as it requires little mental effort (Krosnick & Fabrigar, 1997). Furthermore, as the PMCQ measures the frequency of PM concerns and failures experienced by participants, it was assumed that participants are knowledgeable about their memory concerns and that a neutral or undecided category would be redundant.

For each response option, both verbal and numerical labels were used. The use of verbal labels for all response categories maximises the amount of information that is available to participants when answering items. This in turn can increase the consistency, reliability, and validity of responses. In fact, participants themselves have reported a preference for the use of verbal labels for all response categories in questionnaire items due to the added clarity provided (Davis, Wellens, & DeMaio, 1996; Krosnick & Fabrigar, 1997; Rohrmann, 1998). The four verbal labels used in this questionnaire (Never, Sometimes, Often, and Always) are terms that are universally understood and recognised for the description of behaviour frequency (Rohrmann, 2007). Whilst there is some debate regarding the use of such terms in category labels, it has been found that people use both verbal (i.e. category labels) and non-verbal (i.e. the location of the category in relation to other categories) information when responding to rating scale items (Christian & Dillman, 2004; Davis et al., 1996).

Numeric labels are also often used in conjunction with verbal labels to assist in the readability of questionnaire responses. Krosnick and Fabrigar (1997) argued that numerical labels are easier for respondents to hold in their memory when completing rating scales. In this questionnaire the labels 0 to indicate Never, 1 to indicate Sometimes, 2 to indicate Often,
and 3 to indicate *Always* were used. Due to the fact that the term *Never* refers to the nonexistence or non-occurrence of something, it was logical that the numerical label for this response was 0 to maintain consistency with the verbal label. As the subsequent verbal labels indicated an increase in frequency, it also made sense that the numerical labels increased in ascending order from zero to match their verbal counterparts.

**Procedure**

Ethics approval for Study 2 was granted by the Greater Western Area Health Service Human Research Ethics Committee.

**Recruitment of the non-referred group.** In recruiting a non-referred group it was important that the sample were as representative as possible of the population sampled. This population was a regional community located in Central Western New South Wales, Australia. Consequently, people of various age groups, backgrounds, and occupations were targeted in order to represent the many facets of the community. The only inclusion criteria were that participants were aged over 18 years and that their primary language was English.

Locations used to recruit participants included community groups such as Rotary, Probus, and Lions Clubs. Participants were also obtained from local church congregations and a meditation group. In addition, local businesses such as car dealerships, beauty therapists, petrol stations, dentists, accounting and human resources firms, a surveying firm, gyms, and physiotherapists were used in recruiting participants.

The managers at these locations were contacted by email or in person and were given a research flyer (Appendix H) and information sheet (Appendix J) with details of the research. They were asked to either place this information on a bulletin board within the facility or to hand out flyers to staff. Interested parties were invited to contact the researcher using the phone number provided in order for a questionnaire to be mailed to them. Questionnaires were also left with the community groups and businesses for those interested
in participating to complete in their own time. In many cases, questionnaires were left at the 
door for members of community groups or businesses to take with them following staff or 
group meetings. These individuals were also invited to pass on the flyers and questionnaires 
to any relatives, friends, or colleagues that might be interested in participating.

The research flyer was also placed on the “Mature Age Students” and “Classifieds” 
online student message boards on the Charles Sturt University website. Interested students 
were invited to contact the researcher by phone or email in order for a questionnaire to be 
sent to them by mail. The recruitment of participants through local community groups, 
businesses, and university forums utilised convenience and snowball sampling methods. All 
questionnaires were distributed with a reply paid envelope for participants to return 
questionnaires to the researcher. A response rate of 54% for the non-referred group was 
obtained with 113 completed questionnaires returned from the 208 questionnaires distributed.

**Recruitment of the brain injury subsample.** Brain injury rehabilitation services 
from two regional health districts in New South Wales, Australia were used in the 
recruitment of the brain injury subsample. The directors at each of the brain injury services 
were asked to identify clients that met the inclusion criteria for this study. These criteria 
included that participants were aged over 18 years, primarily spoke English, were seen to 
experience PM difficulties, had sustained an ABI, and they were currently registered as an 
inpatient or outpatient with brain injury service. Although the recruitment of individuals on 
the basis of them having PM difficulties has been criticised (Mathias & Mansfield, 2005), it 
was necessary to include such participants in this study to assess whether the PMCQ 
distinguished between those with and those without PM problems.

Clients that met the inclusion criteria were sent an invitation letter with information 
about the research by the brain injury service (Appendix I). Clients interested in participating 
were asked to contact either the researcher or the brain injury service for a questionnaire to be
sent to them. Questionnaire packages sent to participants included a reply paid envelope addressed to the researcher for the return of completed questionnaires. Packages also contained a research information sheet (Appendix J) and consent form that requested participants’ permission for the brain injury service to access clinical data on behalf of the researcher (Appendix K). A guardian consent form (Appendix L) was also provided for participants who were unable to provide their own consent, however this was not required for any of the participants who returned completed questionnaires in this study.

Once all completed questionnaires had been returned, a list of participants was given to the brain injury services. The service directors then retrieved clinical data for each client from the New South Wales Brain Injury Rehabilitation Program Clinical Data Set. This data included the client’s cause of injury, nature of injury, date of injury, hospitalisation dates, PTA length, and GCS scores on hospital admission and at the scene of injury. Not all information was available for all participants (e.g. if a participant did not have PTA). Furthermore, clinical data was recoded so that information was not identifiable.

**Recruitment of the mild cognitive impairment/dementia subgroup.** A regional Aged Care Assessment Team memory clinic in central western New South Wales, Australia was utilised for the recruitment of the MCI/dementia subsample. The memory clinic gerontologist identified clients that met the inclusion criteria. These criteria were that participants were seen to have PM impairments, have a diagnosis of either a MCI or dementia (primarily Alzheimer’s type although other forms of dementia were accepted), were currently registered as an inpatient or outpatient with the Aged Care Assessment Team, were aged over 18, and that their primary language was English.

Clients from the memory clinic that met the inclusion criteria were sent an invitation letter with information about the study by mail. Those who were interested in participating were advised to contact the memory clinic in order for the clinic to send them a questionnaire.
package in the mail. The questionnaire package included an information sheet and a consent form for the aged care service to access participants’ clinical data. For participants who were unable to provide their own consent, a guardian consent form was also included. However, the guardian consent form was not used by any participants who returned completed questionnaires in this study. In addition, the package contained a reply paid envelope addressed to the researcher for participants to return completed questionnaires.

After participants had returned completed questionnaires the memory clinic staff retrieved clinical information about these participants from the memory clinic’s patient database. This information included clinical diagnosis, medications or treatments prescribed, and MMSE scores. This information was recoded to maintain patient confidentiality.

**Analyses**

Before any analyses were conducted, items in the draft PMCQ were recoded and scale scores calculated. For the draft PMCQ, 35 items were worded negatively (i.e. “I forget” as opposed to “I remember”). Hence, these items were reverse scored to ensure that all items were unidirectional, with a high score indicating better memory or less memory concerns. This meant that the response category numbering of these items was reversed so that a response of 0 (Never) was re-coded to 3 (Always), a response of 1 (Sometimes) became 2 (Often) and so on.

Analyses in this study were carried out to assess scale structure, reliability and validity, and also to inform decisions of retaining or eliminating items from the PMCQ. These analyses were conducted in a number of phases whereby sequential processes eliminated items on psychometric and theoretical criteria, resulting in intermediate versions of the scale. The first phase reduced the number of items from 78 to 69, the second phase from 69 to 46, and the third phase from 46 to the final 42 item scale.
Both CTT and Rasch analyses were used to assess scale structure, reliability, and validity and for item elimination. Using CTT methods, PCAs were used to assess scale structure and establish the construct validity of the draft PMCQ. Analyses of internal consistency reliability using Cronbach’s alpha assessed the inter-correlations of items within the PMCQ. Furthermore, a DA assessed validity in terms of how well the PMCQ classified individuals into the referred or non-referred groups. Similarly, one-way ANOVAs assessed group differences on the PMCQ. Rasch analyses were conducted to assess the PMCQ item hierarchy, scale unidimensionality (using a PCAR), item fit, and rating scale functioning.

Rasch analyses were conducted using Version 3.70.0.2 of the Winsteps Rasch Measurement programme (Linacre, 2009a). All other statistical analyses including descriptive statistics were performed using IBM SPSS Statistics Version 20. As analyses in this study were exploratory in nature, a decision-wise error rate of .05 was used for all comparisons. In addition, effect sizes for ANOVAs were calculated using partial eta-squared whereby an effect size of .0099 indicated a small effect, .0588 a medium-sized effect and .1379 a large effect (J. Cohen, 1988).

Results

Data Screening

Before commencing analyses the dataset was inspected for missing responses. It was found that nine individuals within the sample had several missing responses in a row. Further examination of these responses revealed that these clusters of missing responses were the result of questionnaire pages being left blank where the pages were not separated. In addition, a small number of individual items were left blank for other participants. Again, further analyses of the questionnaires indicated that these missing responses were not due to an unwillingness to answer items. Instead, these values appeared to be missing due to participants accidentally overlooking these items. Where necessary, missing data was
removed using the list-wise deletion method for relevant analyses. An analysis of outliers was not conducted for this study, as it was important to retain individuals of various ability levels for decisions of keeping or eliminating items in the scale. Removal of outliers may have restricted the range of the samples and limited the generalisability of the scale. In particular, this may have resulted in the more severe clinical cases being excluded.

**Item Analyses**

This section reports the results of the item analyses assessing the structure, reliability and validity of the draft PMCQ scale, and removal of scale items. First, the investigation of the 78 item draft PMCQ scale is reported followed by the removal of items from the scale. As the second and third phases of analysis (i.e. reducing the scale from 69–46 and 46–42 items respectively) were intermediate steps in developing the PMCQ, the essential information pertaining to these analyses is briefly discussed in this section, with the supplementary statistics reported in detail in Appendix M. Finally, this section presents the characteristics of the final 42 item version of the PMCQ.

**Analysis of the 78 item scale.** The 78 item draft PMCQ scale was analysed using a PCA and Rasch analysis to determine the structure of the scale. First, a PCA was carried out on the 78 items. The adequacy of the sample for the purpose of carrying out the PCA was assessed using the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy (Kaiser, 1970) and Bartlett's test of sphericity (Bartlett, 1950). The KMO index of .59 indicated that the sample was adequate according to criteria presented by Kaiser and Rice (1974). Bartlett's test of sphericity also supported the adequacy of the sample, $\chi^2 (3003) = 5663.77, p < .001$ (Dziuban & Shirkey, 1974). Within the PCA, Velicer's (1976) Minimum Average Partial Correlation (MAP) test was used to determine the number of components in the data. From this, five components were extracted, and an item was determined to load onto a component if it had a component loading greater than .3 (Tabachnick & Fidell, 2012). A direct oblimin
(oblique) rotation and a Varimax (orthogonal) rotation with Kaiser normalisation were carried out on the five component structure. The direct oblimin (oblique) rotation was carried out on the five component structure to assess the factor correlation matrix for correlations amongst the factors. Both Tabachnick and Fidell (2012) and Nunnally and Bernstein (1994) argue that if correlations are greater than .32 then an oblique rotation is warranted as there is substantial overlap in variance among the factors. However, if correlations between factors are low (less than .32) an orthogonal rotation is recommended due to its simplicity, ease of interpretation, and its additive properties. Inspection of the component correlation matrix showed that none of the correlations were greater than the criteria of .32 (Tabachnick & Fidell, 2012) and so the orthogonal rotation was selected. This solution accounted for 36.37% of the variance within the data. Table 6 shows the variance explained by each of the five components in the rotated solution and their corresponding eigenvalues.

Table 6

<table>
<thead>
<tr>
<th>Component</th>
<th>Eigenvalue</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Everyday memory</td>
<td>7.53</td>
<td>9.66</td>
</tr>
<tr>
<td>Declarative PM</td>
<td>6.78</td>
<td>8.69</td>
</tr>
<tr>
<td>Planning</td>
<td>6.22</td>
<td>7.98</td>
</tr>
<tr>
<td>Cognitive processes</td>
<td>4.37</td>
<td>5.60</td>
</tr>
<tr>
<td>Memory strategies</td>
<td>3.47</td>
<td>4.45</td>
</tr>
</tbody>
</table>

Note. % = percentage of variance explained.

The five components were inspected to uncover common themes amongst items within each component. Component 1 was labelled Everyday Memory and contained items relating to memory successes and failures typically encountered, for example, Item 18 “I forget where I have placed things e.g. keys or money”. Component 2 was titled Declarative
Prospective Memory and was seen to measure aspects of PM content that could be declared such as remembering instructions. For example, Item 48 “I forget important dates, birthdays, or anniversaries” loaded onto this component. Component 3 was labelled Planning and contained items pertaining to the planning of future activities, for example, Item 25 “If I have a lot of things to do, I like to plan how and when I will do them”. Component 4 was named Cognitive Processes and included items relating to the cognitive processes involved in PM tasks (i.e. encoding, storage, and retrieval), for example, Item 63 “I like to keep track in my mind of things that I have done”. Finally, Component 5 was labelled Memory Strategies and related to strategies used to improve PM, for example, Item 46 “I use a diary or calendar to help me remember to do things”. Of the 78 items, four did not load significantly (> .3) on to any of the five components. The significant rotated component loadings of the 78 items onto the five components are illustrated in Table 7.
### Component Loadings in the Principal Component Analysis of the 78 Item Scale

<table>
<thead>
<tr>
<th>Items</th>
<th>Description</th>
<th>Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>I put things in the wrong place e.g. milk in the cupboard and sugar in the fridge</td>
<td>0.61</td>
</tr>
<tr>
<td>18</td>
<td>I forget where I have placed things e.g. keys or money</td>
<td>0.58</td>
</tr>
<tr>
<td>14*</td>
<td>If I do not put things in their normal place (e.g. keys) I will not remember where I put them</td>
<td>0.57</td>
</tr>
<tr>
<td>5</td>
<td>There are times when I remember that I need to do something but I can’t remember what it is</td>
<td>0.55 0.30</td>
</tr>
<tr>
<td>54</td>
<td>I tell people the same story because I forget that I have already told them</td>
<td>0.55</td>
</tr>
<tr>
<td>15</td>
<td>I forget to hang the washing out once the washing machine cycle has finished</td>
<td>0.54</td>
</tr>
<tr>
<td>44*</td>
<td>I get a nagging feeling that there is something I need to do but I can’t remember what it is</td>
<td>0.51 0.32</td>
</tr>
<tr>
<td>52</td>
<td>I do things twice because I forget that I have already done them e.g. take a tablet twice</td>
<td>0.50</td>
</tr>
<tr>
<td>65</td>
<td>I forget to take my medication as prescribed</td>
<td>0.49</td>
</tr>
<tr>
<td>53</td>
<td>I think that I have done things when I actually have not done them</td>
<td>0.49 -0.33</td>
</tr>
<tr>
<td>6</td>
<td>I walk into a room and forget why I went there</td>
<td>0.47</td>
</tr>
<tr>
<td>10</td>
<td>I forget important appointments</td>
<td>0.46 -0.30</td>
</tr>
<tr>
<td>17</td>
<td>I am more likely to remember to do something if there is something to remind me e.g. an object or a person</td>
<td>0.46 0.44</td>
</tr>
</tbody>
</table>

Note. * = items eliminated from 78 item scale. Component 1 = Everyday Memory, Component 2 = Declarative Prospective Memory, Component 3 = Planning, Component 4 = Cognitive Processes, Component 5 = Memory Strategies.
### Table 7 (continued).

**Component Loadings in the Principal Component Analysis of the 78 Item Scale**

<table>
<thead>
<tr>
<th>Items</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>66 I forget to turn the stove or iron off</td>
<td>.45</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23 I forget to do things because I get carried away doing something else</td>
<td>.45</td>
<td>.36</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>67* I forget dates, appointments, or events, even if they are important to me</td>
<td>.43</td>
<td>.35</td>
<td>-.31</td>
<td></td>
<td></td>
</tr>
<tr>
<td>22 When I have to do two things at once, I have trouble remembering to do both</td>
<td>.41</td>
<td>.34</td>
<td>-.34</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seeing places or objects can remind me that I need to do something, but I can’t remember exactly what it is</td>
<td>.39</td>
<td></td>
<td></td>
<td>.30</td>
<td></td>
</tr>
<tr>
<td>19* I leave objects (e.g. keys) in obvious places to remind me to do things</td>
<td>.39</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 I forget what I was talking about midsentence</td>
<td>.39</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>27 I forget to do things but remember that I was meant to do them after it is too late</td>
<td>.37</td>
<td>.30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24 I find that I don’t get anything done that I planned to do because I get interrupted all the time</td>
<td>.31</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>58 I have trouble remembering recent events in my life</td>
<td>.69</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>48 I forget important dates, birthdays, or anniversaries</td>
<td>.66</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>34 I have trouble remembering things that I need to do in a few hours’ time</td>
<td>.57</td>
<td></td>
<td>-.36</td>
<td></td>
<td></td>
</tr>
<tr>
<td>33 I have trouble remembering things I that need to do in 15 minutes time</td>
<td>.56</td>
<td></td>
<td>-.35</td>
<td></td>
<td></td>
</tr>
<tr>
<td>37 I have trouble remembering directions or instructions</td>
<td>.55</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note. * = items eliminated from 78 item scale. Component 1 = Everyday Memory, Component 2 = Declarative Prospective Memory, Component 3 = Planning, Component 4 = Cognitive Processes, Component 5 = Memory Strategies.
Table 7 (continued).

Component Loadings in the Principal Component Analysis of the 78 Item Scale

<table>
<thead>
<tr>
<th>Items</th>
<th>Component</th>
<th>Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>57</td>
<td>I have trouble remembering the names of people and places</td>
<td>.54</td>
</tr>
<tr>
<td>70</td>
<td>It takes me longer to do mental tasks than it used to e.g. crosswords</td>
<td>.53</td>
</tr>
<tr>
<td>77</td>
<td>I have trouble thinking of ways to help my memory</td>
<td>.52</td>
</tr>
<tr>
<td>68</td>
<td>I worry that my memory is getting worse</td>
<td>.48</td>
</tr>
<tr>
<td>38</td>
<td>If I am given instructions, I will forget at least one step</td>
<td>.46</td>
</tr>
<tr>
<td>72*</td>
<td>I get frustrated with myself because I forget to do things I was supposed to do</td>
<td>.45</td>
</tr>
<tr>
<td>71</td>
<td>My memory is as good as most people my age</td>
<td>-.35 - .44</td>
</tr>
<tr>
<td></td>
<td>If I am anxious or worried about something, I forget things that I am supposed to be doing e.g. I forget items on the shopping list</td>
<td>.31 .44</td>
</tr>
<tr>
<td>29</td>
<td>I have trouble switching my attention between two different things e.g. watching TV and talking to someone at the same time</td>
<td>.40</td>
</tr>
<tr>
<td>39</td>
<td>I forget to do some things I have planned to do</td>
<td>.31 .40</td>
</tr>
<tr>
<td>41</td>
<td>When I am tired, stressed, angry, or upset I forget to do things more often than normal</td>
<td>.37</td>
</tr>
<tr>
<td>35</td>
<td>At the supermarket I can remember at least 5 things that I need to buy without using a list</td>
<td>-.36</td>
</tr>
<tr>
<td>11</td>
<td>If interrupted while doing something, I remember to finish it later</td>
<td>-.34</td>
</tr>
<tr>
<td>59</td>
<td>I have trouble remembering events from my childhood or a long time ago</td>
<td>.31</td>
</tr>
</tbody>
</table>

Note. * = items eliminated from 78 item scale. Component 1 = Everyday Memory, Component 2 = Declarative Prospective Memory, Component 3 = Planning, Component 4 = Cognitive Processes, Component 5 = Memory Strategies.
Table 7 (continued).

Component Loadings in the Principal Component Analysis of the 78 Item Scale

<table>
<thead>
<tr>
<th>Items</th>
<th>Components 1</th>
<th>Components 2</th>
<th>Components 3</th>
<th>Components 4</th>
<th>Components 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am good at remembering dates, phone numbers, and birthdays</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>I like to make sure that I am never late if I have to be somewhere e.g. an appointment</td>
<td>.58</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I forget to pass important messages on to family, friends, or colleagues</td>
<td>-.56</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>If I have a lot of things to do, I like to plan how and when I will do them</td>
<td>.55</td>
<td>.32</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I remember to do things that I need to do on a daily basis e.g. brush my teeth, shower, and eat meals</td>
<td>.54</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>When I am given a message to pass on, I forget what the message was</td>
<td>-.53</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am the person in our household responsible for remembering appointments, birthdays, or events</td>
<td>.50</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I like to be organised all of the time</td>
<td>.50</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am good at remembering to do things on time</td>
<td>-.33</td>
<td>.49</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I forget to do daily tasks such as paying bills, posting letters, or putting the garbage out</td>
<td>.38</td>
<td>-.48</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>When there is something I must remember to do at a certain time I look at the clock more often</td>
<td>.48</td>
<td>.41</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I remember things that I need to do even if I am in the middle of a busy task</td>
<td>.41</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>If I miss an appointment, I will remember to reschedule it for a later time</td>
<td>-.34</td>
<td>.40</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. * = items eliminated from 78 item scale. Component 1 = Everyday Memory, Component 2 = Declarative Prospective Memory, Component 3 = Planning, Component 4 = Cognitive Processes, Component 5 = Memory Strategies.
Table 7 (continued).

*Component Loadings in the Principal Component Analysis of the 78 Item Scale*

<table>
<thead>
<tr>
<th>Items</th>
<th>Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>I forget to do things that can be done in a sequence e.g. buy a stamp, put the stamp on an envelope, and post it</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>I am able to remember to do something if it involves telling somebody something e.g. passing on a message</td>
<td></td>
</tr>
<tr>
<td>I am more likely to remember to do something if it is related to what I am already doing e.g. I remember to get petrol whilst driving</td>
<td>-- -- -- --</td>
</tr>
<tr>
<td>I am more likely to remember to do something if I am anxious or worried about it</td>
<td>.64</td>
</tr>
<tr>
<td>I like to keep track in my mind of things that I have done</td>
<td>.61</td>
</tr>
<tr>
<td>I remember to do things by associating them with other things e.g. I associate a person who I need to pass a message on to with a certain place</td>
<td>.59</td>
</tr>
<tr>
<td>Seeing places (e.g. a supermarket) or objects (e.g. a teapot) can remind me that I need to do something (e.g. buy sugar)</td>
<td>.44 .50</td>
</tr>
<tr>
<td>I think through the things I need to do before they have to be done</td>
<td>-.42 .47</td>
</tr>
<tr>
<td>I am more likely to remember to do things if I say them over and over to myself</td>
<td>.47</td>
</tr>
<tr>
<td>I am more likely to remember to do something if I do it often</td>
<td>.37 .45</td>
</tr>
<tr>
<td>I can only remember that I have a message to pass on when I see the person the message is for</td>
<td>.42</td>
</tr>
<tr>
<td>I am always thinking about things that need to be done</td>
<td>.42</td>
</tr>
</tbody>
</table>

*Note.* *= items eliminated from 78 item scale. Component 1 = Everyday Memory, Component 2 = Declarative Prospective Memory, Component 3 = Planning, Component 4 = Cognitive Processes, Component 5 = Memory Strategies.
Table 7 (continued).

Component Loadings in the Principal Component Analysis of the 78 Item Scale

<table>
<thead>
<tr>
<th>Items</th>
<th>Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am able to remember to do something if it involves an action e.g. going somewhere</td>
<td>.42  .42</td>
</tr>
<tr>
<td>Worrying about things that I have to do means that I tend to keep thinking about them</td>
<td>.41</td>
</tr>
<tr>
<td>I have thoughts of things I need to do in the future pop into my head</td>
<td>.40  .40</td>
</tr>
<tr>
<td>If I am doing something important or that I enjoy I forget about other things I need to do</td>
<td>.35  .35</td>
</tr>
<tr>
<td>I remember the main parts of instructions (e.g. buy milk) but I forget details (e.g. buy two litres of skim milk)</td>
<td>.34</td>
</tr>
<tr>
<td>I make lists to help me remember to do things</td>
<td>.76</td>
</tr>
<tr>
<td>I use a diary or calendar to help me remember to do things</td>
<td>.69</td>
</tr>
<tr>
<td>I am more likely to remember to do things if I make lists or draw pictures</td>
<td>.31  .65</td>
</tr>
<tr>
<td>I use an alarm clock or a phone to help me remember to do things</td>
<td>.64</td>
</tr>
<tr>
<td>I know that I am going to need a memory aid such as a note, list or alarm</td>
<td>.46  .50</td>
</tr>
<tr>
<td>If I borrow someone else’s personal belongings (e.g. a book) I will remember to give it back</td>
<td>--  --  --  --  --</td>
</tr>
<tr>
<td>If I lend someone a personal belonging (e.g. a book) I will remember to ask for it back</td>
<td>--  --  --  --  --</td>
</tr>
</tbody>
</table>

Note. * = items eliminated from 78 item scale. Component 1 = Everyday Memory, Component 2 = Declarative Prospective Memory, Component 3 = Planning, Component 4 = Cognitive Processes, Component 5 = Memory Strategies.
Following the PCA, a Rasch analysis was conducted for all five components to determine whether the items within each component were targeting a range of ability levels, that is, that there was a good spread of difficult and easy to endorse items within the scale. This was explored using the Wright maps for each component. The five component Wright maps are depicted in Figures 3a-e.

In each of the figures, the central line represents the logit scale, whilst the numbers on the far left are the logit measurement units. On this logit scale, M represents the mean person or item measure, S one standard deviation from the mean, and T two standard deviations from the mean. To the left of the central logit scale in each diagram is the distribution of persons on each component (i.e. person measures). These persons are ordered from those with the highest degree of memory impairment at the top of the scale to those with the lowest degree of memory impairment at the bottom. On the right-hand side of the logit scale are the item measures, that is, the distribution or hierarchy of items ordered from the most difficult (or severe memory problems) at the top to the easiest (less severe memory issues) at the bottom of the scale. It was these item measures that were of interest in this analysis of whether items were targeting a range of person ability levels.
a) Everyday Memory Component  

b) Declarative Prospective Memory  
c) Planning

Figure 3. Wright maps depicting item hierarchies on the five PMCQ components.

Note. # = 2 persons and “.” = 1 person. Figure 3a, # = 3 persons.
**SELF-REPORTED PROSPECTIVE MEMORY**

**d) Cognitive Processes**

**e) Memory Strategies**

*Figure 3.* Wright maps depicting item hierarchies on the five PMCQ components (continued).

*Note.* # = 2 persons and “.” = 1 person.
As can be seen in Figures 3a-e, the items within each component generally cover a wide range of the person ability distribution. The mean item measure for the Everyday Memory (Figure 3a) and Declarative Prospective Memory (Figure 3b) scales were higher than the mean person measures, indicating that the items were measuring more severe memory concerns than were present in the person sample. Alternatively, the mean measure for the Planning (Figure 3c) and Memory Strategies (Figure 3e) scales were lower than the mean person measure, suggesting the planning and strategy behaviours assessed in these items were frequently carried out by participants (i.e. the sample were reportedly good at planning and formulating memory strategies). As the sample used in these analyses consisted primarily of non-referred adults, these distributions would be somewhat expected. However, there was an issue with the Planning scale (Figure 3c) as items were located at the extremes of the scale rather than the centre of the scale, which indicates that items were not targeting average performance well. The opposite effect was found in Figure 3e whereby items were located at the centre of the person distribution and therefore did not measure extremely high or low memory strategy use.

On each component there were several instances where multiple items had similar item measures, that is, they were located at the same difficulty level on the logit scale. As these items targeted a similar level of person ability they were redundant in the information they provided in the measurement of the component. For example, in Figure 3a items 5, 14, and 23 had item measures of approximately -1.20. Items that were targeting similar difficulty levels, and therefore providing similar information about the component, were flagged for further analysis.

**Item removal.** A combination of item content, Rasch item measures, and PCA component loadings were used for identifying items to be deleted from the draft PMCQ. Criteria for removing items included that items had very small loadings onto one or more
components whereby loadings were below or around .3. In addition, when two or more items from within a PCA component were located at a similar difficulty level on the Rasch scale, the item with the lower component loading was usually removed. Items were also removed when those with similar content within each component were located at the same difficulty level (i.e. had similar item measures) on the Rasch scale. In total, nine items were eliminated from the draft PMCQ during these analyses. Specifically, items 14, 19, 44, and 67 were removed from the Everyday Memory component; Item 72 was deleted from the Declarative Prospective Memory component; and items 42, 43, 56, and 64 were eliminated from the Cognitive Processes component. Following these analyses 69 items remained in the scale.

**Analysis of the 69 item scale.** The remaining 69 items underwent further analyses to investigate the structure, reliability, and validity of the scale. In addition, these analyses informed decisions regarding the elimination of from the scale. A detailed description of these analyses is provided in Appendix M.

**Construct validity.** A PCA was carried out on the 69 item scale to assess the structure and construct validity of the scale. This PCA was carried out using the same procedure and criteria as the PCA of the 78 item scale. This analysis resulted in an orthogonal four component solution that accounted for 33.2% of the variance within the 69 item scale.

**Internal consistency reliability.** The 69 item scale and the four component scales obtained in the PCA were examined for internal consistency reliability using Cronbach’s alpha. The 69 item scale was found to have good reliability (α = .81) whilst the four components had adequate to excellent internal consistency scores (ranging from α = .77-.90). The internal consistency reliability analysis was also used to inform the decision of which items to retain and which to eliminate on the basis of improving scale reliability. This was done by observing the four component alphas and comparing them to the component alphas if
any of the scale items were deleted. If component reliability was improved significantly by the removal of an item, this suggested that the item should be deleted from the scale.

**Predictive validity.** In addition to determining the structure and reliability of the draft PMCQ, the predictive validity of the draft PMCQ was assessed. Specifically, one-way ANOVAs were conducted to assess how well the scale and its components discriminated between participants in the non-referred group from those in the referred group. The 69 item draft PMCQ scale was able to discriminate between the two groups, with the referred group reporting more memory concerns than the non-referred group. Two of the four components also demonstrated predictive validity with the referred group reporting significantly more memory concerns than the non-referred group on these scales.

A DA was also conducted to assess the effectiveness of the draft PMCQ items in predicting membership to either the non-referred or the referred group. This analysis revealed that the draft PMCQ scale correctly classified 97% of the non-referred group and 78.9% of participants in the referred group. This finding was promising considering the small size of the sample where analyses were adjusted to account for the differences in group sizes.

**Scale dimensionality.** The total draft PMCQ and component scales also underwent a Rasch analysis. The unidimensionality of these scales was assessed using a PCAR once the modelled dimension was removed. The 69 item scale and two of the component scales showed some multidimensionality with eigenvalues above the criterion of 2.0. This suggested that these scales contained items that were measuring more than one dimension and that some items may need to be eliminated.

**Item fit.** In addition to analyses evaluating the overall functioning of the draft PMCQ total scale, an assessment of the functioning of individual items within each of the scales was carried out. These analyses assisted in informing decisions of retaining or removing of items from the PMCQ. Mean square fit statistics were assessed for each item within the four
components. Fit statistics for the draft PMCQ total scale were not assessed as this would have overlapped with analyses of the item fit statistics within each of the components. These analyses revealed that four items were underfitting and unpredictable, whilst another four items were overfitting and possibly redundant. These items were identified as possible items to eliminate from the scale.

**Rating scale functioning.** The functioning of the rating scale response categories for each PMCQ item within the four components was assessed to ensure that response categories were being used correctly. Just as items should be located at a specific point or difficulty level on a dimension, so should response categories within items. Specifically, a person high in PM ability on any given item should endorse a higher response category than a person with low levels of PM ability. For example, an individual with more memory concerns should endorse the *Always* category more often than an individual with less memory concerns. Therefore, an examination of item response category average measures for items within each of the four components was carried out. Average measures can be defined as the average ability of persons responding to a particular response category, for example, the average ability of persons that respond to the *Never* category (Linacre, 2009b). These ability measures theoretically should increase in ascending order so that more difficult items are endorsed by people with greater ability (i.e. the category should be ordered 0, 1, 2, 3). If these measures are disordered then the response categories are not performing as expected. For example, when a person of high ability is more likely to rate an item as 2 (*Sometimes*), whilst a person of lower ability is more likely to rate the same item as 3 (*Often*). Category disordering such as this may occur because people of higher or lower ability than intended for the response category are endorsing the category unexpectedly, the response category is not being used as predicted, or there is a problem with the item.
The analyses of average ability measures revealed that the average measures increased monotonically for the majority of items. There were two items with a considerable amount of category disordering, and a few items that had minor category disordering. Another issue identified was that for some items, not every category was endorsed. For example, in Item 7 “I put things in the wrong place e.g. milk in the cupboard and sugar in the fridge” the Always category was not endorsed by any participants. Items that demonstrated disordering or had categories that were not endorsed were flagged for potential elimination.

**Item removal.** The findings of the PCA, Reliability Analysis, and Rasch analysis were used collectively to determine which items were performing poorly and needed to be deleted. Poorly performing items were those on the PCA with low component loadings (around .3) or items that loaded significantly onto multiple components. In the Reliability Analysis, items that were found to improve scale validity if they were deleted were also highlighted as indicating poor functioning. Problematic items in the Rasch analysis were those that demonstrated misfit or poor category functioning. Items were typically eliminated if they met more than one of these criteria, although item content was considered. For example, when multiple items contained similar content, the items with better psychometric properties were retained whilst the less effective items were eliminated. A total of 23 items were removed from the draft PMCQ as a result of these analyses.

Following these analyses, Item 32 “I remember to do things that I need to do on a daily basis e.g. brush my teeth, shower, and eat meals” and Item 65 “I forget to take my medication as prescribed” required further analysis. These items measured important aspects of PM, however, Item 32 met several criteria for item deletion, and Item 65 was less effective than other items in representing the construct. In order to capitalise on the content of these items, Items 32 and 65 were combined. This combined item is hereafter referred to as Item 32 and reads “I remember to do everyday tasks such as take medication, brush my teeth, or
shower”. Although it was unknown whether this reconstructed item continued to measure the same constructs as the unmerged items, it was anticipated that the content was similar enough to tap these constructs when analysed further in Study 3. At the conclusion of these analyses, 46 items remained within the draft PMCQ.

**Analysis of the 46 item scale.** As with the analysis of the 69 item scale, the analysis of the 46 item scale was an intermediate step in developing the final PMCQ. Therefore, Appendix M includes a full description of these analyses.

**Construct validity.** A PCA was conducted on the remaining 46 items in order to assess scale structure, construct validity, and to further reduce the number of items in the PMCQ. This analysis utilised the same procedures and criteria as the PCAs of the 78 and 69 item versions of the scale. The PCA resulted in an orthogonal three factor solution that accounted for 33.07% of the variance in the 46 item scale. The three factors obtained in this PCA were labelled Forgetting Behaviours, Memory Concerns, and Retrieval Cues.

**Internal consistency reliability.** Following the PCA, an examination of the internal consistency of the draft PMCQ scale and its three components was carried out. The draft PMCQ total scale had excellent reliability (α = .91) whilst the component subscales all had good internal consistency reliability (range α = .77—.84). The Reliability Analysis also assessed whether the deletion of any items would improve each component’s reliability. This was done by comparing each scale’s alpha score with the alpha if items were to be deleted from the scale.

**Item removal.** At this stage of the analysis, Item 78 was found to have met multiple criteria for deletion, that is, the PCA revealed that the item loaded significantly onto all three components, each with low loadings. Furthermore, the reliability analysis indicated that the Memory Concerns component would be improved if this item were deleted. As a result, Item 78 was eliminated from the draft PMCQ.
An investigation of the PCA component loadings of the remaining 45 items revealed that many items cross loaded onto multiple components. A series of Rasch analyses were therefore conducted to maximise the psychometric properties of each component. During these analyses, cross loading items were taken from their highest loading component and placed on to components where they loaded to a lesser extent but where item fit and person reliability indices were best. A PCAR in the first contrast after the modelled dimension was removed was also carried out on each component. This was done to ensure that the unidimensionality of each component was maintained during the rearrangement of items. Consequently, three items (Items 27, 33, and 34) were removed as they were found to decrease the psychometric properties of all three components. These items had poor item fit regardless of which component they were placed on and they also lowered the dimensionality of each component. In addition, five items that were cross loading were moved to the component that resulted in the best psychometric properties (see Table 8).

Table 8

*Rearrangement of Cross Loading Items Onto Different Components*

<table>
<thead>
<tr>
<th>Item</th>
<th>Original Component</th>
<th>New Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>I put things in the wrong place e.g. milk in the cupboard and sugar in the fridge</td>
<td>Retrieval Cues</td>
</tr>
<tr>
<td>8</td>
<td>In the middle of a sentence I forget what I was going to say</td>
<td>Memory Concerns</td>
</tr>
<tr>
<td>11</td>
<td>If interrupted while doing something, I remember to finish it later</td>
<td>Memory Concerns</td>
</tr>
<tr>
<td>21</td>
<td>Seeing places or objects can remind me that I need to do something, but I can’t remember exactly what it is</td>
<td>Forgetting Behaviours</td>
</tr>
<tr>
<td>66</td>
<td>I forget to turn the stove or iron off</td>
<td>Retrieval Cues</td>
</tr>
</tbody>
</table>
Finally, some items were slightly reworded to increase item reliability. However, overall content and phrasing of these items was maintained to preserve the psychometric properties of the items. These changes are shown in Appendix M. At the conclusion of these analyses, 42 items were retained for what was to be the final version of the PMCQ.

**Characteristics of the final 42 item PMCQ.** The final version of the scale contained 42 items that measured PM concerns. The PCA in the 46 item stage revealed that the scale comprised of three components, although, four items were deleted as the psychometric properties of the components were improved without these items. In addition, some cross loading items were moved from their highest loading component to components where they loaded to a lesser extent for the purpose of maximising the overall functioning of the three components. A PCA was not conducted on the remaining 42 items as the items on these three components had acceptable psychometric properties. Instead, a CFA would be used in Study 3 to assess the final scale structure on an independent sample. Therefore, at this stage Component 1 of the PMCQ was labelled Forgetting Behaviours and contained 16 items. Component 2 was titled Memory Concerns and contained of 14 items, whilst Component 3 was named Retrieval Cues and included 12 items. Table 9 lists the PMCQ scales and items.
Table 9

*Items within the Three Components of the Final 42 Item PMCQ Scale*

<table>
<thead>
<tr>
<th>Items</th>
<th>Forgetting Behaviours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I forget to do daily tasks such as paying bills, posting letters, or putting the garbage out</td>
</tr>
<tr>
<td>2</td>
<td>I forget to pass important messages on to family, friends, or colleagues</td>
</tr>
<tr>
<td>7</td>
<td>I put things in the wrong place e.g. milk in the cupboard and sugar in the fridge</td>
</tr>
<tr>
<td>8</td>
<td>In the middle of a sentence I forget what I was going to say</td>
</tr>
<tr>
<td>10</td>
<td>I forget important appointments</td>
</tr>
<tr>
<td>11</td>
<td>If interrupted while doing something, I remember to finish it later</td>
</tr>
<tr>
<td>13</td>
<td>When I am given a message to pass on, I forget what the message was</td>
</tr>
<tr>
<td>16</td>
<td>I forget to do things that can be done in a sequence e.g. buy a stamp, put the stamp on an envelope, and post it</td>
</tr>
<tr>
<td>22</td>
<td>When I have to do two things at once, I have trouble remembering to do both</td>
</tr>
<tr>
<td>23</td>
<td>I forget to do things because I get carried away doing something else</td>
</tr>
<tr>
<td>32</td>
<td>I remember to do everyday tasks such as take medication, brush my teeth, or shower</td>
</tr>
<tr>
<td>36</td>
<td>I remember to do things I need to do even if I am in the middle of another task</td>
</tr>
<tr>
<td>50</td>
<td>I am good at remembering to do things on time</td>
</tr>
<tr>
<td>52</td>
<td>I do things twice because I forget that I have already done them e.g. take a tablet twice</td>
</tr>
<tr>
<td>53</td>
<td>I think that I have done things when I actually have not done them</td>
</tr>
<tr>
<td>66</td>
<td>I forget to turn the stove or iron off</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Items</th>
<th>Memory Concerns</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>There are times when I remember that I need to do something but I can’t remember what it is</td>
</tr>
<tr>
<td>26</td>
<td>I forget to do some things that I have planned to do</td>
</tr>
<tr>
<td>29</td>
<td>I forget things that I am supposed to be doing if I am anxious or worried about something</td>
</tr>
<tr>
<td>37</td>
<td>I have trouble remembering directions or instructions</td>
</tr>
<tr>
<td>39</td>
<td>I have trouble switching my attention between two different things e.g. watching TV and talking to someone at the same time</td>
</tr>
<tr>
<td>41</td>
<td>When I am tired, stressed, angry or upset, I forget to do things more often than normal</td>
</tr>
<tr>
<td>48</td>
<td>I forget important dates, birthdays, or anniversaries</td>
</tr>
</tbody>
</table>
Table 9 (continued).

*Items within the Three Components of the Final 42 Item PMCQ Scale*

<table>
<thead>
<tr>
<th>Memory Concerns (Continued)</th>
</tr>
</thead>
<tbody>
<tr>
<td>57</td>
</tr>
<tr>
<td>58</td>
</tr>
<tr>
<td>68</td>
</tr>
<tr>
<td>69</td>
</tr>
<tr>
<td>70</td>
</tr>
<tr>
<td>72</td>
</tr>
<tr>
<td>77</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Retrieval Cues</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
</tr>
<tr>
<td>15</td>
</tr>
<tr>
<td>17</td>
</tr>
<tr>
<td>18</td>
</tr>
<tr>
<td>20</td>
</tr>
<tr>
<td>21</td>
</tr>
<tr>
<td>24</td>
</tr>
<tr>
<td>51</td>
</tr>
<tr>
<td>54</td>
</tr>
<tr>
<td>60</td>
</tr>
<tr>
<td>61</td>
</tr>
<tr>
<td>62</td>
</tr>
</tbody>
</table>
**Internal consistency reliability.** The internal consistency of the PMCQ and its components was assessed using Cronbach’s alpha. The alphas obtained in this analysis are reported in Table 10. These alphas indicate that the PMCQ total scale had very good reliability, whilst all three components had good internal consistency. The reliability analysis also revealed that internal consistency was not improved with the removal of any items from the PMCQ or its subscales.

Table 10

*Internal Consistency of the PMCQ and its Three Components*

<table>
<thead>
<tr>
<th>Scale</th>
<th>α</th>
</tr>
</thead>
<tbody>
<tr>
<td>PMCQ total scale</td>
<td>.90</td>
</tr>
<tr>
<td>Forgetting Behaviours</td>
<td>.86</td>
</tr>
<tr>
<td>Memory Concerns</td>
<td>.85</td>
</tr>
<tr>
<td>Retrieval Cues</td>
<td>.77</td>
</tr>
</tbody>
</table>

*Note.* Alpha scores range from 0–100 with higher scores indicating better reliability.

**Scale dimensionality.** A Rasch analysis was conducted on the PMCQ and each of the three components. The dimensionality of the PMCQ and its components was assessed using a PCAR following the removal of the initial dimension. Table 11 shows the eigenvalues from the PCAR in the first contrast for each scale after the modelled dimension was removed. The eigenvalue for the PMCQ total scale indicated that the scale had some multidimensionality and contained some variance not explained by the target dimension. As the PCA of the PMCQ indicated that the questionnaire had three components, it was of greater importance that the three subscales were all unidimensional with eigenvalues below 2.0. Therefore, all subsequent Rasch analyses were conducted on the three components rather than the total PMCQ scale.
Table 11

*PCAR Eigenvalues for the 42 Item PMCQ*

<table>
<thead>
<tr>
<th>Scale</th>
<th>Eigenvalues of PCA of Residuals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forgetting Behaviours</td>
<td>1.7</td>
</tr>
<tr>
<td>Memory Concerns</td>
<td>1.5</td>
</tr>
<tr>
<td>Retrieval Cues</td>
<td>1.9</td>
</tr>
<tr>
<td>PMCQ total scale</td>
<td>3.3</td>
</tr>
</tbody>
</table>

**Item fit.** Within each component, individual item fit statistics were assessed. Item 32 “I remember to do everyday tasks such as take medication, brush my teeth, or shower” was the only item to demonstrate misfit. This item had underfitting mean square scores on the Forgetting Behaviours scale (infit = 1.65, outfit = 1.68). However, this misfit was somewhat expected as this item was significantly modified earlier in Study 2. It was anticipated that the psychometric properties of this new item would improve when tested in Study 3.

**Predictive validity.** A DA was conducted on the 42 item PMCQ to determine how well the scale could predict membership to the referred or non-referred group. This analysis revealed that the scale was effective in distinguishing between participants as PMCQ scores correctly classified 97.5% of the non-referred group and 57.4% of cases in the referred group. Similar to the earlier item analysis stages in this study, differences between the referred and non-referred groups on the PMCQ and its components were assessed. First, average component scores were calculated for the three components using the procedure described in Appendix M. Using these component scores, one-way ANOVAs were carried out to compare the scores of the non-referred and referred groups on the PMCQ and its three components. Descriptive statistics for the two groups are provided in Table 12.
Table 12

Comparison of PMCQ Scores in the Non-Referred and Referred Groups

<table>
<thead>
<tr>
<th>Scales</th>
<th>Non-referred (n = 134)</th>
<th>M</th>
<th>SD</th>
<th>Referred (n = 19)</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forgetting Behaviours</td>
<td></td>
<td>.57</td>
<td>.30</td>
<td>.81</td>
<td>.55</td>
<td></td>
</tr>
<tr>
<td>Memory Concerns**</td>
<td></td>
<td>.89</td>
<td>.38</td>
<td>1.32</td>
<td>.57</td>
<td></td>
</tr>
<tr>
<td>Retrieval Cues</td>
<td></td>
<td>1.01</td>
<td>.38</td>
<td>1.06</td>
<td>.44</td>
<td></td>
</tr>
<tr>
<td>PMCQ total scale*</td>
<td></td>
<td>.80</td>
<td>.29</td>
<td>1.05</td>
<td>.46</td>
<td></td>
</tr>
</tbody>
</table>

*Note. Mean scores are average scale scores that range from 0–3 with high scores indicating more memory concerns. Scores of 0 = Never, 1 = Sometimes, 2 = Often, and 3 = Always.  
*p < .05, **p < .01

In these analyses, Levene’s test of homogeneity of variances revealed unequal variances on the Forgetting Behaviours component (14.30, *p* < .001), the Memory Concerns component (10.72, *p* = .001), and on the PMCQ total scale (8.62, *p* = .004). Consequently, the Welch test and Games-Howell post-hoc tests were used for the analyses of these scales. Participants in the non-referred group reported having less memory concerns than referred participants on all scales however not all effects were significant. The non-referred group only differed significantly from the referred group on the Memory Concerns component, *F*(1, 20.39) = 9.86, *p* = .005, and on the PMCQ total scale, *F*(1, 20.08) = 5.18, *p* = .034.

In order to assess group differences more thoroughly, the referred group were separated into brain injury, and MCI/dementia groups for a second set of ANOVAs. Descriptive statistics for the three groups are shown in Table 13. Levene’s test of homogeneity of variance revealed that variances were unequal on the Forgetting Behaviours component (6.22, *p* = .003), the Memory Concerns component (5.48, *p* = .005), and on the PMCQ total scale (5.29, *p* = 0.06). As a result, the Welch test and Games-Howell post-hoc test were used for these scales.
Table 13

Comparison of PMCQ Scores Across Groups

<table>
<thead>
<tr>
<th>Scales</th>
<th>Non-referred (n = 134)</th>
<th>Brain Injury (n = 12)</th>
<th>MCI/Dementia (n = 7)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
</tr>
<tr>
<td>Forgetting Behaviours</td>
<td>.57</td>
<td>.30</td>
<td>.74</td>
</tr>
<tr>
<td>Memory Concerns*</td>
<td>.89</td>
<td>.38</td>
<td>1.33</td>
</tr>
<tr>
<td>Retrieval Cues</td>
<td>1.01</td>
<td>.38</td>
<td>1.10</td>
</tr>
<tr>
<td>PMCQ total scale</td>
<td>.80</td>
<td>.29</td>
<td>1.04</td>
</tr>
</tbody>
</table>

* p < .05

Note. Mean scores are average scale scores that range from 0–3 with high scores indicating more memory concerns. Scores of 0 = Never, 1 = Sometimes, 2 = Often, and 3 = Always.

As can be seen in Table 13, the non-referred group reported less memory concerns than the referred subgroups on the PMCQ total scale as well as on the Forgetting Behaviours and Memory Concerns components. However, this effect was only significant for the Memory Concerns component, $F(2, 10.93) = 4.41, p = .039$. Post hoc analyses on this component revealed that the non-referred group reported less memory concerns than the brain injury group although this did not reach significance ($p = .069$).

**Discussion**

The aims of Study 2 were to assess the structure, reliability, and validity of the PMCQ and to reduce the number of scale items from 78 to approximately 40 items. Therefore, during Study 2, the PMCQ was analysed sequentially across three stages. In the first stage, the 78 item scale was analysed and items with poor psychometric properties were eliminated. This process was repeated with 69 and 46 item versions of the scale, which resulted in the development of the final version of the PMCQ. This 42 item scale had three subscales: Forgetting Behaviours, Memory Concerns, and Retrieval Cues. The PMCQ and its subscales
were found to have good reliability, fit statistics, and rating scale category functioning. Furthermore, the PMCQ total score was able to discriminate between non-referred and referred groups. Although the 42 item PMCQ was shown to have good psychometric properties in this study, it was important to conduct a full validation study analysing the PMCQ with a new (larger) sample. Therefore, the PMCQ was to undergo further investigation in Study 3.
CHAPTER 6

Study 3: Scale Validation, Standardisation, and Investigation of Variables Related to the Measurement of Self-Reported Prospective Memory

This chapter presents the method, results, and implications of the third study for this thesis. The primary thesis aim was to develop the PMCQ, which was to be a brief, self-report scale for the assessment of PM failures and concerns. In Study 2, the 42 item final version of the PMCQ was developed. A part of the primary thesis aim was to investigate the psychometric properties of this scale in order to determine its utility in the measurement of self-reported PM. In addition, it was important to obtain normative data for the PMCQ for healthy adults across the lifespan to increase the utility of the scale. Therefore, the first aim of Study 3 was to assess the structure, reliability, and validity of the PMCQ. The second aim was to obtain normative data for the PMCQ for both males and females across the lifespan. These aims reflect the final two scale development steps outlined in Chapter 3.

The development of the PMCQ within Studies 1 and 2 incorporated a combination of CTT and IRT. The investigation of the psychometric properties of the final version of the PMCQ in Study 3 also included the combined use of techniques derived from these test theories. As this approach of merging test theories is untested in the PM field, the second thesis aim was to determine whether the PMCQ was similar in content and structure to existing self-report PM scales that were not developed using this approach. This aim was to be explored in Study 3. The PRMQ (G. Smith et al., 2000) was used in this study for comparisons with the PMCQ as it is the most commonly cited PM self-report scale in the PM literature. The development of the PRMQ involved creating 16 items targeting eight categories (two items per category). These categories were PM short-term self-cued, RM short-term self-cued, PM long-term self-cued, RM long-term self-cued, PM short-term environmentally-cued, RM short-term environmentally-cued, PM long-term environmentally-
cued, and RM long-term environmentally-cued. The 16 items were reviewed by eight memory research experts to ensure that the categorisation of items was appropriate. As the PMCQ and PRMQ development procedures were dissimilar it was hypothesised that the PMCQ developed in this research would be a unique self-report scale that differed in content and structure to the PRMQ. However, it was predicted that the PMCQ would measure the same PM construct as the PRMQ, demonstrating convergent validity.

The third and final aim of the thesis was to investigate the relationship between self-reported PM and a number of variables that might be expected to be related to self-reported PM. These relationships included the relationship between self-reported PM and naturalistic PM in clinical disorders (namely ABI, MCI, and dementia) and in normal ageing, the relationship between self-report and naturalistic PM measures, and the influences of personality and social desirability on the measurement of self-reported and naturalistic PM. This investigation was carried out in this study in conjunction with the validation of the PMCQ. The PMCQ was used as a measure of self-reported PM, whilst three naturalistic tasks were used to measure naturalistic PM performance.

As reported in Chapter 2, individuals with ABI have been found to perform more poorly than healthy controls on naturalistic measures of PM (Brooks et al., 2004; R. Hannon et al., 1995; Mathias & Mansfield, 2005). However, using self-report measures, R. Hannon et al. (1995) only found individuals with ABI to have poorer performance than younger adults on the Short Term Habitual subscale of the PMQ. Furthermore, it has been observed that individuals with ABI did not report more memory failures on the CAPM than controls despite informant reports of PM failures being greater than controls (Radford et al., 2011; Roche et al., 2002; Roche et al., 2007). These authors attributed these findings to a potential lack of awareness of impairments in individuals with ABI. Hence, further clarification of self-reported PM failures or concerns in individuals with ABI is needed in order to assess whether
these individuals differ from healthy adults in their self-reporting of PM, and whether these differences are consistent with those observed in naturalistic PM tasks. This in turn will assist in determining the utility of self-report scales (such as the PMCQ developed in this research) in the assessment of PM in ABI.

An aim of this study therefore was to investigate both naturalistic and self-reported PM in individuals with ABI. In line with previous findings of PM impairments in naturalistic tasks it was hypothesised that in this study individuals with ABI would perform more poorly than non-referred individuals (without ABI) on the naturalistic PM tasks. Although the findings are unclear on ABI and self-reported PM—given the naturalistic task findings of PM impairments in ABI—it was hypothesised that individuals with ABI would report more memory failures and concerns on the PMCQ than non-referred individuals.

Similar to individuals with ABI, individuals diagnosed with MCI and dementia have been consistently found to be impaired on naturalistic PM tasks (Huppert et al., 2000; Jones et al., 2006; Livner et al., 2009; Thompson et al., 2011; E. van den Berg et al., 2012). However, self-reported PM in MCI and dementia has received little attention. Although not specifically a PM scale, Tam and Schmitter-Edgecombe (2013) found that individuals with MCI reported more memory failures on the Memory Functioning Questionnaire than healthy adults. In contrast, Eschen et al. (2009) did not find differences between individuals with MCI, dementia, or healthy adults on the PRMQ. They did however find that the difference between PM and RM scores did separate those with dementia from the other two groups, suggesting the utility of self-report measures in individuals with dementia. However, the use of self-report measures in individuals with MCI and dementia and the relationship between self-reported and naturalistic PM in these populations needs to be explored further before conclusions can be made.
Consequently, an aim of this study was to assess naturalistic and self-reported PM in individuals with MCI and dementia. Due to issues in recruiting a large number of participants with MCI and dementia, a combined dementia/MCI group was used in this study. Whilst it is acknowledged that MCI and dementia are not a single diagnosis, they both fall under the category of neurocognitive disorder in the DSM-V (American Psychiatric Association, 2013) and have similarities in the types of impairments exhibited (e.g. RM and executive functioning; Malloy et al., 2006). Therefore, in this study the combined dementia/MCI group was conceptualised as a sample that had clinically relevant cognitive impairments that could be compared with the non-referred group. Combining the dementia and MCI groups meant that there was a large enough sample size to be statistically robust and to permit comparisons between these individuals and individuals in the non-referred group. Given the previous findings of self-reported and naturalistic PM studies whereby individuals with MCI and dementia experienced more PM failures than healthy adults, it was hypothesised in this study that individuals in the MCI/dementia sample would perform more poorly than non-referred individuals (not diagnosed with MCI or dementia) on the naturalistic PM tasks. Furthermore, it was predicted that individuals in the dementia/MCI sample would report more PM failures and concerns on the PMCQ than non-referred individuals.

The current research is the first known PM study to include both participants with ABI and participants with MCI or dementia. As mentioned, it was expected that these groups would each perform more poorly than healthy adults on the naturalistic PM tasks and also report more PM failures or concerns on the PMCQ than healthy adults. However, whether individuals with ABI differ from those with MCI or dementia is unknown. Therefore, although not a main aim of the study, this study involved an exploratory investigation of whether there are differences between individuals with ABI, MCI, and dementia on self-reported and naturalistic PM.
The next area to be investigated in this study was the relationship between normal ageing, self-reported PM, and naturalistic PM. As discussed in Chapter 2, there is an age-PM paradox whereby young adults typically outperform older adults on PM tasks in the laboratory, but in naturalistic settings older adults are able to perform at a similar level to or better than younger adults (Henry et al., 2004). One area that has not received much attention is the relationship between age and self-reported PM. In the few studies that have investigated this relationship, several have found no differences between younger and older adults on the PMQ (R. Hannon et al., 1995), or on the PRMQ (Crawford et al., 2003; Piauilino et al., 2010; G. Smith et al., 2000). However, similar to the findings of age differences on naturalistic PM tasks, other studies have found older adults to report less PM problems than younger adults on the PRMQ (Hsu & Hua, 2011; Rönnlund et al., 2008) and the CAPM (Chan et al., 2010; Chau et al., 2007).

As the relationship between ageing, self-reported PM, and naturalistic PM is unclear, further exploration is required. Of particular importance is the assessment of whether age differences in PM exist, the nature of these age differences (i.e. do older or younger adults experience PM impairments and what factors mediate these differences), and the utility of self-report and naturalistic PM measures in detecting age effects. Therefore, an aim of the current study was to assess self-reported and naturalistic PM in relation to normal ageing. On the basis of the findings discussed in the previous paragraph, it was predicted that older adults would perform better than younger adults on naturalistic PM tasks. Furthermore, as similar age effects have been detected on some self-report measures, it was hypothesised that older adults would also report less memory failures or concerns on the PMCQ than younger adults.

An important consideration in using self-report PM measures is whether they reflect “actual” PM performance. Laboratory, naturalistic, and clinical PM tasks have been designed to measure PM performance, although as mentioned in chapters 1 and 2, there are questions
about the ecological validity of these methods (Philips et al., 2008). Nevertheless, the correlations between laboratory PM tasks and self-report PM measures have been weak, and correlations between naturalistic PM tasks and self-reported PM even lower (R. Hannon et al., 1995; Kliegel & Jäger, 2006a; Uttl & Kibreab, 2011). This effect can also be seen in studies using individuals with ABI (Fleming et al., 2009; Man et al., 2011), MCI, and dementia (Eschen et al., 2009) whereby PM impairments observed in laboratory, naturalistic, and clinical measures are not mirrored in self-report data. This does not necessarily mean that self-report measures are poor predictors of actual PM performance, instead these measures may assess different aspects of PM to other methods, for example short versus long-term PM tasks (Man et al., 2011). Hence, there is a need to clarify the relationship between self-report measures and other methods of assessing PM in order to understand their role in assessment. Therefore, this study assessed the relationship between self-reported PM (as measured using the PMCQ) and naturalistic PM tasks. Based on the existing findings, it was hypothesised that scores on the PMCQ would correlate weakly with naturalistic PM performance.

Another variable that has been related to the measurement of PM using self-report and naturalistic measures is personality. Various personality theories exist, although the current research focuses on the five-factor model of personality (P. T. Costa, Jr & McCrae, 1992). Although relationships between the five personality factors and self-reported PM have not been consistently found across studies, individuals high in extraversion (Heffernan & Ling, 2001; Steinberg et al., 2013), openness to experience (Gondo et al., 2010), conscientiousness (Cuttler & Graf, 2007; Gondo et al., 2010; Steinberg et al., 2013; Uttl & Kibreab, 2011), and those low in neuroticism (Gondo et al., 2010; Steinberg et al., 2013; Uttl & Kibreab, 2011) have been found to report having less memory failures on self-report measures than those at the opposite ends of these dimensions. In naturalistic settings, some of the aforementioned personality studies have found only high levels of conscientiousness to be related to superior
naturalistic PM performance (Cuttler & Graf, 2007; Gondo et al., 2010; Steinberg et al., 2013; Uttl & Kibreab, 2011).

What can be concluded from this pattern of findings is that the relationship between personality and PM is not well-established. Furthermore, with so few studies investigating this relationship there is a need for additional research to clarify the role of the five factors of personality in self-reported and naturalistic PM. Therefore, an aim of this study was to investigate the relationships between the five factors of personality, self-reported PM, and naturalistic PM. Based on the above findings it was hypothesised that individuals high in neuroticism would report more PM failures or concerns on the PMCQ, but that neuroticism would not be related to performance on the naturalistic PM tasks. In addition, it was predicted that individuals high in conscientiousness would have less memory failures or concerns on the PMCQ, and would also perform better on the naturalistic PM tasks. No predictions were made regarding openness to experience, agreeableness, and extraversion and their relationship with self-reported or naturalistic PM due to the inconsistent findings previously reported.

As it was anticipated that self-reported PM performance would be related to personality (namely neuroticism and conscientiousness), an additional aim of this study was to assess whether self-reported PM was merely an artefact of these significant personality variables. Specifically, do scores on the PMCQ assess PM concerns or failures above and beyond what is predicted by personality factors? If the PMCQ is able to predict PM concerns and failures above the variance accounted for by personality factors, this would provide evidence for the validity of self-report PM measures such as the PMCQ.

A final area of investigation was the relationship between social desirability, self-reported PM, and naturalistic PM. As self-report PM scales assess the sensitive issue of memory decline, they may be subject to social desirability bias. Individuals may respond in a
socially desirable way by over-exaggerating memory ability or downplaying memory failures, as they do not want to be associated with the negative aspects of memory failure (i.e. the onset of ageing or dementia). Surprisingly, the relationship between self-reported PM and social desirability has not been assessed in the literature. However, Cuttler and Graf (2007) did observe that social desirability was not related to laboratory or naturalistic PM tasks.

Therefore, Study 3 aimed to conduct an exploratory investigation into the relationship between self-reported PM (using the PMCQ), naturalistic PM, and social desirability (using the SDS-17, a self-report social desirability scale). It was also important to determine that the PMCQ scores were not merely an artefact of socially desirable responding. Therefore, it was hypothesised that the PMCQ would be related to social desirability, in that individuals with high social desirability scores would report having less memory concerns on the PMCQ. However, it was also predicted that the PMCQ scores would assess PM failures above that predicted by social desirability.

**Method**

**Participants**

Participants were 226 individuals recruited from a sample of non-referred individuals consisting of assumedly healthy community dwelling adults, as well as a clinically-referred group consisting of adults with ABI, dementia, or MCI.

The Addenbrookes Cognitive Exam-Revised Australian version (ACE-R; Mioshi, Dawson, Mitchell, Arnold, & Hodges, 2006) was used as a screening tool for cognitive deficits among participants. A description of the ACE-R is provided in the Measures section later in this chapter. When the ACE-R is used for screening purposes Mioshi et al. (2006) recommend a cut-off score of 88 for the detection of dementia. Within the non-referred group, 19 individuals scored below 88. This indicated that these individuals may have had cognitive impairments that they did not disclose or were not aware of. Consequently, these 19
individuals were removed from further analyses. One individual in the dementia/MCI group (ACE-R score = 89) and seven individuals in the brain injury group (scores = 90–96) scored above the 88 cut-off, and were observed to be high functioning during the assessment.

Furthermore, two of the high functioning brain injury participants met the criteria of a mild or minor brain injury based on GCS scores (refer to Chapter 5 for these criteria). This suggests that the cognitive impairments of some participants within the clinically-referred group were of a mild nature whereby individuals were able to perform at the level of a healthy adult on the ACE-R. However, due to the small sample sizes of the brain injury and dementia/MCI groups, and because individuals in these groups were close to the cut-off, it was decided that these individuals should be retained for further analyses.

During data collection, four individuals from the non-referred group reported having brain pathology. One participant was being tested for suspected epilepsy, whilst three participants had a history of a previous stroke or transient ischaemic attacks. These individuals did not report experiencing any cognitive impairment nor were any functional deficits observed during their assessments. Furthermore, these individuals each scored above 88 on the ACE-R (range = 91–98); as they did not show any brain pathology related cognitive impairments, they were retained in subsequent analyses. Mean ACE-R scores for the non-referred, brain injury, and dementia/MCI groups are reported in Table 14.

Table 14

*Performance of the Three Groups on the ACE-R*

<table>
<thead>
<tr>
<th>Sample</th>
<th>M</th>
<th>SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-referred group (n = 207)</td>
<td>94.80</td>
<td>3.22</td>
<td>88-100</td>
</tr>
<tr>
<td>Brain injury (n = 18)</td>
<td>81.83</td>
<td>12.26</td>
<td>61-96</td>
</tr>
<tr>
<td>Dementia/MCI (n = 11)</td>
<td>78.36</td>
<td>6.91</td>
<td>56-89</td>
</tr>
</tbody>
</table>

*Note.* Scores on the ACE-R range from 0-100 with higher scores indicating better cognitive function.
The performance of healthy adults in the non-referred group on the ACE-R and the five cognitive subdomains was found to be comparable to the performance of the normative group reported by Hodges (2011). This normative group consisted of 148 Australian and English individuals aged 50–59, 60–69 and 70–79. Normative data for the ACE-R was not available for those aged below 50 years or above 80 years.

A one-way ANOVA was used to compare the performance of the non-referred, brain injury, and dementia/MCI groups on the ACE-R. The assumption of homogeneity of variance was violated (Levene’s statistic = 85.00, \(p < .001\)) and so the Welch test and Games-Howell post-hoc test were used. The three groups were found to significantly differ on the ACE-R, \(F(2, 17) = 25.67, p < .001\). The non-referred group had significantly higher ACE-R scores than the brain injury group, \(p = .001, 95\% \text{ CI } [5.53, 20.39]\), and the dementia/MCI group, \(p < .001, 95\% \text{ CI } [8.69, 24.18]\). However, the brain injury and dementia/MCI groups did not differ in the amount of cognitive impairments observed on the ACE-R, \(p = .671, 95\% \text{ CI } [-6.58, 13.52]\).

After removing the 19 individuals in the non-referred group who scored below 88 on the ACE-R, the non-referred group included 129 females and 78 males aged 18 to 89 years. The brain injury sample was comprised of 11 females and 7 males aged between 22 and 63 years. The dementia/MCI sample was made up of 4 females and 7 males aged from 74 to 86 years. Descriptive statistics for age within these groups are reported shown in Table 15.

Table 15

<table>
<thead>
<tr>
<th>Sample</th>
<th>(M)</th>
<th>(SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-referred group ((n = 207))</td>
<td>48.51</td>
<td>18.56</td>
</tr>
<tr>
<td>Brain injury ((n = 18))</td>
<td>42.83</td>
<td>11.50</td>
</tr>
<tr>
<td>Dementia/MCI ((n = 11))</td>
<td>79.64</td>
<td>4.03</td>
</tr>
</tbody>
</table>
A one-way ANOVA confirmed that the three groups differed in age. The assumption of homogeneity of variance was violated (Levene’s statistic = 16.52, \( p < .001 \)) and therefore the Welch statistic and Games-Howell post-hoc test were used. A large statistically significant difference between the groups in regards to age was detected, \( F(2, 34.71) = 180.92, \ p < .001, \eta^2_p = .13 \). The dementia/MCI sample were significantly older than both the brain injury sample, \( p < .001, \) 95% CI [29.36, 44.24] and non-referred group, \( p < .001, \) 95% CI [26.82, 35.43]. However, the non-referred and brain injury samples did not differ in age, \( p = .162, \) 95% CI [-1.79, 13.15]. In addition, there were no proportional differences between the three groups in relation to gender, \( \chi^2(2, N = 236) = 2.91, \ p = .234 \). Here, Fisher’s exact test was used, as the cell count was less than five in one cell. The highest level of completed education reported by participants in each study sample is shown in Table 16.

Table 16

<table>
<thead>
<tr>
<th>Level of Education</th>
<th>Non-referred</th>
<th>Brain Injury</th>
<th>Dementia/MCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower than Year 10</td>
<td>4</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Year 10</td>
<td>30</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Year 12</td>
<td>17</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>TAFE/Diploma</td>
<td>60</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Undergraduate</td>
<td>65</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>Postgraduate</td>
<td>18</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Other</td>
<td>12</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

*Note. \( n = 1 \) in the non-referred group did not report highest level of education completed.*

**Characteristics of the brain injury sample.** The brain injury sample included 12 individuals who had sustained TBIs and 5 individuals with ABIs. The TBIs in the sample were the result of motorbike accidents (\( n = 4 \)), motor vehicle accidents (\( n = 3 \)), and falls (i.e.
from pushbikes or horses, \( n = 5 \). The cause of injury for one participant with a TBI was unknown due to unavailable medical records. The ABIs in the sample were the result of cerebrovascular accidents (CVA, \( n = 3 \)), hypoxia (\( n = 1 \)), and encephalitis (\( n = 1 \)). The time since individuals sustained their injury (TBI or ABI) ranged from 45 days to 21 years with an average of 2744.39 days or 7.5 years (\( SD = 2525.13 \) days/7 years). On average, these individuals spent 75.12 days in hospital (\( SD = 80.47 \), range = 6–237) and 194.67 days in inpatient rehabilitation (\( SD = 186.76 \), range = 0–730).

For participants with TBI, severity of injury was judged on the basis of the length of PTA as well as scores on the GCS. According to the PTA criteria outlined in Chapter 5 (Ponsford et al., 2013), all but one individual (with a PTA length of 7 days, i.e. a severe injury) in the sample with TBI would be classified as very severe with PTA scores ranging from 26 to 187 days (\( M = 93.55 \), \( SD = 73.12 \), \( n = 11 \)). Similarly, on the basis of the GCS criteria provided in Chapter 5 (Teasdale, 1995; Teasdale & Jennett, 1974), brain injuries in this group were on average classified as moderate to severe with scores ranging from 6 to 15 (\( M = 8.6 \), \( SD = 3.71 \), \( n = 5 \)) at the scene of injury and 3 to 15 (\( M = 6.22 \), \( SD = 4.58 \), \( n = 9 \)) on hospital admission. It should be noted that a GCS was provided for one participant with an ABI following a CVA, which was included in the statistics reported above. This individual scored 15 (a minor injury) at the scene and on hospital admission. Considering TBI individuals alone, all four GCS scores at the scene indicated severe injuries (GCS scores of 6-8). On hospital admission, one individual had a mild injury (GCS = 13), whilst all others were classified as severe injuries (GCS scores of 3-6).

**Characteristics of the dementia/mild cognitive impairment sample.** The dementia/MCI sample was heterogeneous in regards to participant diagnoses. The sample consisted of four individuals diagnosed with dementia. Specifically, the diagnoses were: one individual diagnosed with Supranuclear palsy, one diagnosed with dementia with
Parkinson’s, one diagnosed with dementia with Parkinson’s and Lewy bodies, and another diagnosed with frontotemporal dementia (early stages). The remaining seven participants in the sample had a diagnosis of MCI. Three of these individuals were diagnosed with amnestic MCI, one was diagnosed with non-amnestic MCI, and the remaining three were diagnosed with non-amnestic MCI with vascular pathology.

All but two participants in the dementia/MCI group had been diagnosed within the 12 months prior to participation in this study. The individual diagnosed with Supranuclear palsy received a diagnosis 6 years prior to participation, whilst the individual diagnosed with dementia with Parkinson’s/Lewy bodies was diagnosed 5 years prior to participation. Severity of cognitive impairment of these individuals was assessed using the ACE-R. As mentioned earlier in this chapter, all but one individual in the dementia/MCI sample scored below the 88 cut-off used to indicate dementia (this individual scored 89). All other participants in the sample scored between 56 and 82. Hence, individuals in this group overall demonstrated cognitive impairments consistent with those expected for dementia.

**Measures**

**Prospective Memory Concerns Questionnaire.** The PMCQ was used to measure concerns about PM ability. The PMCQ contains the 42 items retained from Study 2 and includes three subscales derived from the factor analysis in Study 2. The first subscale, Forgetting Behaviours contains 16 items measuring the frequency of everyday memory failures. The second subscale, Memory Concerns contains 14 items that assess concerns about memory ability. The third subscale, Retrieval Cues contains 12 items and examines the frequency of which individuals utilise retrieval cues and strategies in memory tasks. All items on the PMCQ use a 4-point rating scale with the response options 0 (*Never*), 1 (*Sometimes*), 2 (*Often*), and 3 (*Always*), with items 8, 21, 26, and 36 reverse scored. Higher scale scores
indicate greater concerns about memory or a higher frequency of self-reported memory failure. A list of the PMCQ items is shown in Table 17.

Table 17

**PMCQ Items**

<table>
<thead>
<tr>
<th>Forgetting Behaviours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I forget to do daily tasks such as paying bills, posting letters, or putting the garbage out</td>
</tr>
<tr>
<td>2. I forget to pass important messages on to family, friends, or colleagues</td>
</tr>
<tr>
<td>5. I put things in the wrong place e.g. milk in the cupboard and sugar in the fridge</td>
</tr>
<tr>
<td>6. In the middle of a sentence I forget what I was going to say</td>
</tr>
<tr>
<td>7. I forget important appointments</td>
</tr>
<tr>
<td>8. If interrupted while doing something, I remember to finish it later</td>
</tr>
<tr>
<td>9. When I am given a message to pass on, I forget what the message was</td>
</tr>
<tr>
<td>11. I forget to do things that can be done in a sequence e.g. buy a stamp, put the stamp on an envelope and post it</td>
</tr>
<tr>
<td>16. When I have to do two things at once, I have trouble remembering to do both</td>
</tr>
<tr>
<td>17. I forget to do things because I get carried away doing something else</td>
</tr>
<tr>
<td>21. I remember to do things I need to do even if I am in the middle of another task</td>
</tr>
<tr>
<td>26. I am good at remembering to do things on time</td>
</tr>
<tr>
<td>28. I do things twice because I forget that I have already done them e.g. take a tablet twice</td>
</tr>
<tr>
<td>29. I think that I have done things when I actually have not done them</td>
</tr>
<tr>
<td>36. I remember to do everyday tasks such as take medication, brush my teeth, or shower</td>
</tr>
<tr>
<td>37. I forget to turn the stove or iron off</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Memory Concerns</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. There are times when I remember that I need to do something but I can’t remember what it is</td>
</tr>
<tr>
<td>19. I forget to do some things that I have planned to do</td>
</tr>
<tr>
<td>20. I forget things that I am supposed to be doing if I am anxious or worried about something</td>
</tr>
<tr>
<td>22. I have trouble remembering directions or instructions</td>
</tr>
<tr>
<td>23. I have trouble switching my attention between two different things e.g. watching TV and talking to someone at the same time</td>
</tr>
<tr>
<td>24. When I am tired, stressed, angry, or upset I forget to do things more often than normal</td>
</tr>
</tbody>
</table>
Table 17 (continued).

**PMCQ Items**

<table>
<thead>
<tr>
<th>Items</th>
<th>Memory Concerns (continued).</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>I forget important dates, birthdays, or anniversaries</td>
</tr>
<tr>
<td>31</td>
<td>I have trouble remembering the names of people and places</td>
</tr>
<tr>
<td>32</td>
<td>I have trouble remembering recent events in my life</td>
</tr>
<tr>
<td>38</td>
<td>I worry that my memory is getting worse</td>
</tr>
<tr>
<td>39</td>
<td>I know that I am going to need a memory aid such as a note, list, or alarm</td>
</tr>
<tr>
<td>40</td>
<td>It takes me longer to do mental tasks than it used to e.g. crosswords</td>
</tr>
<tr>
<td>41</td>
<td>I get frustrated with myself because I forget to do things I was supposed to do</td>
</tr>
<tr>
<td>42</td>
<td>I have trouble thinking of ways to help my memory</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Items</th>
<th>Retrieval Cues</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>I walk into a room and forget why I went there</td>
</tr>
<tr>
<td>10</td>
<td>I forget to do things that I have started e.g. hanging washing out once the washing machine has finished</td>
</tr>
<tr>
<td>12</td>
<td>I am more likely to remember to do something if there is something to remind me e.g. an object or a person</td>
</tr>
<tr>
<td>13</td>
<td>I forget where I have placed things e.g. keys or money</td>
</tr>
<tr>
<td>14</td>
<td>Seeing places (e.g. a supermarket) or objects (e.g. a teapot) can remind me that I need to do something (e.g. buy sugar)</td>
</tr>
<tr>
<td>15</td>
<td>Seeing places or objects can remind me that I need to do something, but I can’t remember exactly what it is</td>
</tr>
<tr>
<td>18</td>
<td>I find that I don’t return to planned tasks if I get interrupted</td>
</tr>
<tr>
<td>27</td>
<td>I can only remember that I have a message to pass on when I see the person the message is for</td>
</tr>
<tr>
<td>30</td>
<td>I tell people the same story because I forget that I have already told them</td>
</tr>
<tr>
<td>33</td>
<td>I remember the main parts of instructions (e.g. buy milk) but I forget details (buy two litres of milk)</td>
</tr>
<tr>
<td>34</td>
<td>I remember to do things by associating them with other things e.g. when I see John at work I remember to pass on a message to him</td>
</tr>
<tr>
<td>35</td>
<td>I am more likely to remember to do things if I say them over and over to myself</td>
</tr>
</tbody>
</table>
**Prospective and Retrospective Memory Questionnaire.** The PRMQ (Appendix N) was used in this study to establish the convergent and divergent validity of the PMCQ using the PM and the RM subscales of the PRMQ respectively. In addition, the PRMQ was used as an existing PM self-report measure for comparisons with the PMCQ.

The PRMQ (G. Smith et al., 2000) is a 16-item questionnaire used to rate the frequency of PM and RM failures. Furthermore, questions are also subdivided into eight categories including: prospective short-term self-cued memory, prospective short-term environmentally-cued memory, prospective long-term self-cued memory, prospective long-term environmentally-cued memory, retrospective short-term self-cued memory, retrospective short-term environmentally-cued memory, retrospective long-term self-cued memory, and retrospective long-term environmentally-cued memory. The frequency of memory failures are reported using a 5-point rating scale with the following response options: 1 (Never), 2 (Rarely), 3 (Sometimes), 4 (Quite Often), and 5 (Very Often). Scores can be summed to create a general PRMQ scale score (16 items). Alternatively scores from the eight PM items can be summed to form a PM scale, and the eight RM scores can be added to form an RM scale. Higher scores on the PRMQ and its subscales indicate higher frequency of forgetting.

Construct validity of the PRMQ has been demonstrated in several studies whereby CFA has confirmed a tripartite latent structure consisting of a general memory factor as well as orthogonal PM and RM factors (Crawford et al., 2003; Piauilino et al., 2010; Rönnlund et al., 2008). Internal consistency reliability for the PRMQ has also been established, with good Cronbach’s alpha coefficients that ranged from .86 (Kliegel & Jäger, 2006a) to .89 (Crawford et al., 2003) for the general scale, .79 (Kliegel & Jäger, 2006a) to .86 (Rönnlund et al., 2008) on the PM scale, and .72 (Kliegel & Jäger, 2006a) to .84 (Gondo et al., 2010) on the RM scale.
Despite a recent argument that the PRMQ has poor convergent and divergent validity with laboratory and naturalistic PM tasks (Uttl & Kibreab, 2011), earlier evidence to the contrary was provided in two Swedish studies. Mäntylä (2003) observed a relationship between PM and RM complaints and performance on PM but not RM task performance whilst Rönnlund et al. (2008) reported positive correlations between PRMQ scores and indices of global subjective memory. Concurrent validity for the PRMQ has also been demonstrated, with Kliegel and Jäger (2006a) finding a relationship between the PRMQ and an existing measure of metamemory, the Metamemory in Adulthood Questionnaire (Dixon & Hultsch, 1984).

Social Desirability Scale-17 (SDS-17). In this study the SDS-17 English language version (Stöber, 2001) was used as a measure of socially desirable responding. The SDS-17 has the advantage of being shorter in length than other social desirability scales such as the Marlowe Crowne Social Desirability Scale (MC-SDS) but more importantly, this scale has been found by Stöber (2001) to be less affected by age effects than the MC-SDS. This finding is supported by Blake et al. (2006) who reported no age effects in three studies with an American, albeit relatively young sample (mean ages: Study 1 = 21.57, Study 2 = 36.45, Study 3 = 22.95).

The SDS-17 (Appendix O) is a 16-item scale which includes 10 positively worded items relating to infrequent but socially desirable behaviours (e.g. Item 15 “I always eat a healthy diet”) and 6 negatively worded items assessing frequent but socially undesirable behaviours (e.g. Item 10 “I occasionally speak badly of others behind their back”). Responses to items are recorded on a dichotomous True or False scale whereby True responses are dummy coded as 1 and False responses as 0. To obtain an overall SDS-17 scale score the 16 item scores are summed. This scale was modified from the original 17-item German version of the SDS-17 (Stöber, 1999), with one item “I have tried illegal drugs (for example,
marijuana, cocaine, etc)” removed from the English language version due to low item-total correlations.

Reliability for the English version of the SDS-17 has been found to be acceptable with KR 20 coefficients ranging from .64 in a standard instruction condition to .92 in a fake good instruction condition using an American sample (Blake et al., 2006). In addition, Cronbach’s alpha coefficients ranged from .61 to .80 across age groups in a German sample (Stöber, 2001). Test-retest reliability has not been established for the English language version of the SDS-17, however, for the German language version of the scale test-retest reliability over a 4-week period was .82 (Stöber, 1999). Predictive validity of the SDS-17 was found with Stöber (2001) reporting higher scores on the scale under a fake job interview condition compared to when standard instructions were given. Similar findings were reported by Blake et al. (2006) who found higher SDS-17 scores in a fake good condition, as opposed to a standard instruction condition or honest response condition.

Convergent validity has also been demonstrated by Stöber (2001) who found positive correlations between the SDS-17 and other scales designed to assess social desirability including the Eysenck Personality Questionnaire-Lie Scale (EPQ; Eysenck & Eysenck, 1991), the Sets of Four Scale (Borkenau & Ostendorf, 1992), and the MC-SDS (Crowne & Marlowe, 1960). Blake et al. (2006) observed a similar relationship between the SDS-17 and MC-SDS. Furthermore, the SDS-17 was found to relate to another measure of social desirability, the Balanced Inventory of Desirable Responding (BIDR; Paulhus, 1994) by both Blake et al and Stöber (2001). Blake and colleagues reported relationships between the SDS-17 and both subscales of the BIDR (Impression Management and Self-Deception) under fake good conditions. Under standard conditions, Blake et al. (2006) and Stöber (2001) only found a relationship with the Impression Management scale. Evidence of discriminant validity for the SDS-17 was reported by Stöber (2001) with weak correlations between the scale and
openness to experience, neuroticism, extraversion, and psychoticism personality dimensions of the EPQ and NEO Five Factor Inventory (NEO-FFI; P. T. Costa, Jr & McCrae, 1992). A significant positive relationship between the SDS-17 and personality factors of agreeableness and conscientiousness also was reported, which may violate discriminant validity, although this relationship remains unclear (Stöber, 2001).

**Australian Personality Inventory.** The API (Appendix P) developed by Murray et al. (2009) was used in this study to assess the five-factor model of personality (P. T. Costa, Jr & McCrae, 1992). The API contains 50 items selected from the International Personality Item Pool (Goldberg, 1999). The API is divided into five subscales each with 10 items measuring one of five factors of personality (openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism). All items on the API scales are measured on a 5-point rating scale with the anchors: 1 (*very inaccurate*), 2 (*moderately inaccurate*), 3 (*neither accurate nor inaccurate*), 4 (*moderately accurate*), and 5 (*very accurate*). Half of the items on the API are scored in reverse, and scale scores are obtained by summing the 10 item ratings. Each of the five factor scale scores range from 10 to 50 with higher scores indicating a greater amount of that personality trait.

The API was shown by Murray et al. (2009) to have adequate reliability with internal consistency scores in a non-referred group as follows: Openness to Experience, $\alpha = .71$; Conscientiousness, $\alpha = .82$; Extraversion, $\alpha = .81$; Agreeableness, $\alpha = .78$; and Neuroticism, $\alpha = .83$. Comparable alphas were also reported in this study using a sample of university students. In addition, Murray et al. (2009) demonstrated strong convergent and divergent validity of the API through comparisons with the NEO-FFI (P. T. Costa, Jr & McCrae, 1992). Construct validity was also established through a PCA of the API, which supported the proposed latent structure of the five-factor model.
Addenbrookes Cognitive Exam-Revised. The Australian version of the ACE-R, Version A (Mioshi et al., 2006) was used in this study for the purpose of excluding participants in the non-referred sample who met the criterion cut-off score of 88 which indicates cognitive impairment. The scale was also used to evaluate cognitive function in all participants. This scale was employed as extensive cognitive function testing (e.g. the WAIS-IV) was not possible in the current study, and because the ACE-R provides subdomains relevant to this study.

The ACE-R (Appendix Q) comprises of five subscales each assessing a different cognitive domain including: Attention and Orientation (18 points), Memory (26 points), Verbal Fluency (14 points), Language (26 points), and Visuospatial Ability (16 points). These subscale scores were combined to create an overall ACE-R (maximum 100 points). The Australian version of the exam differs slightly from the original English version in that the question relating to the name of the female Prime Minister is replaced with a question asking for the name of the New South Wales Premier. In addition, the Australian state of New South Wales is used in the place of the English county Devon.

The ACE-R (original English version) has been found to have good reliability with a Cronbach’s alpha of .80 (Mioshi et al., 2006). Concurrent and convergent validity for this scale was also established by Mioshi et al. who compared the ACE-R with the Clinical Dementia Rating scale (Morris, 1997) producing a Spearman Rho coefficient of -.32 (p < .001). Whilst there is no validation data available for the Australian version of the ACE-R, it has been found to be an effective tool for screening for dementia (Terpening, Cordato, Hepner, Lucas, & Lindley, 2010). Using an optimal cut-off score of 84, sensitivity of the scale was .85, specificity was .80, and the positive predictive value (PPV) was .90. The ACE-R is also reported to be a valuable screening tool for use in brain injury patients (Gaber, 2008).
**Naturalistic prospective memory tasks.** Participants completed three naturalistic PM tasks based on those used in previous studies: an event-based PM task (Dobbs & Rule, 1987), a time-based PM task (Troyer & Murphy, 2007), and a 24-hour naturalistic task (Kvavilashvili & Fisher, 2007).

**Time-based task.** This task was designed to assess participants’ ability to respond to a PM target at a particular time. Participants were asked to keep their eye on a clock during the assessment and to notify the researcher when 15 minutes had lapsed. Before commencing this task, participants were shown a round face clock, which was positioned on a wall to the side of the room. This meant that the participant needed to turn their head approximately 90° to the side to view the clock, allowing the researcher to observe participants’ clock monitoring. At the beginning of this task, the clock was also wound to the nearest 5-minute interval (e.g. the clock was wound to 12:05 p.m. rather than 12:03 p.m.) to ensure that the retrieval time was distinct and readable on the clock.

**Event-based task.** This task was designed to assess participants’ ability to respond to a particular PM target event. In this task, participants were given a black pen and a blue pen and were asked to use the black pen to commence filling out the questionnaire. They were then told that when they reached Part 2 of the questionnaire that they should change pens and use the blue pen to complete the remainder of the questionnaire. Thus, they needed to remember to complete the PM task of changing pens once they reached Part 2 of the questionnaire.

The questionnaire booklet was therefore divided into two parts; Part 1 contained the PMCQ, and Part 2 included the PRMQ, SDS-17, and API. Both parts began with a title page, which was a blank white page with the words “Part 1” or “Part 2” in large (size 40 Tahoma) black font centred on the page. These title pages were designed to be distinctive and easily seen by participants. The title page “Part 1” was located before the instructions for the PMCQ
and served several purposes. First, this title page demonstrated to participants what their retrieval cue looked like so that when they reached Part 2 they would easily recognise their retrieval cue. Second, the Part 1 title page acted as a reminder for participants of the event-based task, and also for the time-based task that was concurrently taking place. Finally, the Part 1 title page had the purpose of distracting participants. More specifically, this page identified participants who had not paid attention to or had forgotten the instructions and therefore responded prematurely to the event-based task.

24-hour task. This task was designed to measure participants’ PM performance over a longer retention interval. In this task, participants were given a business card that displayed the researcher’s phone number and email address. Participants were asked to remember to contact the researcher the following day after 12 p.m. by phone, SMS, or email and to leave their name in a message. They were also told that if they forgot to contact the researcher between midday and midnight the following day, that they should contact the researcher as soon as they remembered to do so even if it was weeks later. The use of external aids and reminders for the 24-hour task were not controlled for several reasons. The business card in itself acted as a reminder, and during assessments several participants incidentally wrote “call after 12 p.m.” on the back of the card. Furthermore, it was impossible to prevent participants from using reminders or external aids once they left the assessment session. However, participants were discouraged from using reminders or external aids for this task.

Procedure

Participant recruitment. Ethics approval for this study was granted by the Greater Western Area Health Service Human Research Ethics Committee. Participants in the non-referred group were recruited through convenience sampling. Requests for research participants were placed in local media including newspaper, television, and radio. In addition, recruitment flyers (Appendix R) were placed on noticeboards in supermarkets,
shopping centres, community centres, churches, and in local businesses. A Facebook page containing the information from the recruitment flyer was also created in order to recruit participants for the study. Links to this page were posted on Facebook classifieds pages and on the researcher’s own Facebook page. Snowball sampling methods were also utilised, as individuals were encouraged to share links to the Facebook page with friends, relatives, and co-workers; several participants passed on recruitment flyers to others. Before completing the assessment, participants were screened over the phone or by email to ensure that they met the inclusion and exclusion criteria. Inclusion criteria were that individuals were aged over 18 and that their primary language was English. The exclusion criterion was that individuals had not completed one of the earlier studies in this research.

Participants in the brain injury sample were recruited through three brain injury rehabilitation units in NSW, Australia. These brain injury units mailed invitation letters (Appendix S) to clients that met the inclusion and exclusion criteria. Inclusion criteria were that participants were aged over 18 years, their primary language was English, they had sustained either a TBI or ABI, and they were current outpatients of one of the brain injury units. The only exclusion criterion was that individuals had not participated in Study 2 of this research. Individuals interested in participating were asked to contact the researcher in order to complete the assessment. Following assessment, clinical information regarding participants’ brain injuries was retrieved from the NSW Brain Injury Clinical Data Set.

Participants in the dementia/MCI sample were recruited through three regional Aged Care Assessment Teams in NSW. The aged care teams mailed invitation letters to clients who met the inclusion and exclusion criteria. Inclusion criteria included that individuals were aged over 18 years, their primary language was English, they had been diagnosed with either MCI or dementia, and they were under the inpatient or outpatient care of one of the Aged Care Assessment Teams. The exclusion criterion was that individuals had not participated in Study
2 of this research. Individuals were asked to contact the researcher if they were interested in completing the assessment. Following assessment, clinical information about participants’ MCI or dementia was obtained from the Aged Care Assessment Team clinical database.

The target number of participants for the brain injury and dementia/MCI subgroups was initially 20 participants per group. However, there was difficulty in obtaining these numbers for both groups in data collection. Only three of the seven brain injury rehabilitation centres and three of the six aged care teams approached were able to assist in providing participants for the study. Barriers in recruiting participants included lack of suitable participants, unavailability of clients (e.g. they had moved interstate), clients already participating in existing research projects, and practical difficulties within the rehabilitation centres or aged care teams that meant clients were unable to be referred. Due to these recruitment issues, inclusion and exclusion criteria were limited in order to maximise the sample sizes. Despite this, after an extended period of data collection, it was clear that the target sample sizes would not be reached.

As an incentive for individuals to participate in the research, all research recruitment material offered participants the opportunity to go into the draw to win one of 20 shopping vouchers valued at $20 each. Before completing assessments, participants who wished to enter the draw were asked to complete an entry form that requested their name, phone number, and address. They were also asked to select one of four retailers they would like to win the voucher from (Bunnings, Boating Camping and Fishing, Coles/Myer, or Big W). Entry forms were placed in a box with winners drawn at the completion of data collection.

**Data collection.** Participants attended a 1-hour assessment where they were given a research information sheet (Appendix T) and consent form (Appendix U) to sign. For individuals in the brain injury and dementia/MCI samples who were unable to give their
consent, a guardian consent form was provided for the guardian of the participant to sign (Appendix V).

At the beginning of the assessment, participants were given instructions for the time-based PM task where they were told the current time and asked to notify the researcher when 15 minutes had lapsed on the clock from that time. Participants were then given the instructions for the event-based PM task where they were told to remember to change pen colours when they reached Part 2 of the questionnaire. Following these instructions, participants were given the questionnaire booklet to complete, which contained the PMCQ, PRMQ, SDS-17, and API. This order of scales within the questionnaire booklet was the same for all participants. Participants were told that the questionnaire contained both memory and personality items. Furthermore, participants were told that there were no right or wrong answers, they should answer as honestly as possible, they should not leave any answers blank, there were no time limits, and to not rush through the questionnaire. Participants were given the opportunity to ask questions before commencing.

After completing the questionnaire booklet, participants completed the ACE-R. The questionnaire booklet acted as the ongoing activity for both naturalistic PM tasks. In cases where participants had completed the questionnaire booklet in less than 15 minutes, the time-based task continued whilst participants completed the ACE-R. After participants had completed the ACE-R, they were given instructions for the 24-hour naturalistic PM task. Here, they were given a business card with the researcher’s contact details and were asked to remember to contact the researcher after 12 p.m. the following day.

Whilst completing the questionnaire booklet, participants’ clock monitoring behaviour within the time-based task was observed by the researcher. Qualitative notes were made on whether participants monitored the clock and if they did so, how frequently the participant looked towards the clock (e.g. if they looked at the beginning of every page or at
the Part 2 title page). Responses to the event-based and time-based naturalistic tasks were also recorded using the naturalistic tasks scoresheet (Appendix W).

For the time-based task, scoring was based on when the individual retrieved the PM task and reported that 15 minutes had lapsed. Thus, the time that the 15 minute interval began was recorded on the scoresheet. The time that the participant responded to the task, for example by stating “it is now... o’clock” was also recorded. In addition, the researcher circled one of six options on the scoresheet depending on when the individual responded to the task. These options were “on time” if they responded within 30 seconds of the 15 minute target time, “early” if they responded before the 15 minute deadline, or “late” if they responded after the 15 minutes had lapsed. For most participants, the 15 minutes lapsed whilst completing the questionnaire booklet. If at the end of the assessment participants had not remembered to notify the researcher that 15 minutes had lapsed they were given prompts to assess task recall and recognition. Participants were asked “was there anything you were asked to remember to do whilst you were completing the assessment?” If they recalled the PM task following this prompt, the researcher circled prompt 1 on the scoresheet. If participants did not recall the task after the first prompt, they were asked “was there anything you needed to remember about the clock?” as the researcher pointed towards the clock on the wall. If the participant recalled the PM task following this prompt, the researcher circled prompt 2 on the scoresheet. When participants did not recall following the second prompt, the researcher circled no recall on the scoresheet.

Scoring for the event-based task used a similar six option format. These options included early for when participants changed pens before Part 2, Part 2 whereby participants changed pens at the correct time (on the Part 2 title page), and late where participants changed pens after Part 2. If participants had not changed pens when they reached the end of the assessment they were tested for recall and recognition of the task. They were asked “was
there anything that you were asked to remember to do when you were completing the questionnaire?” If participants recalled that they were supposed to change pens, the researcher circled prompt 1. If participants said no, they were prompted further with “was there anything you were supposed to do with the pens?” If participants were able to recall that they were to change pens, the researcher circled prompt 2 on the scoresheet. If participants did not recall after the second prompt, the researcher circled no recall.

For the 24-hour task, the date and time that participants’ made contact was noted and the researcher circled one of four options depending on when individuals responded. These options included early for responses made before 12 p.m. the following day, on time for responses made between midday and midnight the following day, late for responses after midnight the following day, and no recall if the individual failed to contact the researcher. However, it should be noted that it cannot be ascertained whether the failure to respond was the result of failure to remember or whether individuals failed to respond for other reasons. For example, individuals may not have been motivated to make contact or they may have remembered late but felt too embarrassed to contact the researcher.

Analyses

For analyses of performance on the event-based, time-based, and 24-hour naturalistic tasks, an overall naturalistic PM score was used. This combined naturalistic task score was calculated using a Rasch analysis to convert the response categories into an interval level measure. Specifically, the Partial Credit Rasch model was used as the rating scales for the three tasks were not equivalent (i.e. the 24-hour task rating scale had four categories, whilst the event-based and time-based tasks were scored using six response options). The Rasch analysis placed participants and the three naturalistic tasks on a single logit scale. The person measures derived from this scale were used as an index of individuals’ performance on the combined naturalistic tasks in subsequent analyses.
Analyses were conducted to assess the psychometric properties of the PMCQ and to investigate issues relating to self-reported PM. Construct validity of the PMCQ was assessed using a CFA. Cronbach’s alpha was then used to measure the internal consistency reliability of the PMCQ. Next, the convergent and divergent validity of the PMCQ was examined by looking at correlations between the scale and the PRMQ and naturalistic PM tasks. Predictive validity of the PMCQ was then assessed using t-tests, one-way ANOVAs, and a DA. These analyses assessed differences between the non-referred and referred groups on the PMCQ, and the ability of the scale to predict group membership. Rasch analyses were then conducted to evaluate the PMCQ component scales. These analyses included an assessment of person and item distributions, item separation indices, scale dimensionality, item fit, differential test functioning, and rating scale category functioning. Finally, to investigate issues relating to self-reported PM, a combination of correlational analyses, t-tests, one-way ANOVAs, and analyses of covariance (ANCOVAs) were employed.

Rasch Analyses were conducted with WINSTEPS Version 3.70.02, and IBM Amos Version 20 was used for CFAs. All other statistical analyses were carried out using IBM SPSS Statistics Version 20. For inferential testing, a decision-wise error rate of .05 was employed. As one of the primary purposes of this study was the development of a scale, the use of an experiment-wise error rate would be too restrictive. In addition, the small sizes of the clinical groups would not support the use of correction procedures such as Bonferroni. However, to support the analyses conducted the effect sizes for tests are reported. For t-tests, Cohen’s $d$ effect sizes were used with statistics of .02 indicating a small effect, .05 a medium-sized effect, and .08 a large effect (J. Cohen, 1988). Effect sizes for ANOVAs were calculated using partial eta-squared, with .0099 indicating a small effect, .0588 a medium effect, and .1379 indicating a large effect (J. Cohen, 1988). As assessments were supervised,
missing data was kept to a minimum with only two instances where items were accidentally not answered.

Results

Univariate and Multivariate Outliers

Analyses to detect univariate and multivariate outliers were conducted for the PMCQ, PRMQ, and API scales and subscales in the non-referred group only. An analysis of univariate and multivariate outliers within the brain injury and dementia/MCI groups was not carried out due to the small sample sizes of these groups. Furthermore, these groups were expected to contain some outliers based on the heterogeneity of these samples.

Univariate outliers were assessed using standardised scores (z scores) where scores above 3.29 were identified as univariate outliers (Tabachnick & Fidell, 2012). In addition, univariate outliers were detected using visual inspection of box plots where outliers were defined as scores 2.5 lengths from the interquartile range. These analyses revealed a small number of univariate outliers ($n < 6$) within each of the target variables. Multivariate outliers ($n = 3$) were identified through the calculation of Mahalanobis Distance with chi-square probability values of $p < .001$. In order to ascertain whether these univariate and multivariate outliers impacted upon data, dummy variables were created with these outlying individuals. Correlational analyses of the PMCQ, PRMQ, and API scales were carried out to determine whether changes occurred when these outliers were removed. As negligible differences in the data emerged when outliers were eliminated there was no justification for these cases to be removed from the dataset.

Construct Validity

A CFA was conducted in order to test the latent structure of the PMCQ and confirm the three-factor model obtained in the PCA in Study 2. Prior to the analysis, two cases containing missing data were removed from the dataset. The hypothesised three-factor model
of the PMCQ is depicted in Figure 4. This model proposes that the PMCQ contains three latent factors or components that are shown in the ovals: 1) Forgetting Behaviours, 2) Memory Concerns, and 3) Retrieval Cues. The rectangles in the figure depict the measured variables (i.e. the items shown in Table 17 that load on to each latent variable) and the circles containing (e) represent error variance. Arrows between the components and items indicate which items load on to each component, and above each arrow is the standardised loading estimate for each item on that component. Adjacent to each item is the squared multiple correlation ($R^2$) for each item, that is, the amount of variance explained by the component for each item. For example, in Figure 4 it can be seen that Item 17 is the best predictor of Forgetting Behaviours, with a standardised regression weight of .69 and the Forgetting Behaviours component explaining 47% of the variance in this item. Item 21 on the other hand is the poorest predictor of Forgetting Behaviours with a standardised regression weight of .08 and the component explaining only 1% of variance in the item.
Figure 4. CFA of the three component PMCQ latent structure.

In order to test the three-factor structure, maximum likelihood estimation was performed on the variance-covariance matrix. The independence model was tested using the
root mean square error of approximation (RMSEA) fit index as this measure is less sensitive to sample size than the other fit indices. RMSEA values less than .05 typically indicate good fit whilst RMSEA values above .10 suggest that the model should be rejected (Blunch, 2008). Hu and Bentler (1999) recommend an RMSEA index of around .06 as an indicator of good fit. Based on these criteria the PMCQ model was considered to have adequate fit, RMSEA = .064, \( p < .001, 90\% \text{ CI } [.06, .07] \).

**Internal Consistency Reliability**

Following the confirmation of the three component structure in the CFA, the internal consistency reliability of the PMCQ and its three subscales were assessed using Cronbach’s alpha. The results of this analysis are reported in Table 18.

Table 18

<table>
<thead>
<tr>
<th>Scale</th>
<th>( \alpha )</th>
</tr>
</thead>
<tbody>
<tr>
<td>PMCQ</td>
<td>.90</td>
</tr>
<tr>
<td>Forgetting Behaviours</td>
<td>.77</td>
</tr>
<tr>
<td>Memory Concerns</td>
<td>.85</td>
</tr>
<tr>
<td>Retrieval Cues</td>
<td>.74</td>
</tr>
</tbody>
</table>

*Note. Alpha scores range from 0–100 with higher scores indicating better reliability.*

The alphas reported in Table 19 indicate that the total PMCQ scale had excellent reliability. In addition, the Forgetting Behaviours and Retrieval Cues scales were found to have adequate reliability, whilst the Memory Concerns scale had good reliability. The PMCQ and its subscales were not improved if any scale items were to be deleted. The test-retest reliability of the PMCQ and subscales was unable to be tested due to issues with participant follow-up.
Convergent and Divergent Validity

The degree to which the PMCQ displays convergent validity and measures the PM construct was assessed by examining the correlations between the PMCQ and the PRMQ, the latter being a scale designed to measure self-reported prospective (PM scale) and retrospective memory (RM scale). These correlations only included participants from the non-referred sample in order to assess the relationship between scales during the process of normal ageing. The correlations between the PMCQ and PRMQ total scales and subscales are shown in Table 19.

Table 19

<table>
<thead>
<tr>
<th>Scale</th>
<th>FB</th>
<th>MC</th>
<th>RC</th>
<th>PMCQ</th>
<th>PM</th>
<th>RM</th>
<th>Nat</th>
</tr>
</thead>
<tbody>
<tr>
<td>FB</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MC</td>
<td>.60**</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RC</td>
<td>.54**</td>
<td>.64**</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PMCQ</td>
<td>.82**</td>
<td>.90**</td>
<td>.83**</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PM</td>
<td>.60**</td>
<td>.74**</td>
<td>.69**</td>
<td>.80**</td>
<td>--</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RM</td>
<td>.51**</td>
<td>.66**</td>
<td>.57**</td>
<td>.69**</td>
<td>.72**</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Natural</td>
<td>- .02</td>
<td>- .06</td>
<td>- .07</td>
<td>- .06</td>
<td>- .07</td>
<td>- .03</td>
<td>--</td>
</tr>
</tbody>
</table>

Note. FB = Forgetting Behaviours scale, MC = Memory Concerns scale, RC = Retrieval Cues scale, PMCQ = total PMCQ scale, PM = PRMQ PM scale, RM = PRMQ RM scale, Nat and Natural = naturalistic PM task person measures. \( n = 207 \) with pairwise deletion used where necessary. ** \( p < .001 \)

The inter-correlations between the three PMCQ subscales and total scale were high. The inter-correlation between the PRMQ PM and RM scales was also high. Evidence for the convergent validity of the PMCQ was found with the PRMQ PM scale correlating highly with each of the PMCQ scales, and even more so with the PMCQ total scale. The PMCQ
its subscales also correlated highly with the RM scale of the PRMQ, which suggests that the PMCQ items measure RM to some extent. This is not surprising as PM behaviours such as those included in the PMCQ items involve an RM component (i.e. remembering the content of the intention and information about the retrieval context). Although there was a significant correlation between the PMCQ total scale and the PRMQ RM scale, Fisher’s $z$ test revealed that the PMCQ total scale correlated more highly with the PM scale than it did the RM scale of the PRMQ ($z = 2.49, p = .013$). This provided evidence of divergent validity for the PMCQ. The three PMCQ subscales also correlated more highly with the PRMQ PM scale than they did the PRMQ RM scale although this difference was only significant for the Retrieval Cues correlations ($z = 1.99, p = .047$).

Convergent validity of the PMCQ was also assessed by comparing PMCQ scores with naturalistic PM performance. Correlations between the combined naturalistic task person measures and self-reported PM as measured by the PMCQ and PRMQ are reported in Table 20. Here, naturalistic PM task performance did not correlate significantly with self-reported PM on the PMCQ or PRMQ.

**Predictive Validity**

A series of t-tests were conducted to assess whether the non-referred group differed from the clinically-referred group on the PMCQ or its subscales. Group means are presented in Table 21.
Table 20

Descriptive Statistics for Non-referred and Referred Groups on PMCQ Scales

<table>
<thead>
<tr>
<th>Scale</th>
<th>Non-referred (n = 207)</th>
<th>Referral (n = 29)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>Forgetting Behaviours**</td>
<td>.64</td>
<td>.27</td>
</tr>
<tr>
<td>Memory Concerns*</td>
<td>.95</td>
<td>.40</td>
</tr>
<tr>
<td>Retrieval Cues</td>
<td>1.00</td>
<td>.35</td>
</tr>
<tr>
<td>PMCQ**</td>
<td>.85</td>
<td>.29</td>
</tr>
</tbody>
</table>

Note. Mean scores are average scale scores that range from 0–3 with high scores indicating more memory concerns. Scores of 0 = Never, 1 = Sometimes, 2 = Often, and 3 = Always.

* p < .01, ** p < .001

A medium to large effect size was observed on the overall PMCQ scale. This scale was able to distinguish between the referred and non-referred groups with the referred group reporting greater memory concerns than the non-referred group, t(234) = -4.02, p < .001, 95% CI [-.35, -.12], d = 0.72. On the Forgetting Behaviours scale, a large effect was found whereby the referred group reported having a higher frequency of memory failures than the non-referred group, t(234) = -5.31, p < .001, 95% CI [-.40, -.19], d = 1.00. The Memory Concerns scale violated the assumption of homogeneity of variance (F = 4.50, p = .035). On this scale, there was a medium to large effect as the referred group reported having greater memory concerns than the non-referred group, t(32.88) = -3.08, p = .004, 95% CI [-.52, -.11], d = 0.67. No differences between the referred and non-referred group were observed on the Retrieval Cues scale, t(234) = -1.07, p = .288, 95% CI [-.21, .06], d = 0.19.

One-way ANOVAs were carried out to assess these group differences on the PMCQ scales in further detail. Specifically, comparisons were made between participants in the non-referred group, the brain injury group, and the dementia/MCI group. For all analyses, the assumption of homogeneity of variance was met and so post-hoc tests were carried out using
Tukey’s Honestly Significant Difference (HSD) test. Mean scores and standard deviations for the three groups on the PMCQ and its subscales are reported in Table 21.

Table 21

Descriptive Statistics for Non-referred, Brain Injury, and Dementia/MCI Groups on PMCQ Scales

<table>
<thead>
<tr>
<th>Scale</th>
<th>Non-referred</th>
<th>Brain injury</th>
<th>Dementia/MCI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(n = 207)</td>
<td>(n = 18)</td>
<td>(n = 11)</td>
</tr>
<tr>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>SD</td>
<td>SD</td>
<td>SD</td>
<td>SD</td>
</tr>
<tr>
<td>Forgetting Behaviours</td>
<td>.64&lt;sup&gt;a&lt;/sup&gt;</td>
<td>.92&lt;sup&gt;b&lt;/sup&gt;</td>
<td>.95&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Memory Concerns</td>
<td>.95&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.25&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.27&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Retrieval Cues</td>
<td>1.00&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.06&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.09&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>PMCQ total scale</td>
<td>.85&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.07&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.10&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Note. Mean scores are average scale scores that range from 0–3 with high scores indicating more memory concerns. Scores of 0 = Never, 1 = Sometimes, 2 = Often, and 3 = Always. Superscripts indicate significant (α < .05) differences between groups whereby the same letters indicate no differences between groups and differing letters indicate group differences.

On the total PMCQ scale, a medium-sized effect was found, \( F(2, 233) = 8.06, p < .001, \eta^2_p = .07 \). The dementia/MCI group reported a higher frequency of overall memory concerns than the non-referred group, \( p = .018, 95\% \text{ CI} [.03, .47] \), and the brain injury group also reported more overall memory concerns than the non-referred group, \( p = .006, 95\% \text{ CI} [.05, .40] \). There were no differences between the brain injury and dementia/MCI groups on the PMCQ total score, \( p = .975, 95\% \text{ CI} [-.24, .29] \).

A medium to large-sized significant effect was observed on the Forgetting Behaviours scale, \( F(2, 233) = 14.10, p < .001, \eta^2_p = .11 \). Post-hoc tests revealed that individuals in the dementia/MCI group reported more forgetting behaviours than those in the non-referred group, \( p = .001, 95\% \text{ CI} [.11, .52] \) and that those in the brain injury group also reported more forgetting behaviours than those in the non-referred group, \( p < .001, 95\% \text{ CI} [.12, .44] \). The
brain injury and dementia/MCI groups did not differ significantly on the amount of reported forgetting behaviours $p = .955$, 95% CI [-.22, .28]. A medium-sized significant effect was also found on the Memory Concerns scale, $F(2, 233) = 6.92, p = .001$, $\eta^2_p = .06$. Both the dementia/MCI, $p = .036$, 95% CI [.02, .63] and brain injury groups, $p = .011$, 95% CI [.06, .54] reported more memory concerns than the non-referred group. However, there were no significant differences between the brain injury and dementia/MCI groups on the amount of memory concerns reported, $p = .989$, 95% CI [-.36, .40]. On the Retrieval Cues scale, the three groups did not differ on use of retrieval cues with only a small effect size obtained, $F(2, 233) = .58, p = .562$, $\eta^2_p = .01$.

**Discriminant analysis.** A DA was conducted on the PMCQ total scale to assess whether the scale could discriminate between healthy adults in the non-referred group and those in the referred group diagnosed with ABI, MCI, or dementia. Within this analysis, sensitivity and specificity of the PMCQ were calculated. Sensitivity refers to the extent to which a “disease positive” test score correctly identifies individuals with the disease. Specificity on the other hand relates to whether a test score suggesting individuals are “disease-free” correctly identifies disease-free individuals. The PMCQ had good specificity as it correctly classified 96.6% of the non-referred group. Sensitivity of the PMCQ, that is, the ability of the scale to detect real cognitive impairments was lower, detecting 75% of referred individuals who had a brain injury or dementia/MCI.

**Rasch Analyses**

In Study 2, PCAR in the 42-item PMCQ scale indicated that the total scale was multidimensional. Consequently, Rasch analyses in this study were conducted on each of the three PMCQ components as it was of greater importance to ensure that these scales were functioning appropriately in this sample rather than the development sample. The Rasch analyses of these components are presented in the following sections.
For each scale, Wright maps were constructed to assess the distribution of persons and items on the component. The construct validity of the item hierarchies within each subscale was assessed using item separation statistics whereby indices above 3.0 were deemed acceptable (Linacre, 2009a). The construct validity and dimensionality of the subscales was also assessed using PCAR in the first contrast once the target dimension was removed. Here, scales were considered to be unidimensional if the eigenvalue of unexplained variance in the first contrast was below 2.0 (Linacre, 2009a).

In addition to assessing the overall functioning of each component, the Rasch analyses evaluated the construct validity and functioning of items within each scale. This included analyses of item fit with mean square fit statistics between 0.6 and 1.4 deemed as acceptable (Wright & Linacre, 1994). DTF analyses were also carried out to determine whether any items within the scales were being approached differently by those in the clinical groups as opposed individuals in the non-referred group.

Next, the functioning of the rating scale categories for each of the three components was assessed using the procedures outlined by Linacre (1999). Category probability curves were assessed to ensure that the rating scale was being utilised as expected across all items within each component. Category probability curves in a well-functioning scale should resemble “a range of hills” so that each rating scale category has a distinct peak where the probability of endorsing the category is at its highest. Flat category probability curves indicate that the category is not being endorsed and therefore provides little information about the dimension (Linacre, 1999).

Finally, average measures for each rating scale category were assessed for each component. Average measures represent the average ability estimate of individuals who respond to a particular rating scale category. For example, an average measure of 1.0 logits for the *Never* category is the average ability score of individuals who responded to the *Never*
category. Average measures should increase monotonically across the rating scale categories (e.g. in the PMCQ these should be ordered 0, 1, 2, 3). In the context of the PMCQ, this means that individuals with more memory concerns should endorse the *Always* category more frequently and those with less memory concerns should select the *Never* category more often, given any item location on the ability scale.

**Construct validity of the Forgetting Behaviours scale.** The Wright map for the Forgetting Behaviours component is displayed in Figure 5. The left side of the diagram shows the placement of participants on the scale (i.e. person measures), with individuals with more reported forgetting behaviours located at the top of the scale. The right side of the diagram shows the distribution of the 16 scale items (i.e. item measures), with the most difficult items located at the top of the scale. As can be seen in the diagram, person measures covered a large range from 1.06 to -5.50 logits ($M = -1.73$, $SD = 1.08$), whilst the item measures were less expansive ranging from 1.55 to -1.54 logits ($M = 0.00$, $SD = 0.84$). The fact that the mean item measure was higher than the mean person measure indicates that the items were generally targeted at a more difficult level to endorse than participants’ ability levels (particularly for those in the non-referred group). However, item separation for this factor was 6.44, which was well above the recommended criterion of 3 (Linacre, 2009a). This provides evidence to support the item hierarchy and construct validity of the Forgetting Behaviours scale.

Within Figure 5, participants are coded so that the location on the scale of the non-referred, brain injured and dementia groups can be observed. On this scale, eight out of the 18 brain injury group scored above one standard deviation above the mean and 16 out of the 18 scored above the mean. In the dementia/MCI group, four out of the 11 individuals scored above one standard deviation above the mean and 10 of the 11 scored above the mean. In the non-referred group, most individuals scored below the mean, with only 88 of the 207
participants scoring above the mean, and 20 scoring one standard deviation above the mean. Together, these findings indicate that individuals in the referred group are generally placed at the higher end of the person distribution and report more forgetting behaviours.

Figure 5. Wright map for the Forgetting Behaviours scale. Note. On the central scale, M = mean, S = one standard deviation, and T = two standard deviations. The numbers on the left-hand side of the figure represent the logit measures for the scale. Persons are coded so that 1 = non-referred group participants, 2 = brain injury participants, and 3 = dementia/MCI participants.

After the modelled dimension was removed, a PCAR on the first contrast was carried out for the Forgetting Behaviours scale. This analysis suggested that there was some
multidimensionality on this component as the unexplained variance in the first contrast was 2.3, slightly above the recommended value of 2.0 (Linacre, 2009a). On further inspection of items, this multidimensionality reflected the reverse scoring used in four of the items on the scale rather than any differences in content. One of these items, Item 36 “I remember to do everyday tasks such as take medication, brush my teeth, or shower” demonstrated some marginal under fit (infit = 1.42, outfit = 1.46). Mean square fit indices for all other scale items fell within the acceptable range of 1.4 and 0.6 and therefore are not reported.

**Predictive validity of the Forgetting Behaviours scale.** The results of the DTF analysis on the Forgetting Behaviours component are shown in Figure 6. In this diagram, the vertical axis represents the item hierarchy for the referred group, whilst the horizontal axis shows the item hierarchy for the non-referred group. The dotted line represents correlations as a gradient, whilst the solid line represents 95% confidence intervals around the regression. Items that fall outside these confidence boundaries are likely to represent differences in responding patterns across groups, that is, the ordering of items is considerably different for one group compared to the other.
Figure 6. DTF of items on the Forgetting Behaviours scale in referred and non-referred participants.

On the Forgetting Behaviours scale, Item 16 “When I have to do two things at once, I have trouble remembering to do both” was more easily endorsed by the referred group than the non-referred group. Item 11 “I forget to do things that can be done in a sequence e.g. buy a stamp, put the stamp on an envelope, and post it” on the other hand was more easily endorsed by the non-referred group. These differences in responding can be attributed to individuals with brain injury, MCI, and dementia having difficulty with tasks such as these that require executive functions such as multitasking.

**Functioning of the Forgetting Behaviours rating scale.** In order to investigate the functioning of rating scale categories across all items within the Forgetting Behaviours scale, category probability curves were assessed. The Rasch-Andrich rating scale model was used for the analysis of category probability curves, as this is more conservative than the PCM. A comparison of data from the Partial Credit and Rasch-Andrich models indicated that the two models were similar. Figure 7 depicts the functioning of the rating scale categories across all
items within the Forgetting Behaviours scale. This figure shows that the rating scale categories averaged across all items within the Forgetting Behaviours scale were performing well, as each category can be seen to have its own distinct peak. This figure can be used to determine the most probable response for participants at a particular location on the scale. For example, a person with a measure of -4 has the highest probability of responding to the \textit{Never} category.

\textit{Figure 7.} Category probability curve for the Forgetting Behaviours scale. \textit{Note.} 0 = \textit{Never}, 1 = \textit{Sometimes}, 2 = \textit{Often}, and 3 = \textit{Always}. Person measures are shown on the X axis, whilst the probabilities of responding to a particular response category are shown on the Y axis.

Figure 8 depicts the average measures for the response categories within each of the items in the Forgetting Behaviours component. The Forgetting Behaviours scale items are listed on the right-hand side of the diagram, arranged by item measure (i.e. the most difficult item at the top). The average measures for each item (within the box) should increase monotonically from left to right (i.e. 0, 1, 2, 3) and should not be bunched together if the
rating scale is functioning well. As can be seen in Figure 8, several items demonstrated category disordering, whereby the average measure for individuals endorsing the *Always* category was lower than the average measure for those endorsing the *Often* category (items 16, 37, 1, 8, and 26) or the *Sometimes* category (items 28 and 36). In addition, the average measures for some categories (particularly the *Often* and *Always* categories) were quite similar for items 16, 37, 36, 9, 2, 1, and 21. This suggests that these rating categories provided little differentiation between individuals. In items 11, 5, and 29, the *Always* category was not endorsed, although this was not surprising. These items (e.g. Item 5 “I put things in the wrong place e.g. milk in the cupboard and sugar in the fridge”) described behaviours that would not typically occur *Always*.

**Figure 8.** Average measures for rating scale categories in the Forgetting Behaviours scale. *Note.* Average measures (measured in logits) for rating scale categories are listed inside the box with 0 = *Never*, 1 = *Sometimes*, 2 = *Often*, and 3 = *Always* categories. Item numbers are listed on the right-hand side of the figure.
Construct validity of the Memory Concerns scale. A Rasch analysis was carried out on the Memory Concerns scale. The Wright map for this scale is presented in Figure 9. As with the Wright map for the Forgetting Behaviours scale, the left side of the diagram shows the placement of participants on the scale (i.e. person measures) with individuals with greater memory concerns located at the top of the scale. The right side of the diagram shows the distribution of the 14 scale items (i.e. item measures) with the most difficult items located at the top of the scale. On the Memory Concerns scale, the person measures had a large range with participants located from 2.00 down to -5.36 logits ($M = -1.16$, $SD = 1.21$). Again, items on this scale were more restricted in range with item measures ranging from .89 to -.36 logits ($M = 0.00$, $SD = 0.61$). The higher mean item measure compared to the mean person measure suggested that the items were targeting a higher difficulty level than person ability. However, construct validity for the scale was supported with an acceptable item separation statistic of 5.24 (Linacre, 2009a).

In Figure 9, participants were coded so that the position of individuals in the non-referred, brain injury, and dementia/MCI samples can be observed. It can be seen that most individuals in the clinical groups were located towards the top of the distribution indicating that they reported more memory concerns. Specifically, 15 of the 18 brain injury participants scored above the mean, 6 of these scored above one standard deviation above the mean. In the dementia/MCI sample, seven of the 11 participants scored above the mean with five of these scoring over one standard deviation above the mean. In the non-referred group, only 29 of the 207 participants scored above the mean with 13 of these scoring above one standard deviation above the mean.
Figure 9. Wright map for the Memory Concerns scale.

Note. On the central scale, M = mean, S = one standard deviation, and T = two standard deviations. The numbers on the left-hand side of the figure represent the logit measures for the scale. Persons are coded so that 1 = non-referred group participants, 2 = brain injury participants, and 3 = dementia/MCI participants.

A PCAR revealed that the Memory Concerns component was unidimensional with an eigenvalue of 1.9 for the unexplained variance in the first contrast (Linacre, 2009a). An
analysis of the fit of items within the Memory Concerns scale was also carried out, however no items had misfitting mean square statistics.

**Predictive validity of the Memory Concerns scale.** The results of the DTF for the Memory Concerns scale are presented in Figure 10. Item 19 “I forget to do some things that I have planned to do” and item 40 “it takes me longer to do mental tasks than it used to e.g. crosswords” were more difficult for the non-referred sample to endorse than the referred group. The fact that the referred group found these items to be more difficult is somewhat expected, as individuals with brain injuries, MCI, and dementia typically have difficulty with planning tasks and complex mental tasks. Item 20 “I forget things that I am supposed to be doing if I am anxious or worried about something” was also more difficult for the referred group to endorse, and can be attributed to these individuals perhaps being unable to cope with anxiety and complete dual tasks in comparison to non-referred individuals. Item 38 “I worry that my memory is getting worse” on the other hand was more difficult for the referred group to endorse than the non-referred group. This may reflect either a lack of awareness of memory impairment in clinically-referred participants, whereby these participants do not worry as they do not perceive any deficits. Alternatively, these individuals may be aware of and accepting of memory deficits, and therefore are not concerned about any further decline. Conversely, non-referred individuals with intact memory might be more aware of and concerned about any changes in memory.
Figure 10. DTF of items on the Memory Concerns scale in referred and non-referred participants.

**Functioning of the Memory Concerns rating scale.** In order to investigate the functioning of rating scale categories across all items within the Memory Concerns scale, category probability curves were assessed using the Rasch-Andrich rating scale model. A comparison of data from the Partial Credit and Rasch-Andrich models indicated that the two models were similar. Figure 11 shows the functioning of the rating scale categories across all items within the Memory Concerns scale. This figure shows that the rating scale categories averaged across all items within the Memory Concerns scale were performing well as each category can be seen to have its own distinct peak. However, the *Often* category was underutilised slightly as its peak was less distinctive than the other categories.
Figure 11. Category probability curve for the Memory Concerns scale. 
*Note. 0 = Never, 1 = Sometimes, 2 = Often, and 3 = Always. Person measures are shown on the X axis and the probabilities of responding to a particular response category are shown on the Y axis.

Figure 12 depicts the average measures for the rating scale categories of the items within the Memory Concerns scale. Overall, the rating scale categories within each of these items were functioning well. Item 19 showed some slight disordering of the Often and Always categories. In addition, the average measures for the Often and Always categories in Item 32 were slightly similar although they were in the correct order.
Figure 12. Average measures for rating scale categories in the Memory Concerns scale. 

Note. Average measures (measured in logits) for rating scale categories are listed inside the box with 0 = Never, 1 = Sometimes, 2 = Often, and 3 = Always categories. Item numbers are listed on the right-hand side of the figure.

Construct validity of the Retrieval Cues scale. The Retrieval Cues scale was also subject to a Rasch analysis with the Wright map presented in Figure 13. The left side of the diagram shows the placement of participants on the scale (i.e. person measures), with individuals with better use of retrieval cues located at the top of the scale. The right side of the diagram shows the distribution of the 12 scale items (i.e. item measures), with the most difficult items located at the top of the scale. The person measures on the Retrieval Cues scale (1.48 to -5.15 logits) had a wider range than the item measures (.94 to -1.70 logits). Furthermore, the mean item measure ($M = 0.00$, $SD = 0.82$) was higher than the mean person measure indicating that the items were targeting a higher difficulty level than the person
measures ($M = -1.11, SD = 1.03$). Evidence for the construct validity of the scale was also found with an item separation statistic of 7.15.

Participants in Figure 13 were coded so the position of individuals in the non-referred, brain injury, and dementia/MCI groups could be observed. On the Retrieval Cues scale, individuals in the clinical samples were not clearly placed above the mean. For example, eight of the 18 participants scored above the mean with five of these scoring at least one standard deviation above the mean. In the dementia/MCI group, six of the 11 participants scored above the mean with four of these scoring over one standard deviation above the mean. The non-referred group were also split across the mean with approximately half (111 individuals) scoring above the mean. In this group, 28 of the 207 participants scored above one standard deviation above the mean.
Figure 13. Wright map for the Retrieval Cues scale.

Note. On the central scale, M = mean, S = one standard deviation, and T = two standard deviations. The numbers on the left-hand side of the figure represent the logit measures for the scale. Persons are coded so that 1 = non-referred group participants, 2 = brain injury participants, and 3 = dementia/MCI participants.

A PCAR confirmed that this scale was unidimensional with an acceptable eigenvalue of 2.0 for the unexplained variance in the first contrast (Linacre, 2009a). Furthermore, no items on the Retrieval Cues scale demonstrated misfit.
Figure 14. DTF of items on the Retrieval Cues scale in referred and non-referred participants.

Predictive validity of the Retrieval Cues scale. The DTF for the Retrieval Cues scale is presented in Figure 14. As can be seen, Item 14 “Seeing places (e.g. a supermarket) or objects (e.g. a teapot) can remind me that I need to do something (e.g. buy sugar)” and Item 4 “I walk into a room and forget why I went there” were more difficult for the referred group to endorse than the non-referred group. Item 4 fell within the confidence intervals however, this item was placed higher in the item hierarchy for the referred group suggesting that these individuals might have responded differently to this item. Item 12 “I am more likely to remember to do something if there is something to remind me e.g. an object or a person” was also more difficult for referred individuals to endorse than for the non-referred sample. Although Item 12 produced a differential functioning pattern, it was still the easiest item for both the referred and non-referred groups to endorse. Items 15 “Seeing places or objects can remind me that I need to do something, but I can’t remember exactly what it is” and 18 “I find that I don’t return to planning tasks if I get interrupted” were more difficult for non-referred individuals to endorse than for referred participants. Differential responding on
items 12, 14, 15, and 18 can be attributed to difficulties experienced by individuals with brain injury, MCI, and dementia in planning tasks and noticing retrieval cues.

**Functioning of the Retrieval Cues rating scale.** In order to investigate the functioning of rating scale categories across all items within the Retrieval Cues scale, category probability curves were assessed. The Rasch-Andrich rating scale model was used to produce category probability curves. A comparison of data from the Partial Credit and Rasch-Andrich models indicated that the two models were similar. Figure 15 shows the functioning of the rating scale categories across all items within the Retrieval Cues scale. This figure shows that the rating scale categories averaged across all items within the Retrieval Cues scale were performing well, as each category can be seen to have its own distinct peak although, the *Often* category was flatter than the other categories.

![Category Probabilities](image)

*Figure 15. Category probability curve for the Retrieval Cues scale.*

*Note.* 0 = *Never*, 1 = *Sometimes*, 2 = *Often*, and 3 = *Always*. Person measures are shown on the X axis and the probabilities of responding to a particular response category are shown on the Y axis.
Figure 16 depicts the average measures for the rating scale categories of the items within the Retrieval Cues scale. Items within the scale were generally functioning well. Item 10 showed some slight disordering in the *Often* and *Always* categories. In addition, the average measures of the *Often* and *Always* categories in items 18, 34, and 12 were similar.

![Figure 16](image)

*Figure 16. Average measures for rating scale categories in the Retrieval Cues scale.*

*Note.* Average measures (measured in logits) for rating scale categories are listed inside the box with 0 = *Never*, 1 = *Sometimes*, 2 = *Often*, and 3 = *Always* categories. Item numbers are listed on the right-hand side of the figure.

**Standardisation**

Normative data for the PMCQ and its three subscales is reported to allow for future use of the PMCQ. Specifically, this data can be used by future scale consumers to compare performance on the PMCQ to the means and standard deviations of individuals in this normative sample on the basis of age, gender, or clinical group characteristics. Normative data for the non-referred sample is provided in Table 22 in the form of mean scale scores and standard deviations for the PMCQ and its subscales. This normative data is provided for
healthy adults aged 18 to 89 whereby means and standard deviations are broken down into seven age brackets to allow for a more detailed analysis of scores across the lifespan. In addition, data is provided for two reference groups; individuals with MCI or dementia, and individuals with brain injuries. In Table 23 normative data for males within the non-referred group and the reference groups is provided, whilst Table 24 contains the normative data for females within the non-referred and clinical reference groups.
Normative Data (Means and Standard Deviations) for the PMCQ and its Subscales for Healthy Adults and Individuals with Brain Injury, and Dementia/MCI.

<table>
<thead>
<tr>
<th>Age group</th>
<th>FB</th>
<th>MC</th>
<th>RC</th>
<th>PMCQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-29</td>
<td>11.98 (4.58)</td>
<td>14.15 (6.27)</td>
<td>14.46 (3.96)</td>
<td>40.59 (12.86)</td>
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<td>(n = 46)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>30-39</td>
<td>9.64 (4.32)</td>
<td>13.06 (6.14)</td>
<td>12.33 (4.25)</td>
<td>35.03 (12.24)</td>
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<td>(n = 33)</td>
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</tr>
<tr>
<td>40-49</td>
<td>11.65 (4.18)</td>
<td>13.05 (6.18)</td>
<td>11.67 (4.03)</td>
<td>36.35 (12.30)</td>
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<tr>
<td>(n = 20)</td>
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<tr>
<td>50-59</td>
<td>9.87 (3.47)</td>
<td>14.18 (4.81)</td>
<td>11.67 (3.72)</td>
<td>35.72 (10.38)</td>
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<tr>
<td>60-69</td>
<td>9.63 (4.52)</td>
<td>13.53 (4.87)</td>
<td>10.82 (3.62)</td>
<td>33.97 (11.11)</td>
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<tr>
<td>70-79</td>
<td>8.41 (3.43)</td>
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<td>9.82 (3.94)</td>
<td>29.09 (9.78)</td>
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<tr>
<td>80-89</td>
<td>9.56 (5.66)</td>
<td>11.22 (7.66)</td>
<td>9.14 (5.05)</td>
<td>28.86 (17.99)</td>
</tr>
<tr>
<td>(n = 9)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brain injury</td>
<td>14.78</td>
<td>17.50</td>
<td>12.78</td>
<td>45.06</td>
</tr>
<tr>
<td>(n = 18)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dementia/MCI</td>
<td>15.27</td>
<td>17.82</td>
<td>12.70</td>
<td>47.10</td>
</tr>
<tr>
<td>(n = 11)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. FB = Forgetting Behaviours scale; scores on this scale are summed scores of the 16 items with scores ranging from 0 to 48, and higher scores indicating more forgetting behaviours. MC = Memory Concerns scale; scores on this scale are summed scores of the 14 scale items with scores ranging from 0 to 42 and higher scores indicating greater memory concerns. RC = Retrieval Cues scale; scores on the scale are summed scores of the 12 scale items which range from 0 to 36, with higher scores indicating better use of retrieval cues. PMCQ = PMCQ total score; scores on this scale are the summed scores of the 42 PMCQ items and this total score ranges from 0 to 126 with higher scores indicating greater memory concerns.

\(^a\) n = 7 participants for Retrieval Cues scale.

\(^b\) n = 10 participants in Dementia/MCI group on the Retrieval Cues and PMCQ total scales.
Table 23

**Normative Data for Males**

<table>
<thead>
<tr>
<th>Age group</th>
<th>FB</th>
<th>MC</th>
<th>RC</th>
<th>PMCQ</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$M \ (SD)$</td>
<td>$M \ (SD)$</td>
<td>$M \ (SD)$</td>
<td>$M \ (SD)$</td>
</tr>
<tr>
<td>18-29</td>
<td>11.53</td>
<td>13.87</td>
<td>14.20</td>
<td>39.60</td>
</tr>
<tr>
<td>($n = 15$)</td>
<td>(5.95)</td>
<td>(6.28)</td>
<td>(3.49)</td>
<td>(13.44)</td>
</tr>
<tr>
<td>30-39</td>
<td>12.00</td>
<td>14.75</td>
<td>11.67</td>
<td>38.42</td>
</tr>
<tr>
<td>($n = 12$)</td>
<td>(4.16)</td>
<td>(7.06)</td>
<td>(4.81)</td>
<td>(13.77)</td>
</tr>
<tr>
<td>40-49</td>
<td>12.50</td>
<td>14.90</td>
<td>12.20</td>
<td>39.60</td>
</tr>
<tr>
<td>($n = 10$)</td>
<td>(4.60)</td>
<td>(7.85)</td>
<td>(4.61)</td>
<td>(14.70)</td>
</tr>
<tr>
<td>50-59</td>
<td>10.33</td>
<td>13.40</td>
<td>12.00</td>
<td>35.73</td>
</tr>
<tr>
<td>($n = 15$)</td>
<td>(2.61)</td>
<td>(5.23)</td>
<td>(3.62)</td>
<td>(10.03)</td>
</tr>
<tr>
<td>60-69</td>
<td>11.81</td>
<td>14.88</td>
<td>12.00</td>
<td>38.69</td>
</tr>
<tr>
<td>($n = 16$)</td>
<td>(5.29)</td>
<td>(5.43)</td>
<td>(3.88)</td>
<td>(12.95)</td>
</tr>
<tr>
<td>70-79</td>
<td>9.14</td>
<td>8.86</td>
<td>7.43</td>
<td>25.43</td>
</tr>
<tr>
<td>($n = 7$)</td>
<td>(2.79)</td>
<td>(4.91)</td>
<td>(3.87)</td>
<td>(10.10)</td>
</tr>
<tr>
<td>80-89</td>
<td>12.33</td>
<td>16.67</td>
<td>12.50</td>
<td>43.00</td>
</tr>
<tr>
<td>($n = 3$)$^{a}$</td>
<td>(9.07)</td>
<td>(10.60)</td>
<td>(7.78)</td>
<td>(35.36)</td>
</tr>
</tbody>
</table>

*Note. FB = Forgetting Behaviours scale, scores on this scale are summed scores of the 16 items with scores ranging from 0 to 48 and higher scores indicating more forgetting behaviours. MC = Memory Concerns scale; scores on this scale are summed scores of the 14 scale items with scores ranging from 0 to 42, and higher scores indicating greater memory concerns. RC = Retrieval Cues scale; scores on the scale are summed scores of the 12 scale items which range from 0 to 36, with higher scores indicating better use of retrieval cues. PMCQ = PMCQ total score; scores on this scale are the summed scores of the 42 PMCQ items, and this total score ranges from 0 to 126 with higher scores indicating greater memory concerns. $^{a}n = 2$ individuals in the 80 to 89 age group for the Retrieval Cues and PMCQ total scales.*
Table 24

Normative Data for Females

<table>
<thead>
<tr>
<th>Age group</th>
<th>FB</th>
<th>MC</th>
<th>RC</th>
<th>PMCQ</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
</tr>
<tr>
<td>18-29</td>
<td>12.19</td>
<td>14.29</td>
<td>14.58</td>
<td>41.06</td>
</tr>
<tr>
<td>(n = 31)</td>
<td>(3.84)</td>
<td>(6.36)</td>
<td>(4.23)</td>
<td>(12.77)</td>
</tr>
<tr>
<td>30-39</td>
<td>8.29</td>
<td>12.10</td>
<td>12.71</td>
<td>33.10</td>
</tr>
<tr>
<td>(n = 21)</td>
<td>(3.89)</td>
<td>(5.50)</td>
<td>(3.96)</td>
<td>(11.17)</td>
</tr>
<tr>
<td>40-49</td>
<td>10.80</td>
<td>11.20</td>
<td>11.10</td>
<td>33.10</td>
</tr>
<tr>
<td>(n = 10)</td>
<td>(3.77)</td>
<td>(3.36)</td>
<td>(3.51)</td>
<td>(8.95)</td>
</tr>
<tr>
<td>50-59</td>
<td>9.58</td>
<td>14.67</td>
<td>11.46</td>
<td>35.71</td>
</tr>
<tr>
<td>(n = 24)</td>
<td>(3.93)</td>
<td>(4.57)</td>
<td>(3.83)</td>
<td>(10.81)</td>
</tr>
<tr>
<td>60-69</td>
<td>8.05</td>
<td>12.55</td>
<td>9.95</td>
<td>30.55</td>
</tr>
<tr>
<td>(n = 22)</td>
<td>(3.11)</td>
<td>(4.28)</td>
<td>(3.24)</td>
<td>(8.26)</td>
</tr>
<tr>
<td>70-79</td>
<td>8.07</td>
<td>11.80</td>
<td>10.93</td>
<td>30.80</td>
</tr>
<tr>
<td>(n = 15)</td>
<td>(3.73)</td>
<td>(4.02)</td>
<td>(3.56)</td>
<td>(9.48)</td>
</tr>
<tr>
<td>80-89</td>
<td>8.17</td>
<td>8.50</td>
<td>7.80</td>
<td>23.20</td>
</tr>
<tr>
<td>(n = 6)(^a)</td>
<td>(3.37)</td>
<td>(4.72)</td>
<td>(3.90)</td>
<td>(5.76)</td>
</tr>
</tbody>
</table>

Note. FB = Forgetting Behaviours scale, scores on this scale are summed scores of the 16 items with scores ranging from 0 to 48 and higher scores indicating more forgetting behaviours. MC = Memory Concerns scale; scores on this scale are summed scores of the 14 scale items with scores ranging from 0 to 42, and higher scores indicating greater memory concerns. RC = Retrieval Cues scale; scores on the scale are summed scores of the 12 scale items which range from 0 to 36, with higher scores indicating better use of retrieval cues. PMCQ = PMCQ total score; scores on this scale are the summed scores of the 42 PMCQ items, and this total score ranges from 0 to 126, with higher scores indicating greater memory concerns.

\(^a\) n = 5 participants in the 80 to 89 age group for the Retrieval Cues and PMCQ total scales.
Investigation of Variables Relating to the Measurement of Self-Reported Prospective Memory

**Gender.** In the process of developing normative data, exploratory t-tests were carried out in order to investigate whether males and females (in the non-referred group only) differed on the PMCQ. There was a small to medium-sized effect whereby females ($M = 0.60, SD = 0.25$) reported less forgetting behaviours than males ($M = 0.71, SD = 0.29$) on the Forgetting Behaviours scale of the PMCQ, $t(205) = -2.92, p = .004$, 95% CI [-.19, -.04], $d = 0.41$. However, no other gender differences were found on the PMCQ total scale or subscales.

**Age differences.** To assess age differences associated with normal ageing, only participants in the non-referred group were included in the following analyses. The relationship between age and the PMCQ total scale and subscales was examined. Weak significant negative correlations between age and the Forgetting Behaviours scale ($r = -.20, p = .003$), Retrieval Cues scale ($r = -.34, p < .001$), and the PMCQ total scale ($r -.24, p < .001$) indicated that self-reported PM concerns declined with increasing age. Although there did seem to be a near-linear relationship between age and the Memory Concerns scale, the effect was not significant ($r = -.11, p = .113$).

Age 65 was used as the cut-off for the classification of old age in this study, as this age is widely used to classify old age in Australia (e.g. the Australian Bureau of Statistics and Australian Institute of Health and Welfare), and is the age that individuals are eligible to receive the aged care pension (Australian Government Department of Human Services, 2014). Therefore a t-test comparing older adults (aged over 65 years) with younger adults (aged below 65 years) was carried out for each of the PMCQ scales. Mean scores on standard deviations for younger and older adults on the PMCQ and its subscales are provided in Table 25.
Table 25

Means and Standard Deviations Comparing Age on the PMCQ and Subscales

<table>
<thead>
<tr>
<th>Scale</th>
<th>Young (n = 158)</th>
<th>Old (n = 49)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>Forgetting Behaviours</td>
<td>.66</td>
<td>.26</td>
</tr>
<tr>
<td>Memory Concerns</td>
<td>.98</td>
<td>.41</td>
</tr>
<tr>
<td>Retrieval Cues**</td>
<td>1.04</td>
<td>.34</td>
</tr>
<tr>
<td>PMCQ total scale*</td>
<td>.87</td>
<td>.28</td>
</tr>
</tbody>
</table>

Note. Mean scores are average scale scores that range from 0 to 3 with high scores indicating more memory concerns. Scores of 0 = Never, 1 = Sometimes, 2 = Often, and 3 = Always.

* p < .05, ** p < .01

As can be seen in Table 25, on the PMCQ total scale age differences of a small to medium effect size were observed with younger adults reporting greater memory concerns than older adults, \( t(205) = 2.37, p = .019, 95\% \text{ CI } [.02, .20], d = 0.39 \). On the Retrieval Cues scale, a medium effect size was found as younger adults had higher scores than older adults, \( t(205) = 3.05, p = .003, 95\% \text{ CI } [.06, .28], d = 0.50 \). However, no age differences were found between older and younger adults on either the Forgetting Behaviours scale, \( t(205) = 1.43, p = .155, 95\% \text{ CI } [-.02, .15], d = 0.25 \) or on the Memory Concerns scale, \( t(205) = 1.71, p = .088, 95\% \text{ CI } [-.02, .24], d = 0.30 \), both with small effect sizes.

Additional one-way ANOVAs were conducted in order to assess the age differences detected on the Retrieval Cues scale and the PMCQ total scale in more detail, that is, age was broken down further into three groups to determine whether age differences could be detected between young, middle-aged, and older adults. In these analyses, participants were divided into three groups: young adults (aged 39 below), middle aged (40–64), and older adults (aged over 65 years). These age brackets were chosen so that the three groups were roughly equal in sample size and so that each age bracket spanned approximately 20 years. Post-hoc
comparisons were carried out using Tukey’s HSD test. The mean scores and standard deviations for the young, middle-aged, and old age groups on Retrieval Cues scale and the PMCQ total scale are shown in Table 26.

Table 26

Means and Standard Deviations Comparing Age on the Retrieval Cues and PMCQ Scales

<table>
<thead>
<tr>
<th>Scale</th>
<th>Young (n = 79)</th>
<th>Middle-aged (n = 79)</th>
<th>Old (n = 49)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$M$</td>
<td>$SD$</td>
<td>$M$</td>
</tr>
<tr>
<td>Retrieval Cues**</td>
<td>1.13</td>
<td>.35</td>
<td>.95</td>
</tr>
<tr>
<td>PMCQ total scale*</td>
<td>.91</td>
<td>.31</td>
<td>.83</td>
</tr>
</tbody>
</table>

Note. Mean scores are average scale scores that range from 0 to 3 with high scores indicating more memory concerns. Scores of 0 = Never, 1 = Sometimes, 2 = Often and 3 = Always.

* $p < .01$, ** $p < .001$.

As can be seen in Table 26, age differences between the groups were detected on the Retrieval Cues scale with a medium to large effect size, $F(2, 204) = 10.99, p < .001, \eta^2_p = .10$. On this scale, younger adults (aged below 39 years) reported using retrieval cues and strategies less frequently than older adults (aged over 65), $p < .001, 95\% \text{ CI } [.12, .41]$, and middle-aged adults (aged 40–64), $p = .002, 95\% \text{ CI } [.06, .31]$. There were no differences between older adults and middle-aged adults on the scale, $p = .401, 95\% \text{ CI } [-.06, .22]$. On the PMCQ total scale, small to medium-sized age effects were also found, $F(2, 204) = 4.33, p = .014, \eta^2_p = .04$. Here, younger adults reported more memory concerns than older adults, $p = .012, 95\% \text{ CI } [.03, .27]$. No differences were observed between younger adults and middle-aged adults, $p = .195, 95\% \text{ CI } [-.03, .19]$, or between middle-aged and older adults, $p = .352, 95\% \text{ CI } [-.05, .19]$.

Looking at the relationship between age and performance on the combined naturalistic tasks, a weak, but significant positive correlation was found ($r = .27, p < .001$) as
older adults performed better on the naturalistic tasks than younger adults. Table 27 shows the mean scores (as measured in logits) and standard deviations for the young, middle-aged, and older adults on the combined naturalistic tasks. A one-way ANOVA comparing young, middle-aged, and older adults was conducted to further investigate age differences on the naturalistic tasks. The assumption of homogeneity of variance was violated (Levene’s statistic = 5.86, \( p = .003 \)), therefore Welch’s \( F \) statistic and the Games-Howell post-hoc test were applied.

Table 27

**Comparisons of Age on the Combined Naturalistic Tasks**

<table>
<thead>
<tr>
<th>Scale</th>
<th>Young (( n = 79 ))</th>
<th>Middle-aged (( n = 79 ))</th>
<th>Old (( n = 49 ))</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( M )</td>
<td>( SD )</td>
<td>( M )</td>
</tr>
<tr>
<td>Naturalistic</td>
<td>-2.46(^a)</td>
<td>1.89</td>
<td>-1.90(^a)</td>
</tr>
</tbody>
</table>

*Note: Higher item measures indicate poorer performance on the combined naturalistic tasks. Superscripts indicate significant (\( \alpha < .05 \)) differences between groups, whereby the same letters indicate no differences between groups and differing letters indicate group differences.*

Table 27 shows that performance on the naturalistic tasks differed significantly across the three age groups, with a medium effect size, \( F(2, 141.38) = 8.83, p < .001, \eta^2_p = .06 \).

Older adults performed better than both the younger adults, \( p < .001, 95\% \text{ CI}[.63, 2.28] \) and middle-aged adults, \( p = .034, 95\% \text{ CI}[.05, 1.74] \) on the three naturalistic tasks combined.

Younger adults and middle-aged adults did not differ on naturalistic task performance, \( p = .152, 95\% \text{ CI}[-1.27, .15] \).

To determine whether differences observed between the non-referred group, brain injury group, and dementia/MCI group on the PMCQ could be accounted for by ageing effects, ANCOVAs were carried out. After controlling for age, the differences between the three groups remained significant on the PMCQ total scale, \( F(2, 229) = 11.30, p < .001, \eta^2_p = .09 \), the Forgetting Behaviours scale, \( F(2, 232) = 16.64, p < .001, \eta^2_p = .13 \), and on the
Memory Concerns scale, $F(2, 232) = 7.61, p = .001, \eta^2_p = .06$. These effect sizes were medium to large in magnitude. On the Retrieval Cues scale, group differences remained non-significant after controlling for age, $F(2, 229) = 2.57, p = .079, \eta^2_p = .02$. On the naturalistic tasks, differences observed between the non-referred group, brain injury, and dementia/MCI groups remained significant once age was controlled for, although the effect size was only small to medium, $F(2, 232) = 3.96, p = .020, \eta^2_p = .03$.

**Naturalistic task performance.** Performance of the non-referred and clinically-referred groups on the naturalistic tasks (using the combined naturalistic task person logit measures) was assessed using an independent samples t-test. A medium effect was observed whereby clinically-referred participants ($M = -0.71, SD = 2.87$) performed more poorly than the non-referred group ($M = -2.04, SD = 1.93$) on the naturalistic tasks combined, $t(234) = -2.42, p = .021, d = 0.54$. To investigate these differences further the clinically-referred group was subdivided and a one-way ANOVA compared the non-referred group to the brain injury, and dementia/MCI group on the naturalistic task. Homogeneity of variance was violated (Levene’s statistic = 10.07, $p < .001$) and therefore Welch’s $F$ and the Games-Howell post-hoc test was used. Means and standard deviations for these groups are provided in Table 28.

**Table 28**

<table>
<thead>
<tr>
<th>Group</th>
<th>$M$</th>
<th>$SD$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-referred ($n = 207$)</td>
<td>-2.03</td>
<td>1.93</td>
</tr>
<tr>
<td>Brain injury ($n = 18$)</td>
<td>-1.27</td>
<td>3.22</td>
</tr>
<tr>
<td>Dementia/MCI ($n = 11$)</td>
<td>.22</td>
<td>1.97</td>
</tr>
</tbody>
</table>

*Note: Higher item measures indicate poorer performance on the combined naturalistic tasks.*

Group differences on the naturalistic task were significant with a medium effect size, $F(2, 18.22) = 6.96, p = .006, \eta^2_p = .06$. The non-referred group performed better on the
naturalistic task than the dementia/MCI group, \( p = .009 \), 95% CI [.61, 3.90]. There were no differences between the non-referred group and brain injury group, \( p = .591 \), 95% CI [-2.73, 1.20], or between the brain injury and dementia/MCI groups, \( p = .286 \), 95% CI [-.90, 3.88].

**Personality.** The relationships between the PMCQ and the five API personality factors were assessed using correlational methods. The correlations between the PMCQ, its subscales, and the five API personality scales are reported in Table 29. In addition, the correlations between the naturalistic tasks and personality factors are reported in this table. None of the personality scales were found to be related to performance on the naturalistic PM tasks. The relationship of the PMCQ to the API personality factors will be discussed below.

Table 29

<table>
<thead>
<tr>
<th></th>
<th>FB</th>
<th>MC</th>
<th>RC</th>
<th>PMCQ</th>
<th>N</th>
<th>E</th>
<th>O</th>
<th>A</th>
<th>C</th>
<th>Nat</th>
</tr>
</thead>
<tbody>
<tr>
<td>FB</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MC</td>
<td>.60**</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RC</td>
<td>.54**</td>
<td>.64**</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PMCQ</td>
<td>.82**</td>
<td>.90**</td>
<td>.83**</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>.27**</td>
<td>.42**</td>
<td>.27**</td>
<td>.38**</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>-.16*</td>
<td>-.25**</td>
<td>-.06</td>
<td>-.19**</td>
<td>-.28**</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>O</td>
<td>-.10</td>
<td>-.09</td>
<td>.03</td>
<td>-.06</td>
<td>.07</td>
<td>.41**</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>-.23**</td>
<td>-.11</td>
<td>-.12</td>
<td>-.17*</td>
<td>-.31**</td>
<td>.11</td>
<td>.00</td>
<td>--</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>-.46**</td>
<td>-.45**</td>
<td>-.44**</td>
<td>-.53**</td>
<td>-.34**</td>
<td>.10</td>
<td>-.02</td>
<td>.21**</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Nat</td>
<td>-.02</td>
<td>-.06</td>
<td>-.07</td>
<td>-.06</td>
<td>-.07</td>
<td>.06</td>
<td>-.04</td>
<td>.04</td>
<td>.02</td>
<td>--</td>
</tr>
</tbody>
</table>

*Note.* FB = Forgetting Behaviours, MC = Memory Concerns, RC = Retrieval Cues, PMCQ = PMCQ total scale, N = neuroticism, E = extraversion, O = openness to experience, A = agreeableness, and C = conscientiousness. Correlations reported in this table were calculated using only the non-referred sample (\( n = 207 \)), with pairwise deletion used where necessary. * \( p < .01 \). ** \( p < .001 \).
One-way ANOVAs were also conducted to assess differences between the non-referred group, brain injury, and dementia/MCI samples on each of the five personality factors. Additional one-way ANOVAs were conducted to detect differences between non-referred young adults (aged below 39 years), middle-aged adults (aged 40-64), and older adults (aged over 65 years) on the five personality factors. Post-hoc tests for all subsequent analyses were carried out using Tukey’s HSD. Descriptive statistics for the personality factors for the non-referred group, brain injury, and dementia/MCI groups are provided in Table 30. The results of these analyses will be discussed in the following sections.

Table 30

*Means and Standard Deviations for the Five Personality Factors Across Groups*

<table>
<thead>
<tr>
<th>Scale</th>
<th>Non-referred</th>
<th>Brain injury</th>
<th>Dementia/MCI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(n = 207)</td>
<td>(n = 18)</td>
<td>(n = 11)</td>
</tr>
<tr>
<td>Neuroticism</td>
<td>23.62</td>
<td>28.44</td>
<td>27.55</td>
</tr>
<tr>
<td></td>
<td>6.84</td>
<td>6.90</td>
<td>4.66</td>
</tr>
<tr>
<td>Extraversion</td>
<td>33.90</td>
<td>31.29</td>
<td>32.73</td>
</tr>
<tr>
<td></td>
<td>6.45</td>
<td>5.83</td>
<td>6.26</td>
</tr>
<tr>
<td>Openness</td>
<td>36.40</td>
<td>31.83</td>
<td>32.27</td>
</tr>
<tr>
<td></td>
<td>6.14</td>
<td>6.03</td>
<td>4.58</td>
</tr>
<tr>
<td>Agreeableness</td>
<td>40.12</td>
<td>37.17</td>
<td>38.82</td>
</tr>
<tr>
<td></td>
<td>5.20</td>
<td>5.82</td>
<td>6.18</td>
</tr>
<tr>
<td>Conscientiousness</td>
<td>38.42</td>
<td>38.11</td>
<td>33.18</td>
</tr>
<tr>
<td></td>
<td>6.24</td>
<td>7.14</td>
<td>4.42</td>
</tr>
</tbody>
</table>

*Note.* Scores on each scale range from 10 to 50 with higher scores indicating a greater amount of that personality trait.

**Neuroticism.** As shown in Table 29, higher levels of neuroticism had weak to moderate correlations with greater memory concerns on the PMCQ and its three subscales. In addition, differences between groups on the neuroticism scale were significant, with a medium-sized effect, $F(2, 228) = 5.63, p = .004, \eta^2_p = .05$. The brain injury group had higher neuroticism scores than the non-referred group, $p = .011, 95\%$ CI [.90, 8.74]. However, there were no differences between the brain injury group and dementia/MCI group, $p = .936, 95\%$
CI [-5.20, 7.00], or between the non-referred group and dementia/MCI group, \( p = .149 \), 95% CI [-1.02, 8.86]. Furthermore, there were no age differences detected between young, middle-aged, and older adults on the neuroticism scale, \( F(2, 199) = 1.55, p = .215, \eta^2_p = .02 \).

**Extraversion.** As depicted Table 29, weak negative relationships emerged whereby higher levels of extraversion were associated with lower scores and therefore less memory concerns on the Forgetting Behaviours scale, Memory Concerns scale, and the PMCQ total scale. However, the Retrieval Cues scale was not associated with extraversion. No differences between the non-referred group, brain injury, and dementia/MCI group were found on the extraversion scale, \( F(2,227) = 1.42, p = .245, \eta^2_p = .01 \). There were also no age differences between young, middle-aged, and older adults on the extraversion scale, \( F(2, 199) = .81, p = .448, \eta^2_p = .01 \).

**Openness to experience.** The correlations reported in Table 29 indicate that there were no relationships between scores on the openness to experience scale and scores on the PMCQ and its subscales. Contrarily, significant medium-sized differences between groups on the openness to experience scale were detected, \( F(2, 230) = 6.70, p = .001, \eta^2_p = .06 \). More specifically, the non-referred group were found to be more open to experience than the brain injury group, \( p = .007, 95\% \text{ CI [1.05, 8.09]} \). There was no difference between the non-referred group and dementia/MCI group, \( p = .074, 95\% \text{ CI [-.30, 8.56]} \), or between the brain injury group and dementia/MCI group, \( p = .980, 95\% \text{ CI [-5.92, 5.04]} \). There were no age differences between young, middle-aged, and older adults on the openness to experience scale, \( F(2, 201) = .165, p = .848, \eta^2_p = .00 \).

**Agreeableness.** As shown in Table 29 significant weak correlations between scores on the agreeableness scale, and scores on the Forgetting Behaviours and PMCQ total scales were found. People with high levels of agreeableness had less PM concerns as measured by the Forgetting Behaviours and the PMCQ total score. However, the Memory Concerns scale and
Retrieval Cues scale did not relate to agreeableness. On the agreeableness scale, differences between the non-referred group, brain injury, and dementia/MCI groups were not significant, $F(2, 230) = 2.79, p = .064, \eta^2_p = .02$. In addition, there were no differences between the young, middle-aged, and older age groups on the agreeableness scale, $F(2, 201) = 2.77, p = .065, \eta^2_p = .03$.

**Conscientiousness.** The correlations shown in Table 29 indicate moderate negative relationships between scores on the conscientiousness scale, and scores on the PMCQ and its three subscales. Thus, high levels of conscientiousness were associated with lower PMCQ scores and less memory concerns. Small but significant group differences were also observed on the conscientiousness scale, $F(2, 229) = 3.68, p = .027, \eta^2_p = .03$. The non-referred group had higher conscientious scores than the dementia/MCI group, $p = .020, 95\% \text{ CI } [68, 9.80]$. However, there were no differences between the non-referred group and the brain injury group, $p = .977, 95\% \text{ CI } [-3.31, 3.93]$, or between the brain injury group and dementia/MCI group, $p = .100, 95\% \text{ CI } [-.71, 10.57]$. Small age differences were found in conscientiousness, $F(2, 200) = 3.36, p = .037, \eta^2_p = .03$. However, these differences did not emerge in post-hoc comparisons.

**Analyses of covariance.** A series of ANCOVAs were carried out to assess whether the significant differences between the non-referred, brain injury, and dementia/MCI samples on the PMCQ total scale remained after controlling for the five personality factors. Group differences on the PMCQ total scale remained after controlling for neuroticism, $F(2, 225) = 4.09, p = .018, \eta^2_p = .04$, extraversion, $F(2, 223) = 8.36, p < .001, \eta^2_p = .07$, openness to experience, $F(2, 226) = 6.85, p = .001, \eta^2_p = .06$, agreeableness, $F(2, 226) = 7.11, p = .001, \eta^2_p = .06$, and conscientiousness, $F(2, 226) = 6.98, p = .001, \eta^2_p = .06$. These effect sizes were all small to medium in magnitude. However, the results show that the PMCQ is indexing
differences between the target groups that are not attributable to personality variables as represented by the five-factor model.

**Social desirability.** The relationship between the PMCQ and the SDS-17 was examined using data from the non-referred sample only. Small negative correlations were found between SDS-17 scores and the Forgetting Behaviours scale ($r = -.28, p < .001$), the Memory Concerns scale ($r = -.29, p < .001$), Retrieval Cues scale ($r = -.36, p < .001$), and the PMCQ total score ($r = -.36, p < .001$). Thus, higher scores on the SDS-17 were related to lower PMCQ scale scores (indicating less memory concerns). Social desirability was not related to performance on the naturalistic PM tasks, as only a weak non-significant correlation was obtained ($r = .12, p = .078$).

Comparisons between the non-referred group, brain injury, and dementia/MCI groups revealed a significant medium-sized effect of social desirability, $F(2, 229) = 8.37, p < .001, \eta^2_p = .07$. Post-hoc tests using Tukey’s HSD found that the brain injury group ($M = 12.28, SD = 3.06$) had higher scores on the SDS-17 than the non-referred group ($M = 8.95, SD = 3.31$), $p < .001, 95\% CI [1.40, 5.26]$. However, there were no differences between the dementia/MCI group ($M = 9.7, SD = 4.03$) and brain injury group, $p = .123, 95\% CI [-.52, 5.67]$, or between the dementia/MCI group and non-referred group, $p = .767, 95\% CI [-1.79, 3.29]$. After controlling for social desirability scores in an ANCOVA, differences between these groups on the PMCQ total score remained significant, $F(2, 226) = 15.76, p < .001, \eta^2_p = .12$. Moreover, this effect size was reasonably large.

Age differences on the SDS-17 in the non-referred group were assessed. Age was weak to moderately positively correlated with SDS-17 scores ($r = .36, p < .001$) indicating that socially desirable responding increased with age. A one-way ANOVA comparing young, middle-aged, and older adults found medium to large sized differences between the groups on the SDS-17, $F(2, 201) = 11.29, p < .001, \eta^2_p = .10$. Older adults ($M = 10.68, SD = 3.12$) had
higher scores than both younger adults ($M = 7.91, SD = 2.93), p < .001, 95% CI [1.39, 4.15] and middle-aged adults ($M = 8.95, SD = 3.39), p = .009, 95% CI [.36, 3.1] on the SDS-17. However, there were no differences between young adults and middle-aged adults, $p = .101, 95\% \text{ CI } [-2.23, .15]$.

Discussion

Validation and Standardisation of the PMCQ

The primary aim of Study 3 was to assess the structure, reliability, and validity of the final version of the PMCQ that was developed in Study 2. In this study, the PMCQ total scale was found to have excellent internal consistency reliability, whilst the three subscales each had good or adequate indices of reliability. In terms of scale validity, the convergent and divergent validity of the PMCQ were assessed in this study by examining its correlations with the PRMQ (an alternate self-report measure of PM). The high correlations between the PMCQ and the PM scale of the PRMQ indicated that the PMCQ demonstrated convergent validity. In addition, the PMCQ total scale correlated more highly with the PRMQ PM scale than it did with the PRMQ RM scale. This result suggested that the PMCQ was a stronger measure of PM than it was of RM, thus establishing divergent validity. The construct validity of the PMCQ was also demonstrated in Study 3, whereby a CFA supported the three component latent structure obtained in the PCA of the scale within Study 2.

For the PMCQ to have predictive validity, it needed to be able to distinguish between those expected to have less memory concerns (i.e. the non-referred group) and those expected to have greater memory concerns (i.e. individuals with brain injury, MCI, or dementia). The PMCQ total scale was found to have acceptable specificity and sensitivity in terms of classifying individuals as either non-referred or referred. Furthermore, non-referred adults reported having less memory concerns than both individuals with brain injury and individuals with MCI or dementia on the PMCQ total scale and on the Forgetting Behaviours and
Memory Concerns subscales. Rasch analyses of the subscales confirmed these group differences as referred individuals mostly had above average person measures (indicating greater memory concerns); thus demonstrating the predictive validity of these two subscales. The Retrieval Cues scale possessed convergent, divergent, and construct validity. However, the Rasch analysis of this scale could not establish predictive validity as referred participants were evenly spread above and below the average person measure. In addition, no group differences were detected between the non-referred and referred groups on the scale. These findings suggest the Retrieval Cues scale does measure a valid memory dimension, but one that does not discriminate well between non-referred and referred participants.

Overall, these findings in relation to the reliability and validity of the PMCQ suggest that the PMCQ total scale rather than its subscales is the most effective measure of PM concerns. Therefore, the PMCQ total scale scores can be used for the assessment of PM concerns in research and potentially in clinical settings. The PMCQ subscales, especially the Retrieval Cues subscale should currently not be used in isolation. Instead, these subscales and their items can be used to create a more detailed picture of an individual’s concerns about PM and can identify specific areas to be targeted by clinicians.

One objective was to standardise the PMCQ for the general adult population. Therefore, in this study normative data was obtained for both male and female healthy adults aged 18 to 89. Reference group data was also collected for individuals with brain injury and for individuals with MCI or dementia. The development of reference group norms for the PMCQ was limited due to difficulty in obtaining large samples within the brain injury and dementia/MCI groups. Where possible, the recruitment of larger reference groups in future studies would certainly be beneficial. As the brain injury and dementia/MCI reference group samples were small, caution should be used when using this reference group data. Nevertheless, the standardisation of the PMCQ resulted in scores that can be used as a
benchmark for comparison of future scale users’ scores to those of the general population. Furthermore, these scores allow researchers and clinicians to gain insight into individuals’ PM concerns. This information can then be used to determine whether individuals potentially require interventions or memory compensation strategies.

**Comparisons of the PMCQ and PRMQ Content and Structure**

The PMCQ was developed using a unique approach that employed a combination of techniques derived from CTT and IRT. An overall thesis aim and an aim of Study 3 was to investigate whether the PMCQ was similar in content and scale structure to existing self-report PM scales that were developed using different methods. As the most frequently cited self-report PM scale, the PRMQ was used for comparisons with the PMCQ. Development of the PRMQ involved the creation of 16 items with two items assessing each of the eight categories (PM short-term self-cued, RM short-term self-cued, PM long-term self-cued, RM long-term self-cued, PM short-term environmentally-cued, RM short-term environmentally-cued, PM long-term environmentally-cued, and RM long-term environmentally-cued). This categorisation of the 16 items was confirmed by eight expert reviewers in the initial scale development study.

The comparison of scales in this study revealed that the tripartite structure of the PRMQ (obtained in later studies), which consists of a general memory factor as well as orthogonal PM and RM factors (Crawford et al., 2003; Rönnlund et al., 2008), was not reflected in the three orthogonal PMCQ subscales. Some items on the PMCQ were similar in content to items on the PRMQ PM scale, however these PMCQ items did not fall on a single PM factor, as would be expected if the scale replicated the PRMQ. Item content within the PRMQ RM scale was not mirrored in the PMCQ items. The difference between the PMCQ and the PRMQ RM scale can be attributed to the fact that the PMCQ items were developed to measure PM, whereas the PRMQ was constructed to measure both the PM and RM...
constructs. Despite the differences in scale structure and item content, correlations between the PMCQ and PRMQ were relatively high, suggesting that the two scales are indeed measuring a similar construct. These findings generally support the hypothesis that the PMCQ is a unique self-report scale that differed from the PRMQ in content and structure. In addition, the prediction that the PMCQ would measure the same PM construct as the PRMQ was also supported, as convergent validity was established in correlations between the two scales in this study.

Variables Relating to the Self-Reported Measurement of Prospective Memory

Prospective memory in acquired brain injury, mild cognitive impairment, and dementia. An aim of this study was to investigate both naturalistic and self-reported PM in individuals with ABI as well as individuals with MCI or dementia. Although not a key study aim, differences between individuals with ABI and individuals with MCI or dementia were also explored. As discussed earlier in the chapter, a combined dementia/MCI group was used due to issues in recruiting a large number of participants with these diagnoses. It was conceptualised that individuals with dementia and MCI represented the overall diagnosis of neurocognitive disorder and were characterised by similar types of cognitive impairments (American Psychiatric Association, 2013). The ACE-R scores of individuals in the dementia/MCI group supported this notion as all but one participant (who scored 89) had scores below 88 that were indicative of cognitive impairments. Hence, the combination of MCI and dementia participants in this study permitted comparisons to be made between these cognitively impaired individuals and non-referred individuals assumed to not be affected by cognitive impairments.

The hypotheses that both individuals with ABI and individuals with MCI or dementia would perform more poorly on the naturalistic tasks than non-referred adults were confirmed to some extent. The non-referred adults performed better than the combined clinically-
referred group (i.e. brain injury and dementia/MCI participants), a finding that is consistent with previous studies that have reported impaired naturalistic PM task performance in individuals with ABI (e.g. Brooks et al., 2004; R. Hannon et al., 1995; Mathias & Mansfield, 2005), and in individuals with MCI and dementia (e.g. Thompson et al., 2011; E. van den Berg et al., 2012). However, when the clinically-referred subgroups were analysed separately, the non-referred group outperformed the dementia/MCI group, but the brain injury group (whose performance was intermediate to the other groups) did not differ significantly from the non-referred or dementia/MCI groups.

In terms of self-reported PM, it was hypothesised that both individuals with ABI and individuals with MCI or dementia would report more memory failures and concerns on the PMCQ than individuals in the non-referred group. Consistent with this hypothesis, the combined referred group had more memory concerns than the non-referred group on the PMCQ total scale, and the Forgetting Behaviours and Memory Concerns subscales. Considering the group differences in more detail, individuals with ABI reported more memory failures on these scales than the non-referred group, which contradicts the findings of Roche et al. (2007) and Radford et al. (2011). Individuals in the dementia/MCI group also reported more memory failures on these scales than the non-referred group which is consistent with the findings of Tam and Schmitter-Edgecombe (2013).

Contrary to this study’s hypothesis, no group differences were found between the non-referred adults and the referred groups on the Retrieval Cues scale. This finding reflects those of Eschen et al. (2009), who did not find differences between individuals with dementia and healthy adults on self-reported PM. The lack of group differences on the Retrieval Cues scale is also similar to the findings in the brain injury literature that found individuals with ABI did not report using external memory aids more than healthy controls (R. Hannon et al., 1995; Radford et al., 2011; Roche et al., 2007). Thus, although individuals in the referred
group in this study were more concerned about their memory, and reported more memory failures than non-referred adults, they did not report utilising additional internal or external retrieval strategies in order to maximise their potential of noticing PM retrieval cues. As studies have shown that individuals with ABI (McDonald et al., 2011) and MCI (Ozgis et al., 2009; Thompson et al., 2011) benefit from the use of such memory aids, it is important that clinicians encourage these clients to use such strategies in order to minimise the effects of PM impairments.

This research is the first PM study to include both a brain injury and dementia/MCI sample, and consequently provide a comparison between the two diagnoses. On the PMCQ and its three subscales there was very little difference in scores between the two referred groups, which implies that these groups are equivalent in the amount of PM concerns they have. The referred groups also did not differ significantly on naturalistic task performance providing further evidence for the similarity of PM ability in these clinical groups. It should be noted that whilst not significant, the brain injury group did outperform the dementia/MCI group on the naturalistic tasks. However, the sample sizes of these referred groups were considerably small and so these results must be considered with caution. Further comparisons of these clinical groups on self-report and naturalistic PM measures are needed to determine whether individuals with ABI as opposed to those with MCI and dementia differentially experience PM impairments.

**Prospective memory in normal ageing.** One of the aims of this study was to investigate the relationship between normal ageing and PM as measured by naturalistic PM tasks and the self-report PM scale developed in this research, the PMCQ. The hypothesis that older adults would outperform younger adults on the naturalistic tasks was supported. Older adults aged over 65 performed better on the combined naturalistic tasks than did both younger and middle-aged adults (aged 18–39 and 40–64 respectively), although there were
no differences between the young and middle-aged groups. This finding is consistent with previous studies that found improved performance on naturalistic tasks of PM with increasing age (Bailey et al., 2010; Cuttler & Graf, 2007; Henry et al., 2004).

In assessing the relationship between self-reported PM and ageing it was predicted that similar to naturalistic PM performance, older adults would perform better than younger adults on the PMCQ. However, the observed relationship between ageing and the PMCQ was less clear. There was a correlation between the PMCQ total score and age, whereby older adults reported less memory concerns than younger adults. Group comparisons revealed that younger adults (aged 18–39) reported more memory concerns on the PMCQ than middle-aged adults (aged 40–64), and older adults (aged 65–89), although there were no differences observed between the middle-aged and older adults. These findings are generally consistent with those found in relation to naturalistic PM and self-report studies that have found older adults to report less memory failures than younger adults on the PRMQ (Hsu & Hua, 2011; Rönnlund et al., 2008) and the CAPM (Chan et al., 2010; Chau et al., 2007).

An evaluation of the scores on the three PMCQ subscales (i.e. Forgetting Behaviours, Memory Concerns, and Retrieval Cues) provided further insight into the effects of ageing. No differences between younger (less than 65 years) and older adults (over 65 years) were detected on either the Forgetting Behaviours or Memory Concerns scales. These findings are more consistent with self-report studies that have found no differences between younger and older adults on the PMQ (R. Hannon et al., 1995), or on the PRMQ (Crawford et al., 2003; Piauilino et al., 2010; G. Smith et al., 2000). Although, it should be noted that there was a small correlation between Forgetting Behaviours and ageing, indicating that older adults may report less forgetting behaviours than younger adults.

However, a novel finding did emerge whereby older adults reported less concerns than younger adults on the Retrieval Cues scale. When split into three age groups, younger
adults (aged 18–39) reported more concerns on this scale than middle-aged (40–64 years), and older (aged over 65) adults; although, there were no differences between the middle-aged or older adults. Together, these findings suggest that age plays a minor role in the amount of memory concerns reported by individuals (as evidenced by findings on the Memory Concerns and Forgetting Behaviours scales), however it may play a more important role in the frequency with which individuals use retrieval cues and strategies in PM tasks (as demonstrated by scores on the Retrieval Cues scales). Moreover, the ageing effects detected in the overall PMCQ are most likely predominantly a reflection of age differences in the use of retrieval cues. As age-related declines in many types of memory have been extensively reported (Naveh-Benjamin & Ohta, 2012) and older adults have generally been found to perform more poorly than younger adults on a variety of laboratory PM tasks (Henry et al., 2004), the results obtained in this research were contrary to what might be expected. Therefore, further research is required to investigate the relationship between age and PM.

**Prospective memory and gender.** The effects of gender on naturalistic and self-reported PM was examined during the development of normative data as gender effects are seldom reported in the literature. A small to medium effect of gender occurred on the Forgetting Behaviours scale, whereby females reported having less memory concerns than males. However, males and females did not differ on the PMCQ total scale or the other two subscales. In a laboratory-based PM task, Maylor and Logie (2010) found a similar result to the PMCQ Forgetting Behaviours scale, as females outperformed males. In contrast, in the current study no gender differences were detected on the naturalistic PM tasks. The null findings of gender on the PMCQ total scale, and Memory Concerns and Retrieval Cues subscales are consistent with the findings of Hsu and Hua (2011), who reported no gender differences on the Taiwanese version of the PRMQ. Furthermore, in this study no gender differences were observed on the PRMQ. However, the less frequent reporting of Forgetting
Behaviours by females in the current research contradicts a Brazilian study conducted by Piauilino et al. (2010), whereby females reported having more memory failures than males on the PRMQ. This confusing pattern of gender effects may be a result of cultural differences across studies in terms of performance of memory tasks (e.g. household responsibilities), or differences in PM measures (i.e. the PRMQ, PMCQ, naturalistic, and laboratory PM tasks). Therefore, additional research is warranted in order to elucidate these gender effects.

**Prospective memory and education.** The reporting of education effects in PM studies is extremely rare. In fact, the effects of education on PM were not mentioned once in any of the three books that have been written as comprehensive overviews of PM (Brandimonte, Einstein, & McDaniel, 1996; Kliegel, McDaniel, & Einstein, 2008; McDaniel & Einstein, 2007). Only a handful of studies within the PM literature have reported analyses of education. Of these studies, large normative studies using the PRMQ did not find any relationships between prospective memory and education (Hsu & Hua, 2011; Piauilino et al., 2010). Some studies have reported an association between education and PM (Chan et al., 2010) although one of these studies was comprised of individuals with schizophrenia (Y. Wang et al., 2009) which may affect the generalisability of these findings. Other studies that found education effects (Cherry & LeCompte, 1999; Reese & Cherry, 2006) were limited in that they only assessed PM using single items from multidimensional scales including the Memory Functioning Questionnaire and Cognitive Failures Questionnaire or measured education in conjunction with verbal ability rather than as a single construct. In studies that have assessed education effects, education has been reported to have greater effects on RM than PM (Hsu & Hua, 2011; Reese & Cherry, 2006). According to Hsu and Hua (2011) PM may be less affected by education than RM as it involves automatic processing to a large extent whereby information generally "pops into mind" rather than effortful retrieval that may be more reliant on educational attainment. Thus, as the majority of the PM literature does not
suggest that education plays a key role in self-report PM, the effects of education were not analysed nor was education included in the normative data within this study. Data collected on education levels in this study was used purely for the purpose of reporting demographic information in the description of the participants.

**The relationship between self-reported and naturalistic prospective memory.**

Another area investigated in this study was the relationship between self-report measures of PM and naturalistic PM tasks. It was predicted that there would be a small correlation between the PMCQ and naturalistic tasks. This hypothesis was not supported, as there was no relationship between the PMCQ or its subscales and the naturalistic tasks. Furthermore, the poor correlation between self-reported naturalistic PM was not isolated to the PMCQ. In this study, the PRMQ PM and RM scales also did not correlate with naturalistic PM performance. Previous studies have reported similar findings using various self-report measures of PM, whereby very small correlations with naturalistic (R. Hannon et al., 1995), laboratory (Kliegel & Jäger, 2006a), and clinical measures of PM (Man et al., 2011) have been observed.

The lack of correlations between self-report and naturalistic PM measures may lead one to question whether self-report measures of PM have value in the assessment of PM (Uttl & Kibreab, 2011). However, even if self-report measures do not correlate highly with objective PM measures, they do still provide valuable information. For example, PM self-report measures convey individuals' beliefs about their memory ability and concerns about their memory. These beliefs and concerns influence individuals' behaviour (e.g. an individual concerned about their memory may be more likely to utilise memory strategies and comply with treatment) and these beliefs/concerns can be used to target areas of concern within treatments (Hannon et al., 2005; Roche et al., 2002; Shum et al., 2002). Furthermore, self-report PM scales can provide information about an individual's experience in carrying out PM
tasks that cannot be measured using objective measures, for example, non-observable
behaviours such as remembering to tell someone a story can only be measured via
individuals’ self-reports (Shum et al., 2002). Thus, self-report PM scales such as the PMCQ
have clinical utility despite their lack of correlation with objective measures of PM.
Furthermore, these low correlations may be more indicative of other factors related to the
nature of responding to self-report PM scales.

Several explanations for the lack of correlation between self-report and naturalistic
PM measures have been put forward by Man et al. (2011). They proposed that individuals,
particularly individuals with clinical disorders, such as those with ABI, may lack awareness
of their PM ability which could in turn affect the validity of self-report measures. However,
awareness issues were not apparent in the current research as the patterns of findings for the
clinical groups and the non-referred group were similar for the PMCQ and naturalistic PM
tasks. In addition, the ageing effects detected on the PMCQ total scale and naturalistic PM
tasks were comparable in magnitude and direction.

An alternate explanation presented by Man et al. (2011) is that self-report measures
assess PM behaviours that occur over longer periods of time (e.g. remembering appointments
scheduled for days or weeks later). Conversely, laboratory and naturalistic measures of PM
are constrained by the length of an assessment period, and therefore measure shorter-term
intentional tasks (e.g. reporting the time 15 minutes later). This explanation appears valid in
relation to the PMCQ. Items in this questionnaire measured PM behaviours that could be
generalised to several situations or occasions (e.g. passing on a message to two different
people on different occasions). In contrast, the naturalistic tasks used in this research were
one-off and more difficult to generalise (e.g. remembering to change pen colours is not a
common task). Moreover, when completing the PMCQ individuals are likely to recall
examples of having completed the PM behaviours measured in the scale in the context of
their everyday lives. The event-based and time-based naturalistic tasks, whilst attempting to simulate these everyday behaviours, were carried out in an artificial research context. Therefore, it may be that these differences in context are reflected in the lack of correlation between self-report and naturalistic PM tasks.

A similar but slightly different viewpoint suggested by Uttl and Kibreab (2011) is that self-report measures of PM encompass several additional factors other than PM. For example, they found personality, daily activities, and use of strategies predicted 34% of variability in PMQ scores. Chapter 1 included a discussion of many dimensions known to influence PM that may account for scale variance, and it is likely that there are other dimensions yet to be discovered. As the influence of such dimensions is still not fully understood, further investigation of variables that account for PM scale variance is required. Hence, in this research the role of personality and social desirability factors in both self-report and naturalistic measures of PM were explored.

**Personality and prospective memory.** In this study, the relationships between the five factors of personality, self-reported PM (as measured by the PMCQ), and naturalistic PM were investigated. Regarding the factor of neuroticism, as hypothesised, small to medium positive correlations were found whereby individuals with high neuroticism scores reported a greater amount of memory concerns on the PMCQ and its three subscales. This relationship was isolated to self-reported PM, as neuroticism was not related to naturalistic PM performance. These findings were consistent with previous studies that found individuals high in neuroticism reported more PM failures (Gondo et al., 2010; Steinberg et al., 2013; Uttl & Kibreab, 2011), but not those that found relationships between neuroticism and naturalistic, or laboratory PM tasks (Cuttler & Graf, 2007; Uttl & Kibreab). Together, these findings suggest that neuroticism results in greater memory concerns, which in turn facilitates increased attention paid to performance of PM tasks (in the laboratory at least). Cutler and
Graf concluded that the effects of personality on PM may depend on the characteristics of the task, and this may explain the null relationship between naturalistic PM and neuroticism. For example, the PMCQ includes items that pertain to worries or concerns about PM failure (e.g. “I worry that my memory is getting worse”), whereas the naturalistic PM tasks did not encompass these concern components. Perhaps a PM task that included an aspect of urgency (e.g. a speed related task) may have a stronger relationship with neuroticism.

Based on the findings of the same personality studies (Cuttler & Graf, 2007; Gondo et al., 2010; Uttl & Kibreab, 2011), it was predicted that conscientious individuals would have less memory concerns on the PMCQ and would perform better on the naturalistic PM task. As expected, moderate correlations between conscientiousness, the PMCQ, and its subscales were observed. Whilst conscientious individuals reported having less PM concerns, they did not perform better on the naturalistic PM task, unlike the findings of the previous studies. Conscientiousness did positively correlate with social desirability ($r = .37, p < .001$), which could suggest that these individuals were responding to the PMCQ in a way to please the researcher. However, the findings of the previous studies, whereby conscientiousness individuals also had better PM on naturalistic measures, do not support this idea. Instead, it appears more likely that the lack of relationship between conscientiousness and the naturalistic task can be attributed to the characteristics of the naturalistic tasks used in this research (Cuttler & Graf). Adding further support to this interpretation is the lack of correlation between the self-report and naturalistic PM tasks in the current research. This would suggest that the tasks differ in how they measure PM, and therefore how conscientiousness is exhibited on these measures.

As the few existing studies on PM and personality have not found a relationship between PM and the other three personality factors, it was not expected that openness to experience, extraversion, or agreeableness would be related to PMCQ scores or performance
on the naturalistic tasks. Consistent with this prediction and the findings of Salthouse et al. (2004), openness to experience was not related to self-reported or naturalistic PM. In addition, extraversion was not related to naturalistic PM. However, small negative correlations between extraversion and the PMCQ total scale, Forgetting Behaviours, and Memory Concerns subscales were obtained. These findings are similar to those of Heffernan and Ling (2001) who reported that extroverts reported less memory failures than introverts. They argued that extroverts are engaged in more social activities and have enhanced PM planning skills, which results in better PM performance. This explanation does not appear valid in light of the current results, as extroverts did not differ from introverts on their reported use of retrieval cues or performance on the naturalistic PM task. However, items on the Forgetting Behaviours and Memory Concerns scales did have some social elements (e.g. remembering appointments or relaying messages), which extroverted individuals may have capitalised on.

As predicted, agreeableness was not related to naturalistic PM. Small negative correlations between agreeableness and the PMCQ total scale, and the Forgetting Behaviours subscale were found, although agreeableness did not correlate with the other subscales. Hence, individuals high in agreeableness did not report more concerns about memory, use of retrieval cues, and did not have superior performance on the naturalistic PM task. The paradoxical findings of self-reported and naturalistic PM in regards to agreeableness may be attributed to the nature of the tasks. The longer-term self-report measure may reflect the general agreeable disposition of these individuals better than the naturalistic tasks that were short-term and had only a small social component. Alternately, these effects could be an indication of these individuals’ attempts to be agreeable by reporting less PM concerns. Agreeableness did correlate positively with social desirability ($r = .41$, $p < .001$), however
agreeableness was not related to the PMCQ Memory Concerns or Retrieval Cues scales, as would be expected if individuals were responding in such a way.

To determine whether the PMCQ measured PM concerns as a unique construct and was not just an artefact of personality traits, ANCOVAs were conducted using the five personality factors as covariates. After controlling for neuroticism, extraversion, agreeableness, conscientiousness, and openness to experience, differences on the total PMCQ scale between the non-referred, brain injury, and dementia/MCI groups remained significant. These findings indicate that the PMCQ does in fact measure memory concerns above and beyond that predicted by the five factors of personality.

**Social desirability and prospective memory.** A final area of investigation in this study was the relationship between social desirability and PM. It was predicted that there would be a positive correlation between scores on the PMCQ and the SDS-17 (a measure of socially desirable responding). Consistent with this hypothesis, individuals who had high social desirability scores reported having less memory concerns on the PMCQ and its three subscales, although the correlations were weak. Because social desirability was related to the PMCQ scores, an ANCOVA was conducted to assess whether the PMCQ total scale could predict differences between the non-referred, brain injury, and dementia/MCI groups above and beyond the effects of social desirability scores. As hypothesised, differences between the non-referred group and clinical groups remained significant after controlling for SDS-17 scores, which indicates that the PMCQ is able to predict PM concerns above and beyond the variance accounted for by social desirability.

Statistical methods of detecting or eliminating variance accounted for by social desirability scores have been criticised. Those opposed to these procedures argue that statistically controlling for social desirability does not improve the validity of the scale of interest (Ellingson, Sackett, & Hough, 1999; Kurtz, Tarquini, & Iobst, 2008; McCrae &
Costa, 1983; Paunonen & LeBel, 2012). However, the purpose of carrying out the analysis of covariance was not to provide any score adjustments on the PMCQ to improve validity, but instead explore the relationship between social desirability as a trait measure and the PMCQ.

Another criticism of using social desirability scales is that they are not actually a measure of a response style (i.e. impression management or self-deception), but instead measure another undefined personality construct (McCrae & Costa, 1983). Uziel (2010) named this construct “interpersonally oriented self-control” and proposed that high social desirability scores represent individuals’ ability to maintain self-control in social contexts. When reviewing the social desirability literature, Uziel noted that these individuals display high levels of agreeableness, conscientiousness, and social adjustment. Support for this proposed construct was provided in the current research, as social desirability was correlated with both agreeableness and conscientiousness. Stöber (2001) reported similar findings, and recommended further analysis of the relationship between these three constructs.

Opponents of the practice of controlling for social desirability state that if social desirability scales do measure a personality construct rather than a response style, then controlling methods may remove meaningful shared variance from the trait of interest and produce flawed conclusions (Dijkstra, Smit, & Comijs, 2001; Kurtz et al., 2008; Nederhof, 1985). In the context of the current research, high SDS-17 scores may not necessarily reflect a deceptive response style, but instead these individuals may generally be better adjusted, more agreeable, conscientious, and less concerned about their memory. The findings of Fastame and Penna (2012) are in line with this theory as they found social desirability scores to predict a variety of subjective wellbeing measures, including scores on the Cognitive Failures Questionnaire (which assesses some memory components).

In this study, a small to moderate correlation between the SDS-17 and age was found, with older adults demonstrating higher levels of social desirability. In addition, group
comparisons revealed that social desirability increased with age. Although there were no differences between young and middle-aged adults, older adults had higher social desirability scores than the younger two groups. Similar age effects have been observed in several other studies (Dijkstra et al., 2001; Fastame & Penna, 2012; Stöber, 2001). Despite the lack of age differences observed in the personality variables in the current research, Soubolet and Salthouse (2011) found older age to be associated with agreeableness and conscientiousness as well as several other life satisfaction measures. Furthermore, they reported that social desirability was an important factor in accounting for age differences on these personality factors. Future research untangling the relationships between social desirability, personality, and age would therefore certainly be advisable.

Finally, looking at group differences on social desirability, the brain injury group had significantly higher SDS-17 scores than non-referred adults, but there were no differences between the brain injury and dementia/MCI groups, or between dementia/MCI group and non-referred adults. As no previous studies have investigated differences in social desirability within these clinical populations, it is difficult to ascertain why these brain injured individuals had higher social desirability scores. One possible explanation relates to cognitive and behavioural changes sometimes observed after sustaining a brain injury. Following ABI, individuals may begin to exhibit socially inappropriate behaviours and demonstrate a lack of insight or self-awareness (Ponsford et al., 2013). Hence, these individuals may not be aware of some of their less desirable actions and respond to the social desirability scale accordingly. If this theory is correct, it would be expected that participants with dementia/MCI that are also often affected by lack of insight (Vogel et al., 2004) would also have high scores on the SDS-17 compared to non-referred adults, however this was not the case. An alternate explanation is that individuals with ABI might be aware that some of their behaviours are not socially desirable and in an effort to downplay these behaviours, they fake good in order to
make a good impression. This explanation also seems unlikely as the brain-injured participants in this study were observed to be making an effort to provide honest responses within their questionnaires.

Perhaps the most plausible explanation for these findings is that the brain-injured participants interpreted the wording of the SDS-17 items differently to the other groups. Borkenau and Ostendorf (1992) suggested that some individuals may disregard the exact wording of items (i.e. “I always...”) in order to convey a more accurate representation of their general disposition (i.e. “I usually...”). Similarly, Dijkstra et al. (2001) proposed that responses on social desirability scales might depend on an individual’s memory ability. If the individual cannot retrieve instances of socially undesirable behaviours, they will respond in a socially desirable manner. As the brain injury group in this study demonstrated low levels of memory ability, it is highly possible that their higher SDS-17 scores were an artefact of their poor memory. Therefore, it may be worthwhile investigating social desirability in individuals with ABI further to determine whether memory impairments affect their PM self-reports.

In conclusion, Study 3 resulted in a number of important findings. First, it was established that the PMCQ developed in this research was a reliable and valid measure. Second, normative data for the PMCQ was obtained for healthy adults, and reference data for individuals with brain injury, MCI, and dementia was also presented. Third, this study revealed that there are a number of variables that play a role in the self-reported measurement of PM. The investigation of these issues demonstrated that the PMCQ could detect PM values in individuals with ABI, MCI, and dementia, and also age differences in PM. Furthermore, personality and social desirability were both found to be related to self-reported PM. Finally, it was found that the PMCQ was unrelated to performance on the naturalistic PM tasks. There are a number of implications for the measurement of PM in relation to these findings. Chapter 7 will provide a discussion of these implications.
CHAPTER 7

General Discussion

This chapter provides a summary of the results obtained in this thesis and a discussion of these results in relation to the thesis aims. Furthermore, the implications of the findings relating to the development of the PMCQ, and the investigation of variables related to the measurement of PM using self-report measures will be outlined. This will be followed by an evaluation of the limitations of this research and suggestions for future research. Finally, this chapter will present conclusions that can be drawn from this research.

Development of the PMCQ

The primary thesis aim was to develop a brief, self-report scale that measures individuals’ perceptions of and concerns about their PM ability. As a part of this aim, an investigation of the scale’s psychometric properties was carried out and normative data for healthy adults across the lifespan was obtained. The Prospective Memory Concerns Questionnaire (PMCQ) as developed in this research contains 42 items, which load onto three subscales. The first subscale, Forgetting Behaviours consists of 16 items assessing the frequency of forgetting on a variety of PM tasks such as event-based, time-based, and habitual tasks. The 14 items of the second subscale, Memory Concerns, measure common concerns that individuals have about their memory as well as aspects of meta-memory such as knowing when memory aids are needed. The third subscale, Retrieval Cues, includes 12 items that evaluate the extent to which individuals recognise and respond to retrieval cues or use retrieval strategies.

Internal consistency reliability of the PMCQ, as demonstrated in Study 3, showed that the total PMCQ scale had excellent reliability and that all three subscales had acceptable reliability. Content validity was established in Study 1 within the expert review of items. In this study, the expert group rated items on their relevance to the assessment of PM (i.e. their
content validity) and the least relevant items were eliminated from the scale. In Study 3, high correlations with the PRMQ PM scale provided evidence of convergent validity, whilst lower correlations with the PRMQ RM scale demonstrated the divergent validity of the PMCQ. The construct validity of the PMCQ was also established in Study 3, whereby a CFA supported the three component latent structure obtained in the PCA in Study 2. The predictive validity of the PMCQ total scale, Forgetting Behaviours, and Memory Concerns subscales was demonstrated in Study 3. However, the predictive validity of the Retrieval Cues was not established. Overall, the PMCQ total scale was found to have better reliability and validity than the subscales. As the total scale was a more effective measure of PM failures and concerns, this total scale is the preferred scale for use in the assessment PM in research, and potentially clinical settings. The PMCQ subscales and their items can instead be used to provide further insight into individuals’ PM concerns and failures. Furthermore, the subscales and individual scale items may be used to identify particular problem areas that can be targeted in treatment planning.

The PMCQ was developed using a theoretical approach as suggested by McDaniel and Einstein (2007) and Shum et al. (2002). This theoretical approach was employed in the scale construction process, the writing of items, and in the use of test theories during scale development. More specifically, the development of the PMCQ included six scale construction steps: item development, expert review of items, item trials or pretesting the scale, item analysis, scale validation, and scale standardisation (American Educational Research Association et al., 1999; Crocker & Algina, 2006; DeVellis, 2003; Downing & Haladyna, 2006). Furthermore, during Study 1 scale items were written to reflect PM theories, tasks, dimensions, and experimental findings within the PM literature.

The PMCQ was developed using a unique approach that involved combining techniques derived from CTT and IRT. As this approach was new to the development of PM
self-report measures, the second thesis aim was to investigate whether the scale development
techniques employed in this research would result in a scale that was similar in content and
structure to existing self-report PM measures that used different scale development
procedures. In Study 3, the PMCQ was compared to the PRMQ (the most frequently cited
self-report PM scale). Here, it was found that the PMCQ was a unique measure of PM
failures and concerns, as it differed from the PRMQ both in item content and scale structure.
Furthermore, convergent validity between the PMCQ and PRMQ was found, which indicates
that the PMCQ does measure the same PM construct as at least one of the existing self-report
PM scales. The unique scale structure of the PMCQ is advantageous as the scale not only
assesses the frequency of forgetting, but also memory concerns and the use of retrieval cues.
Moreover, it focuses specifically on PM behaviours.

Whilst not directly assessed in the current research, a post-hoc qualitative comparison
of the PMCQ with two other existing self-report PM measures, the PMQ (Appendix X; R.
Hannon et al., 1995) and CAPM (Appendix Y; Roche et al., 2002) indicates that there is
some similarity in item content across the three questionnaires. For example, behaviours such
as forgetting appointments, birthdays or anniversaries, forgetting to pass on messages, and
using memory aids such as a diary or a list are all common themes within these
questionnaires. Even though there are some similarities, each questionnaire does differ in
terms of scale structure. The PMQ items are separated into subscales on the basis of task
frequency (e.g. long-term episodic and short-term habitual tasks) as well as PM strategies.
The CAPM on the other hand has subscales relating to frequency of forgetting (Section A),
perceived amount of concern (Section B), and reasons for success or failure on PM tasks
(Section C). The first two CAPM subscales bear some similarity to the PMCQ, although scale
items do differ considerably across the questionnaires. Furthermore, Section A and B of the
CAPM use two different rating scales measuring different domains for the same subset of
items, whereas the PMCQ Forgetting Behaviours and Memory Concerns scales use the same rating scale but contain separate subsets of items to assess the different domains. Finally, Section C of the CAPM assesses reasons why individuals succeed or fail on PM tasks. Although there is some similarity in item content with the PMCQ Retrieval Cues subscale, the PMCQ scale is focused more specifically on retrieval factors rather than a variety of PM processes. The PMCQ is advantageous in that normative data is available across the adult lifespan (aged 18–89 years). Furthermore, data for brain injured, MCI, and dementia reference groups are provided, which assists in the understanding PM performance in these clinical groups.

**Investigation of Variables Related to the Self-Reported Measurement of Prospective Memory**

The final thesis aim was to investigate the relationship between PM and a number of variables assumed to be involved in the measurement of PM using self-report measures such as the PMCQ developed in this research. This included an investigation of: self-reported PM and naturalistic PM performance in individuals diagnosed with cognitive impairments, namely ABI, MCI, and dementia; the effects of normal ageing on self-reported PM and naturalistic PM performance; the relationship between self-reported PM and naturalistic PM performance; the relationship between personality, self-reported PM, and naturalistic PM performance; and the relationship between social desirability, self-reported PM, and naturalistic PM performance. The following sections discuss the Study 3 findings in relation to these investigations and the implications of these findings.

**Prospective Memory in Brain Injury, Mild Cognitive Impairment, and Dementia**

The first area to be investigated in relation to the self-reported measurement of PM was self-reported and naturalistic PM in individuals with ABI, MCI, or dementia. In Study 3, performance on the naturalistic tasks was poorer for individuals in the referred group (that
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consisted of individuals with ABI, MCI and dementia) compared to individuals in the non-referred group (consisting of assumedly healthy adults). This is consistent with previous studies that have reported naturalistic PM impairments in individuals with ABI (e.g. Brooks et al., 2004; R. Hannon et al., 1995; Mathias & Mansfield, 2005), and in individuals with MCI, and dementia (e.g. Thompson et al., 2011; E. van den Berg et al., 2012). It should be noted that when the brain injury and dementia/MCI groups were analysed separately, the brain injury group performed poorer than, but did not significantly differ from the non-referred group. The dementia/MCI group also performed more poorly than both the brain injury and non-referred groups, but only differed significantly from the non-referred group.

When the PMCQ was used to assess self-reported PM in these individuals it was found that those in the brain injury group reported having more PM failures on the PMCQ total scale. In addition, they reported more PM failures and concerns on the Forgetting Behaviours and Memory Concerns scales than non-referred adults. Similarly, individuals with MCI and dementia reported more PM failures and concerns on the PMCQ total scale and on the Forgetting Behaviours and Memory Concerns scales. However, on the Retrieval Cues scale, the non-referred group did not differ from either of the clinical groups. Together, these findings from the PMCQ suggest that although individuals with ABI, MCI, and dementia reported experiencing more forgetting behaviours and memory concerns than healthy adults, they did not differ from healthy adults in their use of retrieval cues.

Differences between the clinical groups (i.e. those with ABI and those with MCI or dementia) were explored in Study 3 of this thesis, as this was the first known study to include individuals from both of these populations. On the naturalistic PM tasks and the PMCQ total scale and subscales, the brain injury group did not differ significantly from the dementia/MCI group. However, the dementia/MCI group did have slightly higher mean scores on each of the PMCQ scales and on the naturalistic task than the brain injury group (indicating poorer
performance). It is possible that due to the small sample sizes of the clinical groups that there was not enough power to detect meaningful differences between these groups. However, the effect sizes obtained were generally large, which suggests that these findings would be obtained with a larger sample. It is also possible that these groups did in fact have similar levels of PM impairments. Supporting this assertion, it was shown in Study 3 that the brain injury group and the dementia/MCI group did not differ in the amount of general cognitive impairments obtained on the ACE-R. Thus, in this study it appears that individuals with ABI had similar levels of PM and general cognitive impairments to individuals with MCI and dementia. However, it is yet to be seen how varying levels of severity in cognitive impairments might affect this relationship. It would therefore be informative in future studies to investigate whether individuals with MCI differed from individuals with dementia, and to compare individuals with mild, moderate, or severe ABI to individuals with varying degrees of MCI and dementia. Nevertheless, these findings have potential implications for the treatment of PM impairments. If individuals with ABI and MCI dementia do have similar PM failures and concerns, treatments that have been developed for PM failures in ABI may be able to be generalised or adapted to treat PM failures in individuals with MCI or dementia and vice versa.

The findings of Study 3 contradict the majority of existing studies that did not find individuals with ABI to differ from healthy adults on self-report PM measures such as the CAPM (Radford et al., 2011; Roche et al., 2007). Conversely, the findings of impairments in the dementia/MCI group are more similar to previous studies, whereby self-report measures were able to somewhat separate individuals with MCI from healthy controls (Tam & Schmitter-Edgecombe, 2013), and individuals with dementia from controls (Eschen et al., 2009). These findings suggest that the PMCQ may be more sensitive in detecting PM impairments in individuals with ABI, MCI, and dementia than some of the existing PM self-
report measures. The discriminant analysis in Study 3 provided some support for the sensitivity of the PMCQ, as the scale was able to correctly classify 75% of clinical cases. However, direct comparisons between the PMCQ and existing scales would need to be carried out in order to investigate such differences in sensitivity.

The lack of clear findings of PM impairments in the aforementioned self-report studies has been attributed to individuals in these clinical groups having a lack of awareness into their impairments. However, a lack of awareness in clinical individuals did not appear to be the case in this research, as impairments were detected when these individuals were compared to healthy adults. Furthermore, although there was a lack of correlation between the PMCQ and naturalistic PM, group differences on the two measures were similar in nature. Participants in the clinically-referred groups reported more forgetting behaviours and memory concerns on the PMCQ and also performed worse on the naturalistic tasks compared to non-referred adults. However, the lack of group differences on the Retrieval Cues scale could indicate that clinical individuals have impaired awareness of their failures to recognise and use retrieval cues, but it is unlikely that poor awareness would be specific to one PMCQ scale. Although awareness does not appear to be an issue in the current research, it remains an important consideration when measuring PM using self-report scales, including the PMCQ. As suggested by Man et al. (2011), it may be beneficial for future users of the PMCQ (and other self-report PM scales) to also administer a scale measuring an individual’s level of awareness if they are concerned about the accuracy of self-reported PM. Alternatively, another method that may be used to assess awareness and the accuracy of an individual’s self-reported PM is to have an informant (e.g. significant other) report on the individual’s PM ability. Despite having its own drawbacks (e.g. bias due to carer burden and the reliance on observable behaviours), the use of informant reports in previous studies has been found to be valuable in detecting issues of awareness in individuals with ABI (Roche et al., 2002; Roche
et al., 2007). Consequently, it may be worthwhile in the future to develop an informant version of the PMCQ for this purpose.

**Age Differences in Self-Reported and Naturalistic Prospective Memory**

An aim of the thesis and Study 3 was to investigate the effects of normal ageing in relation to self-reported and naturalistic PM. Hence, in Study 3 age differences on the PMCQ and naturalistic tasks were tested. The findings of Study 3 whereby older adults performed better than younger adults on the combined naturalistic tasks is consistent with the literature relating to the age-PM paradox that shows that older adults can perform as well as or better than younger adults on naturalistic PM tasks (Henry et al., 2004).

The findings relating to self-reported PM on ageing as measured by the PMCQ were more mixed. Differences between young adults (aged below 65) and older adults (aged over 65) were not detected on the Forgetting Behaviours or Memory Concerns PMCQ subscales, which would suggest that ageing had little effect on the reporting of PM failures or concerns. Although, a small correlation between age and the Forgetting Behaviours scale indicated that younger adults do report slightly more forgetting behaviours that older adults. This finding was similar to the findings on the PMCQ total scale, whereby younger adults (aged below 65) reported having more memory concerns failures than older adults (aged over 65).

When the younger group was broken down further to assess differences between young adults aged 18–39, middle-aged adults aged 40–64, and older adults aged over 65 years, younger adults reported more PM concerns on the PMCQ total scale than both middle-aged and older adults. However, middle-aged adults did not differ from the older adults in the amount of PM concerns on the PMCQ. This contradicts the naturalistic PM findings where significant age differences were detected between the older age group and both of the young and middle-aged groups, but not between the young and middle-aged groups. Together, these findings indicate that concerns about PM failure may decrease at around the age of 40, at the
start and middle-age. However, performance on naturalistic PM tasks may not begin to improve until the later stages of middle age, at around the age of 65, which is incidentally retirement age for many individuals (Australian Government Department of Human Services, 2014). Indeed, 39 (80%) of the 49 individuals in the older age group in Study 3 were retired as opposed to 14 (18%) of the 79 individuals in the middle-aged group. Thus, it is possible that the reduction of workload and more structured lifestyle associated with retirement may free up cognitive resources and reduce distractions, benefiting PM (Philips et al., 2008). This theory is supported by studies that have found a relationship between reduced busyness, environmental demands, and self-reported PM (Martin & Park, 2003; Uttl & Kibreab, 2011). Although Cuttler and Graf (2007) did not find a relationship between environmental demands and performance on PM tasks, Uttl and Kibreab (2011) found that busyness was related to the use of retrieval strategies in PM tasks which may in turn improve PM performance. It would therefore be informative to investigate this potential relationship between retirement, busyness, strategy use, and PM.

On the PMCQ Retrieval Cues scale, it was found that younger adults reported more concerns than both middle-aged and older adults, although the two older groups did not differ from one another. Combined with the findings of no age effects on the other PMCQ subscales, it appears that age may not affect the amount of PM concerns or failures reported, but may be related to the frequency in which retrieval cues and strategies are utilised. It should also be considered that the ageing effects detected in the overall PMCQ are primarily a representation of the age effects in the use of retrieval cues.

Items within the Retrieval Cues scale related to failures in using retrieval cues frequently. Therefore, it is possible that younger adults are less likely to utilise retrieval cues or strategies needed to perform PM tasks. Henry et al. (2004) argued that older adults have greater experience with memory tasks and therefore have better knowledge of their memory
ability, time management, and planning strategies which allows them to retrieve cues more efficiently. Indeed, Reese and Cherry (2006) found that older adults demonstrate a greater knowledge of memory ageing than younger adults. In addition, they found that those who had better knowledge of memory ageing used more mnemonic strategies. The higher performance of older adults on the naturalistic tasks in Study 3 could reflect the older adults’ memory experience and more frequent use of retrieval cues.

The findings of Shum et al. (2013) provide further support for this account. In their study, when planning strategies were prohibited in naturalistic settings younger adults outperformed older adults, however these age differences disappeared once planning strategies were permitted. Thus, older adults benefited from planning strategies in naturalistic settings. In Study 3, salient and distinctive retrieval cues were present in both the naturalistic time-based task (in the form of a clock placed in peripheral vision) and in the event-based task (in the form of a large print title page within the questionnaire booklet). Older adults may have made more frequent use of these cues although this could not be established empirically as clock monitoring behaviour was not quantitatively recorded.

In the 24-hour naturalistic task, the use of external aids was discouraged but could not be eliminated due to lack of experimental control. Participants were given a business card with the researcher’s contact details to make their PM response the following day. Many participants used this card as a retrieval cue as they wrote on the card during the assessment, or reported when calling the next day that they had used the card as a reminder (e.g. by placing it on their fridge). During data collection, several participants spoke about memory aids they used in everyday life. Older and middle-aged adults typically reported that they used a diary, and some older individuals said that checking their diary at the beginning of each day was a part of their daily routine. Younger adults on the other hand reported being more reliant on electronic devices such as smart phone “reminder” tools with a few
participants even requesting to place a reminder for the 24-hour task in their phones during the assessment. Consistent with these observations, Masumoto, Nishimura, Tabuchi, and Fujita (2011) found that older adults used diaries and calendars more frequently than electronic devices to remind them in naturalistic PM tasks.

The use of mobile phones as memory aids has received very little attention and has only been examined in case studies of individuals with ABI (Stapleton, Adams, & Atterton, 2007; Svoboda, Richards, Leach, & Mertens, 2012; Wade & Troy, 2001). According to McDonald et al. (2011) mobile phones can be considered an “active reminder” whereas diaries are an example of a “passive reminder”. As an active reminder, mobile phone reminder tools alert the user that there is a task that needs to be completed at the appropriate time. This reduces the need for the individual to strategically monitor the environment for retrieval cues regularly. Conversely, passive reminders such as diaries still engage attention monitoring processes, as the individual must remember to check the diary and scan the environment for retrieval cues. Hence, in the current research, age differences in performance on the naturalistic PM task and the self-reported usage of retrieval cues could possibly be attributed to generational differences in the use of active and passive reminder strategies.

With the ever-increasing use of smart phone technology, an investigation of the use of reminder strategies and its relationship to PM, particularly PM retrieval, would be valuable.

An alternate explanation for age differences observed in naturalistic PM tasks, as reported in Chapter 2, is that older adults generally perceive the task to be more important than younger adults. This assertion is supported by several studies that found improved PM performance with manipulations of task importance (Altgassen et al., 2010; Ihle et al., 2012; Kvavilashvili & Fisher, 2007). As age differences were not detected on the Forgetting Behaviours or Memory Concerns scales of the PMCQ, it seems unlikely that task importance can account for the age differences on the naturalistic PM task in this research. Whilst task
importance may not necessarily affect PM performance, some studies reported that it was related to the use of internal and external strategies used (Penningroth & Scott, 2013), activation of intentions in memory (Jeong & Cranney, 2009), and the allocation of strategic monitoring resources (Kliegel et al., 2001; Kliegel, Martin, et al., 2004). The age differences found on the Retrieval Cues scale in this study lends support to this notion as task importance may not have necessarily affected PM performance per se, but instead may have affected the retrieval strategies used by participants.

Self-Reported and Naturalistic Prospective Memory

Another area investigated in this thesis was the relationship between self-report PM measures and naturalistic PM tasks, as previous studies have reported only very small correlations between self-report measures, naturalistic (R. Hannon et al., 1995), laboratory (Kliegel & Jäger, 2006a), and clinical measures of PM (Man et al., 2011). In Study 3, the PMCQ and its subscales were not related to performance on the naturalistic tasks. However, this effect was not isolated to the PMCQ as the PRMQ PM and RM scales also did not correlate with the naturalistic tasks. In the Discussion section of Chapter 6, several explanations for this lack of correlation between self-report and naturalistic PM were explored. These included that the validity of self-report measures may be affected by individuals’ lack of awareness, particularly in clinical samples (Man et al., 2011). However, this did not seem to be the case in the current research, as although the self-report and naturalistic measures did not correlate, the self-report data reflected the patterns of PM impairments observed on the naturalistic measures in relation to the clinical groups and the effects of ageing.

A second explanation put forward by Man et al. (2011) was that self-report scales measure different aspects of PM to naturalistic measures. This claim was supported in the current research as the PMCQ measured PM behaviours that are typically encountered in
individuals’ everyday lives. These tasks tend to be longer term (e.g. remembering appointments scheduled days or weeks in the future) and can be generalised across several occasions. Although the naturalistic PM tasks used in this study were designed to simulate everyday PM behaviours, they were shorter in duration (i.e. a 15 minute time-based task and a 24-hour task), were relatively specific and one-off behaviours (e.g. remembering to change pens is not a frequently performed task in everyday life), and they were carried out in an artificial research context. Therefore, it may be that these differences in task duration, specificity, and context can explain the lack of correlation between the two task types.

This argument has several implications for the PMCQ and the measurement of PM concerns using self-report measures. The lack of correlation between self-report and naturalistic measures does not seem to indicate that self-report measures are inaccurate or poor measures of PM. Instead, self-report PM measures such as the PMCQ appear to measure different aspects of PM to other assessment methods (i.e. naturalistic PM tasks). In fact, they may be a better reflection of everyday PM behaviours as items measure longer-term, generalised multiple-occasion tasks that are typically encountered in daily activities. Even if the PMCQ (and other self-report PM scales) are good measures of everyday PM problems, it has been recommended that self-report measures of SCD be used in conjunction with other cognitive measures to provide a more comprehensive assessment of impairments (Steinberg et al., 2013). This recommendation is supported by Jessen et al., (2014), who found that a combination of subjective and objective measures improved the identification of cognitive decline. Thus, it is recommended that the PMCQ be utilised as a measure of subjective PM concerns, but more importantly, it should be used with other cognitive and psychological measures to provide a more thorough assessment of cognitive decline.

A final explanation explored in relation to the lack of correlation between self-report and naturalistic PM measures was that PM self-report scales measure more than just PM
failures and concerns (Uttl & Kibreab, 2011). In Chapters 1 and 2, a number of dimensions that have been found to affect PM (e.g. task importance, external aids, and ongoing task demands), cognitive processes associated with PM (i.e. executive functioning and RM) and psychological domains (i.e. personality) were highlighted. These are certainly only a few of the variables that would contribute to PM self-reports. Hence, further research investigating variables that account for PM scale variance is required in order to fully understand what self-report PM scales measure.

**Personality and Prospective Memory**

The role of personality in naturalistic PM and self-reported PM is relatively unknown. Therefore an exploratory investigation assessing the relationship between self-reported and naturalistic PM and the five factors of personality—as specified in the five-factor model of personality (P. T. Costa, Jr & McCrae, 1992)—was carried out in Study 3. In this study none of the five personality factors were found to be related to naturalistic PM performance, despite previous studies reporting correlations between naturalistic PM and the personality factors of neuroticism and conscientiousness (Cuttler & Graf, 2007; Uttl & Kibreab, 2011). In contrast, significant correlations between the PMCQ, its subscales, and personality were obtained. As expected, both neuroticism and conscientiousness were related to the PMCQ total scale and all three subscales. Unexpectedly, extraversion correlated with the PMCQ total scale and the Forgetting Behaviours and Memory Concerns subscales, and agreeableness correlated slightly with the PMCQ total scale and Forgetting Behaviours subscale. In Chapter 6, it was suggested that neuroticism may be related to concerns about PM failures, whilst the findings of less memory concerns in individuals high in conscientiousness, extraversion, and agreeableness could be associated with the social nature of PM tasks assessed in the PMCQ. In terms of the lack of correlation between naturalistic PM and the five personality factors, Cuttler and Graf (2007) have suggested that task characteristics (e.g. the extent to which a
task is social) may determine whether a relationship is obtained. It would therefore be of value to assess task characteristics that mediate the relationship between personality and PM performance.

As the personality factors of neuroticism, conscientiousness, extraversion, and agreeableness were found to be related to PMCQ scores, it was important to assess whether the PMCQ measured PM concerns and was not merely an artefact of these personality traits. Hence, in Study 3 these personality factors were used as covariates to determine whether the differences obtained on the total PMCQ scale between the non-referred, brain injury, and dementia/MCI groups were the result of personality factors. After controlling for these personality factors, the differences between the groups remained significant indicating that the PMCQ does in fact measure PM concerns above and beyond that predicted by these personality factors. This has implications for the PMCQ and self-report PM measures in that personality does appear to play a role in individuals’ scale responses. However, the PMCQ is able to detect differences between non-referred, brain injury, and dementia/MCI groups beyond that predicted by these personality variables. Nevertheless, it would be worthwhile to investigate the relationship between personality factors and self-reported PM further to determine the nature of these relationships.

Social Desirability and Prospective Memory

The final area to be investigated in relation to the self-reported measurement of PM was the relationship between social desirability and scores on the PMCQ and naturalistic PM tasks. Social desirability was not related to performance on the naturalistic PM tasks, however there was a weak relationship between social desirability scores and the PMCQ. Hence, it appears that social desirability bias is restricted to self-report measures of PM. This is intuitive as it would be difficult for individuals to present themselves more favourably on a naturalistic task and perform above their actual ability level. It would be more likely that
malingering would occur whereby individuals would intentionally fake PM failures in order to appear as having greater PM impairments than they actually possess. Conversely, self-report measures involve individuals subjectively reporting their PM failures and these reports may be affected by social desirability as individuals underreport their PM failures as to distance themselves from the negative connotations of memory decline. Despite there being a relationship between the PMCQ and social desirability, when social desirability was controlled for, group differences between non-referred, brain injury, and dementia/MCI samples remained on the PMCQ. This finding implies that although social desirability may play a small role in the self-reporting of PM failures, the PMCQ scale did measure PM above and beyond these effects.

In Chapter 6, it was noted that social desirability may not actually measure a bias in responding, but instead it may reflect a new, undefined personality construct (Uziel, 2010). If this is the case then controlling for social desirability may eliminate valuable trait variance and lead to incorrect conclusions (Dijkstra et al., 2001; Kurtz et al., 2008). Despite the potential for the overlap of constructs in the PMCQ and SDS-17 in the current research, the fact that social desirability did not correlate with performance on the naturalistic PM task suggests that an evaluation of the relationship between the two scales was worthwhile. Similarly, Dawes, Palmer, Allison, Ganiats, and Jeste (2011) found that social desirability accounted for a large amount of variance above socio-demographic variables on a variety of wellbeing and cognitive measures (including the Cognitive Failures Questionnaire). They recommended that when measuring constructs such as these, social desirability should be taken into consideration. In addition, justification for the use of the covariance procedures in this study can be seen in a variety of scale development manuals such as the Standards for Psychological and Educational Tests (American Educational Research Association et al., 1999), where it is advised that the effects of social desirability be investigated. This is
particularly important when groups known to have high levels of social desirability (e.g. older adults) are recruited (Stöber, 2001).

The relationship between social desirability and ageing was also investigated in this research. In Study 3, older adults were found to respond in a more socially desirable way than younger adults on the SDS-17. Hence, it appears that age may play a role in individuals’ tendency to respond in a socially desirable manner, and this should be taken into consideration when using self-report measures such as the PMCQ. Importantly for the current research, when social desirability was controlled for, the PMCQ was still able to distinguish between the groups.

A final note should be made in regards to the use of the SDS-17 in the current research. It was assumed that if individuals scored highly on the trait of social desirability (as measured by the SDS-17), then they could also be responding in a socially desirable manner on other scales, particularly the PMCQ. However, there is the possibility that the SDS-17 is not sensitive to socially desirable responses in the memory domain. That is, social desirability scales may measure the tendency to present oneself in a favourable light in general behaviours (e.g. being courteous in social situations), but they may not assess memory specific social desirability. For example, when reporting memory concerns participants may wish to downplay their memory impairments in order to avoid the negative stereotypes associated with memory loss (i.e. dementia). Thus, it would be worthwhile investigating memory specific socially desirable responding in future studies.

**Limitations and Future Considerations**

As outlined in Chapter 3, scale development using CTT methods involves analysing items at a scale level whereby items are only problematic if they impact upon the overall functioning of the scale. Analyses conducted in this research using CTT indicated that the PMCQ and its subscales were performing well. The scales were found to have good
reliability as well as good content, criterion, divergent, and construct validity in internal consistency, correlational, discriminant, and factor analyses. The other test theory used in this research, the one-parameter IRT Rasch model, analyses a scale at the item level. Here, scale validity is assessed in terms of how well items fit the measurement model, and how rating scale response categories are used. Unlike the CTT analyses, the Rasch analysis revealed that there were some issues with the PMCQ. The first issue was that the Forgetting Behaviours subscale was displaying some multidimensionality. It is most likely that the multidimensionality on this scale can be attributed to differences in item wording, specifically, the reversed wording of four items, rather than content variance. It is recommended that future revisions of the PMCQ consider rewording these items in a negative direction to eliminate this variance and the need to recode items for statistical analyses.

A second issue identified by the Rasch analysis was that there was some disordered response categories on a few items. On each item, rating scale difficulty estimates should ideally increase monotonically across response categories (Bond & Fox, 2007; Linacre, 2002), however this was not the case on a few PMCQ items. For example, on some items, persons of high ability (who had less memory concerns) endorsed the Always category more frequently than persons of lower ability (who had more memory concerns). An advantage of the PCM used in this research is that disordered categories can be collapsed into adjacent categories to improve rating scale characteristics (Bond & Fox, 2007). This was not done in the PMCQ for two reasons. First, the disordering of categories was minor and the overall functioning of the rating scale across all items was good. Second and more importantly, collapsing the rating scale categories on these items would have severely impacted upon the ease of administering the PMCQ. Having some items with three item response options and
others with four would make the PMCQ difficult to complete, particularly for those with cognitive impairments such as individuals with ABI, MCI, or dementia.

Another issue identified within the Rasch analyses was that some items on the PMCQ demonstrated differential test functioning. That is, some items were located at a higher point on the dimension for non-referred adults than referred individuals and vice versa. The majority of these differentially functioning items can be attributed to cognitive impairments experienced by clinical individuals with ABI, MCI, or dementia as these individuals would have been more likely to have difficulty with multitasking, planning, and noticing retrieval cues (American Psychiatric Association, 2013; Ponsford et al., 2013). A surprising result was that Item 38 “I worry that my memory is getting worse” was more difficult for referred individuals to endorse than non-referred adults. As referred individuals reported more memory concerns on the PMCQ and performed more poorly on the naturalistic PM tasks it would be expected that these individuals would find this item easier to endorse than non-referred adults. One explanation is that the referred individuals demonstrated a lack of insight into their memory impairments and because they did not perceive memory impairments, were not worried. However, this seems unlikely as they reported more concerns overall and this was reflected in their performance on the naturalistic PM tasks. An alternate explanation is that these clinical individuals are in fact aware that their memory is poor but they are less worried about their memory decline, whereas those who perceive themselves as cognitively well are more worried about the onset of memory decline. This would at least be true for individuals with ABI whereby their memory is poor, but not deteriorating (Ponsford et al., 2013). Nevertheless, these items that demonstrated differential test functioning should be assessed further in future revisions of the PMCQ.

A limitation of the study pertaining to the sample recruited is that the sample sizes of the dementia/MCI and brain injury reference groups were small due to difficulty in recruiting
participants from these populations. The resulting small sample sizes limited the power of analyses involving these samples, although the power obtained was acceptable given the effect sizes in the current study. In order to maximise participant numbers, the inclusion and exclusion criteria for the referred and non-referred groups were not very restrictive. Participants were not screened for variables such as psychiatric illness or substance abuse and the samples were made up of individuals with several aetiologies. For example, the brain injury group consisted of individuals with both ABI resulting from cerebral accidents (e.g. strokes) and individuals with TBI. The other clinical group included individuals diagnosed with both amnestic and non-amnestic MCI and individuals diagnosed with varying types of dementia. Moreover, individuals within these clinical samples ranged considerably in terms of the severity of their cognitive impairments. These sample characteristics obviously impact upon the generalisability of the findings of this research, however these recruitment issues are not unique to the current research. Issues relating to sample size and heterogeneity have been identified in the vast majority of studies assessing PM in MCI (A. Costa, Caltagirone, et al., 2011) and ABI populations (Mathias & Mansfield, 2005). Hence, where practical, researchers investigating PM in these clinical populations should try to obtain large, homogenous samples to shed some light on the differential effects of PM within these populations. In the meantime, caution should be used when interpreting findings from these studies.

Another potential limitation of this research relates to selection bias, whereby participants may have differed in PM concerns and ability from individuals who did not participate in the research. Active selection bias may have occurred whereby individuals consciously chose to participate or not participate (Rogelberg & Stanton, 2007). According to the leverage-salience theory (Groves et al., 2006; Groves & Peytcheva, 2008), the decision to participate will depend on the influence of salient features of the survey request. For example, whether individuals are interested in the topic and whether thinking about the topic will be
rewarding for them. In this research, participants may have chosen to take part because they were concerned about their memory, or were interested in memory and hoped that participating would be beneficial to themselves or others with memory issues. Consistent with this theory, six participants stated during their assessments that they were interested in memory due to a family history of dementia. Alternatively, individuals may have chosen not to participate due to fears of embarrassment or concerns about their memory being realised. Hence, participants may have differed from non-responders in their level of memory concerns and this may have biased the results obtained in this research.

Selection bias may have also occurred in a passive “unconscious” form. Passive selection bias often includes individuals failing to respond because of misplacing the survey, forgetting to complete the survey, or time constraints (Rogelberg & Stanton, 2007). This passive selection bias has been observed in studies following-up individuals that did not respond to surveys (Gliksman, Smythe, & Engs, 1992; Sosdian & Sharp, 1980). It is possible that the current research was affected by passive selection bias, and that this bias was related to PM ability as participation was inherently a PM task in itself. In Study 2, individuals had to remember to return completed questionnaires using the reply paid envelope, whilst in Study 3 individuals had to remember to contact the researcher to take part in the study. Thus, there may have been a bias in that participants and non-responders differed in PM and their ability to respond to the PM tasks involved in participation.

Unfortunately, reasons for selection bias in this research were unable to be examined. Recruitment in Studies 2 and 3 included notices in local media, on Facebook, and flyers placed in the community, making it impossible to identify individuals that had viewed this material and who chose not to participate, and those that would have participated, but forgot. However, the issue of selection bias would not be isolated to the current research as the recruitment of individuals for the majority of PM studies involves individuals performing a
PM task (e.g. returning questionnaire or contacting the researcher). Hence, it would be worthwhile for future research to investigate selection bias in PM studies to assess whether participants differ from non-responders in PM ability and whether these differences bias findings obtained in these studies.

In the current research, three naturalistic PM tasks were used, one event-based, one-time-based, and one 24-hour task. On the event-based and time-based tasks, a score of 1 was used for early responses, 2 for on-time responses, 3 for late responses, 4 and 5 for responses following prompts, whilst a score of 6 indicated no recall. A slightly different rating scale was used for the 24-hour task with a score of 1 for early responses, 2 for on-time responses, 3 for late responses, and 4 for no recall. With these scoring formats, naturalistic PM performance could not be analysed on a continuous scale as an early response (1), which signified an incorrect PM response, would be lower than a correct response (2). Furthermore, as the time and event-based tasks included six scoring categories and the 24-hour task included four, it would have been difficult to compare the 24-hour task with the other two tasks. As this study utilised Rasch methodologies, it made sense to also analyse the naturalistic tasks using this procedure. Using the Rasch model the three naturalistic PM tasks were combined on a single dimension eliminating the four versus six category problem. In addition, the single naturalistic PM task dimension could then be used in correlational and group comparison analyses. The disadvantage of this approach was that comparisons of performance between the three naturalistic tasks could not be made, for example, were individuals more impaired on one type of naturalistic task as opposed to others? The lack of correlation between the PMCQ and the combined naturalistic PM task score could also possibly be a result of combining the three tasks. Perhaps if analysed separately, the individual naturalistic tasks may have correlated with the PMCQ. Therefore, it would be worthwhile for future researchers to assess the relationship between the PMCQ and singular
measures of time-based, event-based, and 24-hour naturalistic PM. In order to ensure the reliability of these measures, more than one task would need to be included.

It was not possible to incorporate a laboratory-based task into the research as the time needed for such a task would have made the assessments excessively long for individuals in the clinical groups. This however provides an avenue for future research whereby the relationship between the PMCQ and laboratory-based PM can be explored. This would be particularly informative considering the null relationship of the PMCQ with the naturalistic PM task found in this research. As PM is a relatively new area of research, there are still a considerable number of gaps that need to be filled (Ellis & Kvavilashvili, 2000). This research added to the PM literature in terms of age differences, the relationship between self-reported and naturalistic PM, as well as the influences of personality and social desirability on PM. Even so, many areas of investigation were beyond the scope of this thesis. For example, this research did not assess PM in other clinical populations, factors which may mediate PM age differences, or the effects of the many PM dimensions (e.g. ongoing task demands, length of retrieval interval, or cue familiarity) on self-reported and naturalistic PM. Hence, there is still much to learn about the PM construct which provides many exciting opportunities for future research in the field.

**Conclusions**

This research has provided several significant contributions to the PM literature. First, the research resulted in the development of a new self-report measure of PM, the PMCQ. The PMCQ can be used in research settings, and potentially in clinical settings as a measure of individuals’ PM concerns. These PM concerns can then be used as a starting point for the implementation of interventions and compensation strategies. It is important to remember that scores on the PMCQ (and other self-report PM scales) reflect individuals’ subjective perceptions of, and concerns about their PM ability and that these scales are not a measure of
PM ability itself. Thus, the PMCQ should be used in conjunction with other performance-based PM measures to provide a complete assessment of PM.

As normative data for the PMCQ is available for healthy adults aged 18 to 89 years the scale can be used to assess PM concerns across the adult lifespan. In addition, the reference group data for individuals with brain injury, MCI, and dementia provides information about PM in these populations. Although the primary assessment of the level of concern should be against the healthy adult normative sample, caution should be used when using this reference group data due to the small sample sizes and heterogeneity of these clinical groups. Furthermore, the sensitivity of the PMCQ was adequate for research purposes, however higher sensitivity is needed for the scale to be used in clinical assessment.

The second contribution to knowledge made in this research was related to the approach of combining CTT and IRT in the development of self-report measures. This research demonstrated that the approach of combining test theories is worthwhile and has many advantages for scale development and validation. The two test theories were found to complement one another in this research and allowed for an in-depth assessment of the PMCQ. Therefore, future researchers in the PM field and other disciplines may wish to consider this approach as an alternative to the traditional method of using a single test theory for scale development and validation.

Finally, this research provided insight into self-reported PM and variables related to the measurement of self-reported PM. Specifically, this research contributed to the PM literature relating to self-reported PM in individuals with ABI, MCI, and dementia, self-reported PM in normal ageing, the relationship between self-reported PM and performance on naturalistic PM tasks, as well as the influences of personality and social desirability on self-reported PM. Certainly, there is much more to learn about the many dimensions involved in PM and this research has provided a framework for future research in this emerging field.
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Appendix A: Study 1 Pilot Questionnaire and Instructions

Questionnaire information

Prospective memory is defined as remembering to carry out an action at a future point in time (i.e. an intention). It is an essential part of everyday life and normal functioning. Examples of prospective memory tasks include: remembering to pass a message onto a friend, remembering appointments, remembering to buy bread on the way home from work, remembering to stir dinner, hang out the washing, pick up the kids from school, remembering to get all the items on a shopping list, following directions or any other task that requires remembering to do something later on.

The following questionnaire contains a series of items that are being considered for inclusion in a self-report test of prospective memory. In completing the questionnaire, please read each item carefully and rate each item on two scales.

The first scale asks you to rate the item on its relevance (i.e. whether you believe that the item is relevant to / measures prospective memory problems that you experience in your everyday life, with family members or in your workplace). The second scale asks you to rate each item on their readability (i.e. whether someone with a mild cognitive impairment will be able to read and understand what the item is asking).

Please answer every item as honestly as possible. There are no correct or incorrect answers. We are only interested in whether you believe these items are suitable for a questionnaire measuring prospective memory.

Thank you for your participation.
Pilot Questionnaire Items

1. If I lend someone a personal belonging (e.g. a DVD or a book) I will always remember to ask for it back

2. If I borrow someone else’s personal belongings (e.g. a DVD or a book) I will always remember to give it back

3. I often remember that there is something I have to do (e.g. get petrol, take food out of the oven) but forget to do it

4. My friends always ask me to do things or remind them to do things because I am more likely to remember than they are

5. I am always forgetting to do daily tasks such as paying bills, posting letters, or picking up the kids from school

6. I often forget to do daily chores such as hanging washing out, feeding the dog, or putting the garbage out

7. I often forget to pass important messages on to family, friends, or colleagues

8. I often forget about important appointments

9. I always forget important dates, birthdays, and anniversaries

10. I often forget to do things (e.g. pass on messages, pay bills) but remember that I was meant to do them after it is too late

11. I often forget where I have placed things (e.g. keys, money)

12. I have difficulty remembering directions or instructions

13. I often walk into a room and forget why I went there

14. I have trouble remembering the names of people and places

15. I have trouble remembering recent events in my life

16. I have trouble remembering events from my childhood or a long time ago

17. When I am given a message to pass on, I often forget what the message was soon after being told the message

18. If there is a change of plans in my daily tasks (e.g. if someone cancels an appointment) I will forget to make the change and will go to the appointment

19. I often put things in the wrong place (e.g. ice cream in a cupboard and ice cream cones in the freezer)

20. I often forget what I was talking about midsentence

21. I never miss appointments
I only ever remember dates, appointments, or events if they are important to me.

I never remember dates, appointments, or events, even if they are important to me.

I often remember that there is something I need to do minutes before I have to do it, but forget to do it when the time comes to actually do it.

I am more likely to remember to do something if there is something to remind me (e.g. object, person).

I sometimes forget to do things because I get carried away doing something else.

I often leave objects laying around (e.g. keys, notes, shoes) to remind me to do something.

I often leave objects laying around (e.g. keys, notes, shoes) to remind me to do something, but end up ignoring them and forgetting to do what I was meant to do.

I am very good at multitasking.

If I am given instructions, I tend to forget at least one step in the process.

I always remember to do things that I need to do on a daily basis (e.g. brush teeth, eat meals, showering).

When I am prescribed medication, I occasionally forget to take a tablet.

I often forget to turn the stove or iron off.

I always forget to hang the washing out once the washing machine cycle has finished.

I tend to remind myself of things I need to do if I have a few spare moments (e.g. whilst driving, walking between places).

If I do not finish what I am doing (e.g. cleaning, typing a letter), I will remember to go back and finish it later.

If I try to call a friend, but they are unavailable, I will remember to call them back later.

If someone else asks me to do something I will only remember if there is something in it for me.

If I am in the middle of doing something boring, I am more likely to remember other things I need to do.

If I am doing something important or that I enjoy, I forget about other things I need to do.

I remember things that people ask me to do, but choose not to do them.

I have pretended to forget to do something someone has asked me to do because I did not want to do it.
43 If there is something that I have to do that is boring, frightening or unpleasant, I will forget to do it
44 If I miss an appointment, I will remember to re-schedule it for another time
45 I don’t have to worry about remembering appointments, birthdays, or events because someone else does it for me
46 I am the person in our household responsible for remembering appointments, birthdays, or events
47 I often find that I don’t get anything done that I planned because I get interrupted all the time
48 I will not remember where things are (e.g. keys) if they are not sitting exactly where I expect them to be
49 I am more likely to remember to do things (e.g. appointment, buy milk) if I am in an unfamiliar place or town
50 I will not remember to do basic daily tasks (e.g. showering, eating) unless someone else reminds me to do them
51 I have trouble remembering things that I need to do in 15 minutes time
52 I have trouble remembering things that I need to do in a few hours’ time
53 At the supermarket, I can remember at least 10 things I need to buy without using a list
54 I am good at remembering large amounts of information (e.g. dates, phone numbers, birthdays)
55 I am more likely to remember things that I need to do when I am busy
56 I can manage to remember things that I need to do even if I am in the middle of a busy task (e.g. calculating, reading)
57 If there is something I need to do (e.g. emailing) I am more likely to remember to do it if I am familiar with the task
58 I am more likely to remember to do something someone asks me to do if their instructions are specific (e.g. buy Kleenex brand tissues)
59 I am more likely to remember to do things someone else asks me to do if the instructions are basic (e.g. buy tissues)
60 I am more likely to remember to do something someone asks me to do if they give me a time limit
61 I am more likely to remember to do something verbal (e.g. passing on a message)
62 I am more likely to remember to do something physical (e.g. go somewhere)
63 I am more likely to remember to do something if there is something that stands out to remind me (e.g. sign, object)

64 If I have to remember to do two things at once, I will forget to do one or both of these things

65 I forgot to do things that can be done in a sequence (e.g. go to supermarket, then visit post office, and then go to the bank)

66 If there is something important that I must remember to do later (e.g. appointment), I try not to do anything distracting because I know that I will forget to do the important task

67 I have trouble blocking out distracting thoughts (e.g. what I’m going to do on the weekend) when I’m supposed to be doing something else

68 I can only remember to do things if I keep repeating over and over in my head what I have to do

69 I have trouble switching my attention between two different things (e.g. watching TV and talking to someone at the same time)

70 I am more likely to remember to do something if it is related to what I am already doing (e.g. remembering to get petrol whilst driving)

71 I am more likely to remember to do something if it has nothing to do with what I am already doing (e.g. remembering to get petrol whilst cooking dinner)

72 I often have random thoughts pop into my head of things I need to do in the future

73 I often see things around me (e.g. places, people, or objects) that remind me that I need to do something

74 I often see things around me (e.g. places, people or objects) that remind me that there is something that I need to do, but I can’t remember what it was I was meant to do

75 When there is something I must remember to do at a certain time (e.g. appointment) I look at the clock more often as that time approaches

76 When there is something I must remember to do at a certain time (e.g. appointment) I check the clock once or twice but still miss the appointment

77 When I am daydreaming, things that I need to do often pop into my head

78 Sometimes I see objects, people, or places which remind me that there is something I need to do, even though the task I need to do has nothing to do with what I’m looking at

79 If I have a lot of things to do, I like to plan how and when I will carry them out

80 I often make plans when I have lots of things to do, but still forget to do some things I planned to do
I find that the more complex my plans are (e.g. making lists, pictures), the more likely I will remember to do them.

If I change how I plan to do something, I will still remember my original plan.

If I have several things to do, I have trouble deciding which to do first.

I often miss important appointments or don’t get things done because I do not plan things well.

I often forget that I have already done something (e.g. taken medication) and so I do it again (e.g. take another tablet).

I sometimes think that I have already done something (e.g. taken a tablet) when in fact I haven’t and so I don’t end up doing what I was meant to do at all (e.g. take no tablets at all).

I like to tick things off in my head once I have done them.

I have trouble deciding whether things actually happened or whether they are a part of my imagination.

I often tell people the same story because I forget that I have already told them.

Something bad has happened because I forgot to do something (e.g. I forgot to turn off the stove/iron).

People get angry at me because I always forget to do things.

I cannot be left alone because I forget to do even simple things (e.g. bathing or eating).

My family and friends do not invite me to social events anymore because I always forget to attend.

I have difficulty keeping a job because I forget to do things I am asked to do (e.g. follow instructions).

I know when I am going to need a memory aid such as a note, list, or alarm.

I am good at remembering to do things on time.

It takes me longer to do mental tasks (e.g. calculations, crosswords, or remembering names of things) than it used to.

My memory is as good as anyone else my age.

I get frustrated with myself because I forget to do things I was supposed to.

I get frustrated with others when they forget to do things they were supposed to.

I believe that people’s memory gets worse with old age.

I believe that if you do not keep your brain active, your memory will get slower.
103 If a person is asked to do something by their friend and they forget to do it, they are a bad person

104 People who forget to do things when they are asked to do them by someone else are careless, lazy or thoughtless

105 When people forget to do something they were asked to do it is probably because they were busy or were preoccupied

106 I am better at remembering to do things earlier in the day

107 I worry that my memory is getting worse

108 I worry that I annoy people because I forget to do things

109 I am worried that I will get dementia

110 I have a hearing, vision, or sensory impairment which makes it difficult for me to remember to do things (e.g. difficulty hearing alarms, difficulty seeing objects)

111 If there is something I need to do (e.g. an appointment, shopping) I feel tense until I can do what I need to do

112 I sometimes get a nagging feeling that there is something I need to do, but I can’t remember what it is I am meant to do

113 If I realise that I have forgotten something I tend to pay more attention to remembering things in the future

114 When I am tired, stressed, angry, or upset I forget to do things more often than normal

115 When I am tired, stressed, angry, or upset I find that I am distracted and forget to do things I am supposed to do

116 If I am anxious or worried about something I have to do I am more likely to remember to do it

117 Worrying about things that I have to do means that I tend to keep thinking about them

118 If I am anxious or worried about something, I tend to forget things that I am supposed to be doing (e.g. skipping instructions, forgetting items on the shopping list)

119 I am always aware of the time so that I can plan things that I need to do

120 I like to make sure that I am never late if I have to be somewhere (e.g. party, appointments)

121 I like to be organised all the time

122 I am always nagging my friends and family so that they get things done on time

123 I am always thinking about things that need to be done
124. I will remember everything I need to do if I rehearse a list of things to do beforehand.

125. If I imagine myself doing the things I need to do beforehand, I am more likely to remember to do them.

126. I have difficulty finding ways to remember to do things.

127. I use a daily planner, calendar, or voice organiser to help me remember to do things.

128. I would remember to do more things if I used a daily planner, calendar, or voice organiser to remind me to do things.

129. I am more likely to remember to do things if I know exactly when and where I will be doing it (e.g. at two o’clock, when I see John at work, I must give him this message).

130. I use an alarm clock/phone to help me remember.

131. I make lists to help me remember to do things.

132. I remember to do things by associating them with other things (e.g. I associate a person who I need to pass the message on to with a certain place).

133. I am more likely to remember to do something later on (e.g. buy milk) if that task is completely different to what I am already doing (e.g. playing Monopoly).

134. If I leave a reminder for myself, it must be very obvious for me to remember (e.g. a note written in large handwriting).

135. Unless I am familiar with a task (e.g. following a particular recipe) I will forget to carry out some parts of the task.
Appendix B: Study 1 Information Sheet

Participant information sheet

My name is Nicole Sugden and I am a Ph.D. student studying psychology at Charles Sturt University. As a part of my Ph.D. research I am conducting a study titled "Prospective memory: A theoretical evaluation and development of a standardised questionnaire". This research will be conducted in three stages: the first stage will involve the development of a questionnaire which measures prospective memory (i.e., memory for future actions or intentions; for example keeping appointments or remembering to buy bread on the way home). In the second and third stages this test will be used to measure prospective memory performance in people of various ages and memory ability.

The aim of this research is to develop a questionnaire which measures prospective memory problems in everyday settings. This questionnaire is expected to be used in the future as an easy to administer instrument which identifies prospective memory problems in both research and clinical settings.

Your participation will only be required for the first stage of this research. In this stage of the research we are interested in what items in this questionnaire healthcare professionals (i.e. nurses, psychologists) and family members/carers who have experience with people with prospective memory impairments in everyday settings believe to be suitable for a prospective memory questionnaire.

Your participation would require you to fill out a questionnaire which will take approximately 40 minutes to complete. The questionnaire contains a series of items about prospective memory. You will be required to rate these in terms of whether the item is readable (that is, whether a person with prospective memory problems will be able to understand the item) and relevant (whether the item is relevant to the problems experienced with prospective memory in everyday settings).

The ratings obtained from your questionnaire will be used to determine which items will be included in the proposed questionnaire. These items will then be used in a questionnaire in the second and third stages of this research. The results from your participation and from the entire research project will be published in a thesis as a part of the requirements of my Ph.D. research. The results will also be published in a peer review journal.

You will not be asked to disclose any personal or identifying information and so participation in this research will be completely anonymous. Your consent for participation in this research will be considered as the return of the completed questionnaire. You are free to withdraw from this study at any time by not completing or returning the questionnaire. There will be no negative consequences if you choose to withdraw from the study at any time.

If you choose to participate in this research, please complete the attached questionnaire and return it by dd/mm/2010 to the following address:
Appendix C: Items Eliminated from draft PMCQ in Study 1

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Appendix C: Items Eliminated from draft PMCQ in Study 1 (continued).

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### Appendix D: Items Retained in the Draft PMCQ Scale That Were Reworded

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Appendix D: Items Retained in the Draft PMCQ Scale That Were Reworded (continued).

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### Appendix E: Changes Made to Items in Study 1

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<th>No.</th>
<th>Original item</th>
<th>New item</th>
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<td>1</td>
<td>If I lend someone a personal belonging (e.g. a DVD or a book) I will always remember to ask for it back</td>
<td>If I lend someone a personal belonging (e.g. a book) I will remember to ask for it back</td>
<td>“DVD or a” and “always” removed.</td>
</tr>
<tr>
<td>2</td>
<td>If I borrow someone else’s personal belongings (e.g. a DVD or a book) I will always remember to give it back</td>
<td>If I borrow someone else’s personal belongings (e.g. a book) I will remember to give it back</td>
<td>“DVD or a” and “always” removed.</td>
</tr>
<tr>
<td>3</td>
<td>I often remember that there is something I have to do (e.g. get petrol, take food out of the oven) but forget to do it</td>
<td>There are times when I remember that I need to do something but I can’t remember what it is</td>
<td>Item reworded.</td>
</tr>
<tr>
<td>5</td>
<td>I am always forgetting to do daily tasks such as paying bills, posting letters, or picking up the kids from school</td>
<td>I forget to do daily tasks such as paying bills, posting letters, or putting the garbage out</td>
<td>“Am always forgetting” changed to “forget”. “Picking up the kids from school” changed to “putting the garbage out”.</td>
</tr>
<tr>
<td>7</td>
<td>I often forget to pass important messages on to family, friends, or colleagues</td>
<td>I forget to pass important messages on to family, friends, or colleagues</td>
<td>“Often” removed.</td>
</tr>
<tr>
<td>8</td>
<td>I often forget about important appointments</td>
<td>I forget important appointments</td>
<td>“Often” and “about” removed.</td>
</tr>
<tr>
<td>9</td>
<td>I always forget important dates, birthdays, or anniversaries</td>
<td>I forget important dates, birthdays, or anniversaries</td>
<td>“Always” removed.</td>
</tr>
<tr>
<td>10</td>
<td>I often forget to do things (e.g. pass on messages, pay bills) but remember that I was meant to do them after it is too late</td>
<td>I forgot to do things but remember that I was meant to do them after it is too late</td>
<td>“Often” removed. Example removed.</td>
</tr>
<tr>
<td>11</td>
<td>I often forget where I have placed things (e.g. keys, money)</td>
<td>I forget where I have placed things e.g. keys or money</td>
<td>“Often” removed. “or” added. Brackets removed.</td>
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### Appendix E: Changes Made to Items in Study 1

<table>
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<th>No.</th>
<th>Original item</th>
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<th>Changes made</th>
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<tr>
<td>12</td>
<td>I have difficulty remembering directions or instructions</td>
<td>I have trouble remembering directions or instructions</td>
<td>“Have difficulty” changed to “have trouble”.</td>
</tr>
<tr>
<td>13</td>
<td>I often walk into a room and forget why I went there</td>
<td>I walk into a room and forget why I went there</td>
<td>“Often” removed.</td>
</tr>
<tr>
<td>17</td>
<td>When I am given a message to pass on, I often forget what the message was soon after being told the message</td>
<td>When I am given a message to pass on, I forget what the message was</td>
<td>“Often” and “soon after being told the message” removed.</td>
</tr>
<tr>
<td>19</td>
<td>I often put things in the wrong place (e.g. ice cream in the cupboard and ice cream cones in the freezer)</td>
<td>I put things in the wrong place e.g. milk in the cupboard and sugar in the fridge</td>
<td>“Often” removed and example changed to “milk in the cupboard and sugar in the fridge”. Brackets removed.</td>
</tr>
<tr>
<td>20</td>
<td>I often forget what I was talking about midsentence</td>
<td>I forget what I was talking about midsentence</td>
<td>“Often” removed.</td>
</tr>
<tr>
<td>23</td>
<td>I never remember dates, appointments, or events, even if they are important to me</td>
<td>I forget dates, appointments, or events, even if they are important to me</td>
<td>“Never remember” changed to “forget”.</td>
</tr>
<tr>
<td>25</td>
<td>I am more likely to remember to do something if there is something to remind me (e.g. object, person)</td>
<td>I am more likely to remember to do something if there is something to remind me e.g. an object or a person</td>
<td>Brackets removed. “,” replaced with “or a”, ‘an’ added.</td>
</tr>
<tr>
<td>26</td>
<td>I sometimes forget to do things because I get carried away doing something else</td>
<td>I forget to do things because I get carried away doing something else</td>
<td>“Sometimes” removed.</td>
</tr>
<tr>
<td>27</td>
<td>I often leave objects laying around (e.g. keys, notes, shoes) to remind me to do something</td>
<td>I leave objects (e.g. keys) in obvious places to remind me to do things</td>
<td>“Often” and “notes, shoes” removed. Item reworded.</td>
</tr>
<tr>
<td>30</td>
<td>If I am given instructions, I tend to forget at least one step in the process</td>
<td>If I am given instructions, I will forget at least one step</td>
<td>“Tend to” changed to “will”. “in the process” removed.</td>
</tr>
</tbody>
</table>
### Appendix E: Changes Made to Items in Study 1

<table>
<thead>
<tr>
<th>No.</th>
<th>Original item</th>
<th>New item</th>
<th>Changes made</th>
</tr>
</thead>
<tbody>
<tr>
<td>31</td>
<td>I always remember to do things that I need to do on a daily basis (e.g. brush teeth, eat meals, showering)</td>
<td>I remember to do things that I need to do on a daily basis e.g. brush my teeth, shower, and eat meals</td>
<td>“Always” removed. Example changed. Brackets removed.</td>
</tr>
<tr>
<td>32</td>
<td>When I am prescribed medication, I occasionally forget to take a tablet</td>
<td>I forget to take my medication as prescribed</td>
<td>Item reworded.</td>
</tr>
<tr>
<td>33</td>
<td>I often forget to turn the stove or iron off</td>
<td>I forget to turn the stove or iron off</td>
<td>“Often” removed.</td>
</tr>
<tr>
<td>34</td>
<td>I always forget to hang the washing out once the washing machine cycle has finished</td>
<td>I forget to hang the washing out once the washing machine cycle has finished</td>
<td>“Always” removed.</td>
</tr>
<tr>
<td>35</td>
<td>I tend to remind myself of things I need to do if I have a few spare moments (e.g. whilst driving, walking between places)</td>
<td>I think through the things I need to do before they have to be done</td>
<td>Item reworded. Example removed.</td>
</tr>
<tr>
<td>36</td>
<td>If I do not finish what I am doing (e.g. cleaning, typing a letter), I will remember to go back and finish it later</td>
<td>If interrupted while doing something, I remembered to finish it later</td>
<td>Example removed. Item reworded.</td>
</tr>
<tr>
<td>40</td>
<td>If I’m doing something important or that I enjoy, I forget about other things I need to do</td>
<td>If I am doing something important or that I enjoy I forget about other things I need to do</td>
<td>“I’m” changed to “I am”.</td>
</tr>
<tr>
<td>44</td>
<td>If I miss an appointment, I will remember to reschedule it for another time</td>
<td>If I miss an appointment, I will remember to reschedule it for a later time</td>
<td>“Another” changed to “a later”.</td>
</tr>
<tr>
<td>47</td>
<td>I often find that I don’t get anything done that I planned because I get interrupted all the time</td>
<td>I find that I don’t get anything done that I planned to do because I get interrupted all the time</td>
<td>“Often” removed. “To do” added.</td>
</tr>
</tbody>
</table>
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<table>
<thead>
<tr>
<th>No.</th>
<th>Original item</th>
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</tr>
</thead>
<tbody>
<tr>
<td>48</td>
<td>I will not remember where things are (e.g. keys) if they are not sitting exactly where I expect them to be</td>
<td>If I do not put things in their normal place (e.g. keys) I will not remember where I put them</td>
<td>Item reworded.</td>
</tr>
<tr>
<td>53</td>
<td>At the supermarket I can remember at least 10 things I need to buy without using a list</td>
<td>At the supermarket I can remember at least 5 things I need to buy without using a list</td>
<td>10 changed to 5.</td>
</tr>
<tr>
<td>54</td>
<td>I am good at remembering large amounts of information (e.g. dates, phone numbers, birthdays)</td>
<td>I am good at remembering dates, phone numbers, and birthdays</td>
<td>“Large amounts of information (e.g.)” removed. “And” added.</td>
</tr>
<tr>
<td>56</td>
<td>I can manage to remember things that I need to do even if I am in the middle of a busy task (e.g. calculating, reading)</td>
<td>I remember things that I need to do even if I am in the middle of a busy task</td>
<td>“Can manage to” removed. Example removed.</td>
</tr>
<tr>
<td>57</td>
<td>If there is something I need to do (e.g. emailing) I am more likely to remember to do it if I’m familiar with the task</td>
<td>I am more likely to remember to do something if I do it often</td>
<td>“If there is something I need to do (e.g. emailing)” removed. Item reworded.</td>
</tr>
<tr>
<td>59</td>
<td>I am more likely to remember to do things someone else asks me to do if the instructions are basic (e.g. buy tissues)</td>
<td>I remember the main parts of instructions (e.g. buy milk) but I forget details (e.g. buy two litres of skim milk)</td>
<td>Item reworded. Example changed.</td>
</tr>
<tr>
<td>61</td>
<td>I am more likely to remember to do something verbal (e.g. passing on a message)</td>
<td>I am able to remember to do something if it involves telling somebody something e.g. passing on a message</td>
<td>Item reworded. Brackets removed.</td>
</tr>
<tr>
<td>62</td>
<td>I am more likely to remember to do something physical (e.g. go somewhere)</td>
<td>I am able to remember to do something if it involves an action e.g. going somewhere</td>
<td>Item reworded. Brackets removed.</td>
</tr>
</tbody>
</table>
## Appendix E: Changes Made to Items in Study 1

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<thead>
<tr>
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<th>Original item</th>
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</tr>
</thead>
<tbody>
<tr>
<td>64</td>
<td>If I have to remember to do two things at once, I will forget to do one or both of these things</td>
<td>When I have to do two things at once, I have trouble remembering to do both</td>
<td>Item reworded.</td>
</tr>
<tr>
<td>65</td>
<td>I forget to do things that can be done in a sequence (e.g. go to the supermarket, then visit post office, and then go to the bank)</td>
<td>I forget to do things that can be done in a sequence e.g. buy a stamp, put the stamp on an envelope, and post it</td>
<td>Example changed. Brackets removed.</td>
</tr>
<tr>
<td>68</td>
<td>I can only remember to do things if I keep repeating over and over in my head what I have to do</td>
<td>I am more likely to remember to do things if I say them over and over to myself</td>
<td>Item reworded.</td>
</tr>
<tr>
<td>69</td>
<td>I have trouble switching my attention between two different things (e.g. watching TV and talking to someone at the same time)</td>
<td>I have trouble switching my attention between two different things e.g. watching TV and talking to someone at the same time</td>
<td>Brackets removed.</td>
</tr>
<tr>
<td>70</td>
<td>I am more likely to remember to do something if it is related to what I am already doing (e.g. remembering to get petrol whilst driving)</td>
<td>I am more likely to remember to do something if it is related to what I am already doing e.g. I remember to get petrol whilst driving</td>
<td>Brackets removed. “Remembering” changed to “I remember”.</td>
</tr>
<tr>
<td>72</td>
<td>I often have random thoughts pop into my head of things I need to do in the future</td>
<td>I have thoughts of things I need to do in the future pop into my head</td>
<td>“Often” and “random” removed.</td>
</tr>
<tr>
<td>73</td>
<td>I often see things around me (e.g. places, people, or objects) that remind me that I need to do something</td>
<td>Seeing places (e.g. a supermarket) or objects (e.g. a teapot) can remind me that I need to do something (e.g. buy sugar)</td>
<td>Item reworded. Examples added.</td>
</tr>
</tbody>
</table>
Appendix E: Changes Made to Items in Study 1

<table>
<thead>
<tr>
<th>No.</th>
<th>Original item</th>
<th>New Item</th>
<th>Changes made</th>
</tr>
</thead>
<tbody>
<tr>
<td>74</td>
<td>I often see things around me (e.g. places, people, or objects) that remind me that there is something that I need to do, but I can’t remember what it was I was meant to do</td>
<td>Seeing places or objects can remind me that I need to do something, but I can’t remember exactly what it is</td>
<td>Item reworded.</td>
</tr>
<tr>
<td>75</td>
<td>When there is something I must remember to do at a certain time (e.g. appointment) I look at the clock more often as that time approaches</td>
<td>When there is something I must remember to do at a certain time I look at the clock more often</td>
<td>Example removed. “As that time approaches” removed.</td>
</tr>
<tr>
<td>77</td>
<td>When I am daydreaming, things that I need to do often pop into my head</td>
<td>I have thoughts of things I need to do in the future pop into my head</td>
<td>Item reworded.</td>
</tr>
<tr>
<td>79</td>
<td>If I have a lot of things to do, I like to plan how and when I will carry them out</td>
<td>If I have a lot of things to do, I like to plan how and when I will do them</td>
<td>“Carry them out” changed to “do them”.</td>
</tr>
<tr>
<td>80</td>
<td>I often make plans when I have lots of things to do, but still forget to do some things I planned to do</td>
<td>I forget to do some things I have planned to do</td>
<td>Item reworded. “Often” removed.</td>
</tr>
<tr>
<td>81</td>
<td>I find that the more complex my plans are (e.g. making lists, pictures), the more likely I will remember to do them</td>
<td>I am more likely to remember things if I make lists or draw pictures</td>
<td>Item reworded.</td>
</tr>
<tr>
<td>85</td>
<td>I often forget that I have already done something (e.g. taken medication) and so I do it again (e.g. take another tablet)</td>
<td>I do things twice because I forget that I have already done them e.g. I take a tablet twice</td>
<td>Item reworded.</td>
</tr>
</tbody>
</table>
## Appendix E: Changes Made to Items in Study 1

<table>
<thead>
<tr>
<th>No.</th>
<th>Original item</th>
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<th>Changes made</th>
</tr>
</thead>
<tbody>
<tr>
<td>86</td>
<td>I sometimes think that I have already done something (e.g. taken a tablet) when in fact I haven’t and so I don’t end up doing what I was meant to do at all (e.g. take no tablets at all)</td>
<td>I think that I have done things when I actually have not done them</td>
<td>“Sometimes” removed. Item reworded.</td>
</tr>
<tr>
<td>87</td>
<td>I like to tick things off in my head once I have done them</td>
<td>I like to keep track in my mind of things that I have done</td>
<td>Item reworded.</td>
</tr>
<tr>
<td>89</td>
<td>I often tell people the same story because I forget that I have already told them</td>
<td>I tell people the same story because I forget that I have already told them</td>
<td>“Often” removed.</td>
</tr>
<tr>
<td>95</td>
<td>I know when I am going to need a memory aid such as a note, list, or alarm</td>
<td>I know that I am going to need a memory aid such as a note, list, or alarm</td>
<td>“When” changed to “that”.</td>
</tr>
<tr>
<td>97</td>
<td>It takes me longer to do mental tasks (e.g. calculations, crosswords, or remembering names of things) than it used to</td>
<td>It takes longer to do mental tasks than it used to e.g. crosswords</td>
<td>Item reworded. Example shortened. Brackets removed.</td>
</tr>
<tr>
<td>98</td>
<td>My memory is as good as anyone else my age</td>
<td>My memory is as good as most people my age</td>
<td>“Anyone else” changed to “most people”.</td>
</tr>
<tr>
<td>99</td>
<td>I get frustrated with myself because I forget to do things I was supposed to</td>
<td>I get frustrated with myself because I forget to do things I was supposed to do</td>
<td>“Do” added.</td>
</tr>
<tr>
<td>112</td>
<td>I sometimes get a nagging feeling that there is something I need to do, but I can’t remember what it is I am meant to do</td>
<td>I get a nagging feeling that there is something I need to do but I can’t remember what it is</td>
<td>“Sometimes” and “meant to do” removed.</td>
</tr>
</tbody>
</table>
### Appendix E: Changes Made to Items in Study 1

<table>
<thead>
<tr>
<th>No.</th>
<th>Original item</th>
<th>New item</th>
<th>Changes made</th>
</tr>
</thead>
<tbody>
<tr>
<td>116</td>
<td>If I am anxious or worried about something I have to do I am more likely to remember to do it</td>
<td>I am more likely to remember to do something if I am anxious or worried about it</td>
<td>Item reworded.</td>
</tr>
<tr>
<td>118</td>
<td>If I am anxious or worried about something, I tend to forget things that I am supposed to be doing (e.g. skipping instructions, forgetting items on the shopping list)</td>
<td>If I am anxious or worried about something, I forget things that I am supposed to be doing e.g. I forget items on the shopping list</td>
<td>“Tend to” removed. Example shortened. Brackets removed.</td>
</tr>
<tr>
<td>120</td>
<td>I like to make sure that I am never late if I have to be somewhere (e.g. party, appointments)</td>
<td>I like to make sure that I am never late if I have to be somewhere e.g. an appointment</td>
<td>Brackets removed. Example shortened.</td>
</tr>
<tr>
<td>121</td>
<td>I like to be organised all the time</td>
<td>I like to be organised all of the time</td>
<td>“Of” added.</td>
</tr>
<tr>
<td>126</td>
<td>I have difficulty finding ways to remember to do things</td>
<td>I have trouble thinking of ways to help my memory</td>
<td>“Difficulty” changed to “trouble”. Item reworded.</td>
</tr>
<tr>
<td>127</td>
<td>I use a daily planner, calendar, or voice organiser to help me remember to do things</td>
<td>I use a diary or calendar to help me remember to do things</td>
<td>“Voice organiser” removed.</td>
</tr>
<tr>
<td>129</td>
<td>I am more likely to remember to do things if I know exactly when and where I will be doing it (e.g. at two o’clock, when I see John at work, I must give him this message)</td>
<td>I can only remember that I have a message to pass on when I see the person the message is for</td>
<td>Item reworded. Example removed.</td>
</tr>
<tr>
<td>130</td>
<td>I use an alarm clock/phone to help me remember</td>
<td>I use an alarm clock or a phone to help me remember to do things</td>
<td>“/” changed to “or a”. “To do things” added.</td>
</tr>
<tr>
<td>132</td>
<td>I remember to do things by associating them with other things (e.g. I associate a person who I need to pass the message on to with a certain place)</td>
<td>I remember to do things by associating them with other things e.g. I associate a person who I need to pass a message on to with a certain place</td>
<td>Brackets removed.</td>
</tr>
</tbody>
</table>
### Appendix F: Items Retained from the draft PMCQ Scale with No Changes Made

<table>
<thead>
<tr>
<th>Item</th>
<th>Measure</th>
<th>Rasch SE</th>
<th>Rank</th>
<th>Relevance M</th>
<th>SD</th>
<th>%</th>
<th>Readability M</th>
<th>SD</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>-.51</td>
<td>.20</td>
<td>12</td>
<td>3.34</td>
<td>.91</td>
<td>86.9</td>
<td>3.50</td>
<td>.89</td>
<td>84.3</td>
</tr>
<tr>
<td>15</td>
<td>-.56</td>
<td>.20</td>
<td>9</td>
<td>3.18</td>
<td>.93</td>
<td>76.3</td>
<td>3.55</td>
<td>.83</td>
<td>84.2</td>
</tr>
<tr>
<td>16</td>
<td>-.61</td>
<td>.21</td>
<td>6</td>
<td>3.00</td>
<td>.84</td>
<td>71.1</td>
<td>3.34</td>
<td>1.02</td>
<td>81.6</td>
</tr>
<tr>
<td>46</td>
<td>-.46</td>
<td>.18</td>
<td>15</td>
<td>3.30</td>
<td>1.05</td>
<td>78.4</td>
<td>3.14</td>
<td>1.18</td>
<td>70.3</td>
</tr>
<tr>
<td>51</td>
<td>.15</td>
<td>.17</td>
<td>91</td>
<td>2.84</td>
<td>1.09</td>
<td>70.2</td>
<td>3.41</td>
<td>.83</td>
<td>78.4</td>
</tr>
<tr>
<td>52</td>
<td>.10</td>
<td>.17</td>
<td>86</td>
<td>2.89</td>
<td>1.16</td>
<td>68.6</td>
<td>3.32</td>
<td>.94</td>
<td>78.4</td>
</tr>
<tr>
<td>96</td>
<td>-.65</td>
<td>.20</td>
<td>4</td>
<td>3.29</td>
<td>.93</td>
<td>80.0</td>
<td>3.46</td>
<td>.85</td>
<td>82.8</td>
</tr>
<tr>
<td>107</td>
<td>-.25</td>
<td>.19</td>
<td>40</td>
<td>3.14</td>
<td>.93</td>
<td>80.6</td>
<td>3.42</td>
<td>1.05</td>
<td>80.5</td>
</tr>
<tr>
<td>114</td>
<td>-.54</td>
<td>.20</td>
<td>10</td>
<td>3.22</td>
<td>.87</td>
<td>77.8</td>
<td>3.34</td>
<td>.91</td>
<td>88.6</td>
</tr>
<tr>
<td>117</td>
<td>-.06</td>
<td>.21</td>
<td>64</td>
<td>3.00</td>
<td>.84</td>
<td>82.8</td>
<td>3.20</td>
<td>.87</td>
<td>77.1</td>
</tr>
<tr>
<td>123</td>
<td>-.26</td>
<td>.20</td>
<td>39</td>
<td>3.03</td>
<td>.89</td>
<td>74.3</td>
<td>3.29</td>
<td>1.09</td>
<td>82.4</td>
</tr>
<tr>
<td>131</td>
<td>-.29</td>
<td>.18</td>
<td>36</td>
<td>3.25</td>
<td>1.00</td>
<td>83.4</td>
<td>3.54</td>
<td>.74</td>
<td>91.4</td>
</tr>
</tbody>
</table>

*Note.* Items are listed in numerical order as presented in the questionnaire. Measure = Rasch item measure, Rank = the position of the item in the Rasch item hierarchy with 1 being the most relevant and 135 the least relevant, % = the percentage of participants that rated the item as either Somewhat or Definitely Relevant/May Have a Little Difficulty or Definitely Readable.
Appendix G: Study 2 Pre-Test Participant Feedback Sheet

Please complete the questions in the questionnaire booklet provided.

In addition to your answers we are interested in what you think of the questionnaire itself.

For example
- Are the instructions easy to follow?
- Are the questions easy to understand?
- Is the format/layout easy-to-use?
- Or any other comments you may have

Please feel free to make comments anywhere in the booklet if you think that there is something that can be improved or you may wish to provide comments in the space below.

Comments:

Thank you for your time and suggestions.
Research Participants Needed

I am currently seeking research participants to complete questionnaires on memory processes and personality in normal ageing.

This research is a Ph.D. project being conducted at Charles Sturt University.

I am looking for males and females aged over 18 years with various degrees of memory ability.

Participation will involve filling out a questionnaire which will take 45 minutes to complete.

If you would like to participate in this research or would like further information please contact Nicole Sugden on (mobile number) or at (email).
Appendix I: Study 2 Participant Invitation Letter

**PROSPECTIVE MEMORY: A THEORETICAL EVALUATION AND DEVELOPMENT OF A STANDARDISED QUESTIONNAIRE**

**Invitation to Participate**

My name is Nicole Sayden and I am a Ph.D. student studying Psychology at Charles Sturt University. As a part of my Ph.D. research I am conducting a study titled "Prospective Memory: A Theoretical Evaluation and Development of a Standardised Questionnaire".

Prospective memory is defined as the type of memory used for future actions or intentions. Examples of prospective memory include keeping appointments or remembering to buy bread on the way home.

The aim of this research is to develop a questionnaire that measures prospective memory problems in everyday settings.

We are therefore looking for research participants to help in the development of this questionnaire. We will be recruiting approximately 125 participants aged over 18 years with various degrees of prospective memory ability.

This research project is being conducted in three stages:

1. Development of a questionnaire that measures prospective memory.
2. Completion of this questionnaire plus another questionnaire that measures personality. *This is the stage you will be participating in.*
3. Development of a final version of the questionnaire based on your responses.

Your participation would require you to complete this prospective memory questionnaire. You will also be asked to complete a personality questionnaire. Overall, this will take approximately 45 minutes to complete.

Your responses will be used to find out which questionnaire items measure prospective memory most effectively. These questions will then be used to make a final version of the test that will be administered to another group of people for the development of Norms. (Norms tells us what range of skills is normal and allows us to identify if there are any problems). The results from your participation and from the research project will be published in a thesis and a peer review journal.

The questionnaire may be used in the future to assess and diagnose prospective memory problems. In addition, the questionnaire may guide research into prospective memory and potential treatment options.

You will be required to give permission for your participation in this research by signing a consent form. You will also be required to give permission on this consent form for us to access your health records on the NSW brain injury rehabilitation directorate clinical data set for information about your brain injury. This information will be kept CONFIDENTIAL at all times.

You are free to withdraw from the study at any time and there will be no negative consequences and no effects on your health care if you choose to do so.

**Note.** This invitation letter is the version distributed to the brain injury sample. The MCI/dementia invitation letter is identical except that brain injury version refers to retrieving information from the New South Wales Brain Injury Clinical Dataset whereas the MCI/dementia letter refers to retrieving information from the Aged Care Assessment Team Database. The non-referred group did not receive an invitation letter. Furthermore, researchers’ contact details and signatures have been removed from this letter.
Appendix J: Study 2 Information Sheet

**Prospective Memory: A Theoretical Evaluation and Development of a Standardised Questionnaire**

**Participant Information Sheet**

My name is Nicole Sugden and I am a Ph.D. student studying Psychology at Charles Sturt University. As a part of my Ph.D. research, I am conducting a study titled “Prospective Memory: A Theoretical Evaluation and Development of a Standardised Questionnaire.”

Prospective memory is defined as the type of memory used for future actions or intentions. Examples of prospective memory include keeping appointments or remembering to buy bread on the way home.

The aim of this research is to develop a questionnaire that measures prospective memory problems in everyday settings.

This research project is being conducted in three stages:

1. Development of a questionnaire that measures prospective memory.
2. Completion of this questionnaire plus another questionnaire that measures personality. **This is the stage you will be participating in.**
3. Development of a final version of the questionnaire based on your responses.

Your participation would require you to complete this prospective memory questionnaire. You will also be asked to complete a personality questionnaire. Overall, this will take approximately 45 minutes to complete.

Your responses will be used to find out which questionnaire items measure prospective memory most effectively. These questions will then be used to make a final version of the test that will be administered to another group of people for the development of Norms. (Norms tell us what range of skills is normal and allows us to identify if there are any problems). The results from your participation and from the research project will be published in a thesis and a peer review journal.

If you choose to participate please give your consent for your participation in this research by signing a consent form. On this consent form we also request your permission for us to access your health records on the NSW brain injury rehabilitation directorate clinical data set for information about your brain injury. We will also be requesting your permission on this consent form for us to store this potentially identifiable information about your brain injury for future research purposes. This information will be kept CONFIDENTIAL at all times.

You are free to withdraw from the study at any time and there will be no negative consequences and no effects on your health care if you choose to do so.

Some of the items in this questionnaire may possibly cause distress about your memory if you have a memory problem or if you believe you may have a memory problem. If in completing this questionnaire you become worried about your memory ability or have any other concerns, please contact Lifeline on 13 11 14 or your local GP or brain injury service.

If you would like to participate please complete the questionnaire attached and return it using the reply paid envelope by / / .

Note. This information sheet is the version distributed to the brain injury sample. The MCI/dementia information sheet is identical except that the MCI/dementia letter refers to retrieving information from the Aged Care Assessment Team Database. The non-referred group information sheet did not refer to obtaining consent for information retrieval. Furthermore, researchers’ contact details and signatures have been removed from this letter.
Appendix K: Study 2 Participant Consent Form

Note. This consent form is the version distributed to the brain injury sample. The MCI/dementia consent form is identical except that the MCI/dementia form refers to retrieving information from the Aged Care Assessment Team Database. The non-referred group did not receive a consent form.
Appendix L: Study 2 Guardian Consent Form

Note. This consent form is the version distributed to the brain injury sample. The MCI/dementia consent form is identical except that the MCI/dementia form refers to retrieving information from the Aged Care Assessment Team Database. This form was not applicable to the non-referred sample.
Appendix M: Study 2 Analyses of the 69 and 46 Item Scales

This appendix provides a detailed description of the procedures and results of the 69 and 46 item analysis stages in Study 2.

Analysis of the 69 Item Scale

**Construct validity.** A PCA was conducted on the 69 remaining PMCQ items. Four components were extracted from the scale using the MAP test (Velicier, 1976). An analysis of the component correlations revealed that the four components were orthogonal, as all correlations were below .32. Therefore, a Varimax orthogonal rotation was conducted with Kaiser normalisation and component loading criteria of .3. This PCA provided a solution which accounted for 33.2% of the variance within the scale. The percentage of variance accounted for by the rotated solution and eigenvalues for each of the four components are presented in Table M1.

Table M1

<table>
<thead>
<tr>
<th>Component</th>
<th>Eigenvalue</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Everyday Memory</td>
<td>8.60</td>
<td>12.47</td>
</tr>
<tr>
<td>Memory Concerns</td>
<td>6.87</td>
<td>9.95</td>
</tr>
<tr>
<td>Cognition</td>
<td>4.02</td>
<td>5.82</td>
</tr>
<tr>
<td>Memory Strategies</td>
<td>3.40</td>
<td>4.93</td>
</tr>
</tbody>
</table>

*Note. % = percentage of variance accounted for.*

A visual inspection of the four components was carried out to identify common themes in content amongst items in each component. Component 1 was labelled Everyday Memory and measured PM tasks that are typically encountered in daily life. Item 1 “I forget to do daily tasks such as paying bills, posting letters, or putting the garbage out” had the
highest loading on this component. Component 2, titled Memory Concerns assessed aspects of memory that people are generally worried about including remembering names or directions. An example of an item that loaded onto this component is Item 70 “it takes me longer to do mental tasks than it used to e.g. crosswords”. Component 3 was labelled Cognition and measured the cognitive aspects of PM functioning such as strategic monitoring and recognising cues. Item 63 “I like to keep track in my mind of things that I have done”, which relates to the cognitive activation of intentions loaded onto this component. Finally, Component 4 was named Memory Strategies, and consisted of items pertaining to memory strategies and aids. Item 78 “I make lists to help me remember to do things” had the highest loading on this component. Four items (items 3, 4, 24, and 35) did not meet the loading criterion of .3 on any of the four components. Table M2 shows the significant component loadings for items on the four components.
Table M2

Component Loadings in the Principal Component Analysis of the 69-Item Scale

<table>
<thead>
<tr>
<th>Items</th>
<th>Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 I forget to do daily tasks such as paying bills, posting letters, or putting the garbage out</td>
<td>.61</td>
</tr>
<tr>
<td>*74a I like to make sure that I am never late if I have to be somewhere e.g. an appointment</td>
<td>.61</td>
</tr>
<tr>
<td>2 I forget to pass important messages on to family, friends, or colleagues</td>
<td>.59</td>
</tr>
<tr>
<td>50a I am good at remembering to do things on time</td>
<td>.58</td>
</tr>
<tr>
<td>15 I forget to hang the washing out once the washing machine cycle has finished</td>
<td>.57</td>
</tr>
<tr>
<td>53 I think that I have done things when I actually have not done them</td>
<td>.56 .31</td>
</tr>
<tr>
<td>*12a If I miss an appointment, I will remember to reschedule it for a later time</td>
<td>.55</td>
</tr>
<tr>
<td>22 When I have to do two things at once, I have trouble remembering to do both</td>
<td>.54 .35</td>
</tr>
<tr>
<td>13 When I am given a message to pass on, I forget what the message was</td>
<td>.53</td>
</tr>
<tr>
<td>16 I forget to do things that can be done in a sequence e.g. buy a stamp, put the stamp on an envelope, and post it</td>
<td>.53</td>
</tr>
<tr>
<td>75a I like to be organised all of the time</td>
<td>.52</td>
</tr>
<tr>
<td>10 I forget important appointments</td>
<td>.51</td>
</tr>
<tr>
<td>23 I forget to do things because I get carried away doing something else</td>
<td>.49 .40</td>
</tr>
</tbody>
</table>

Note. * = Items eliminated from 69 item scale. Component 1 = Everyday Memory, Component 2 = Memory Concerns, Component 3 = Cognition, Component 4 = Memory Strategies. 

a = negative component loadings.
Table M2 (continued).

*Component Loadings in the Principal Component Analysis of the 69-Item Scale*

<table>
<thead>
<tr>
<th>Items</th>
<th>Components</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td><em>73a</em> I am the person in our household responsible for remembering</td>
<td>.48</td>
</tr>
<tr>
<td>appointments, birthdays, or events</td>
<td></td>
</tr>
<tr>
<td>52 I do things twice because I forget that I have already done them</td>
<td>.48</td>
</tr>
<tr>
<td>e.g. take a tablet twice</td>
<td></td>
</tr>
<tr>
<td><em>25a</em> If I have a lot of things to do, I like to plan how and when I</td>
<td>.48</td>
</tr>
<tr>
<td>will do them</td>
<td></td>
</tr>
<tr>
<td><em>32a</em> I remember to do things that I need to do on a daily basis e.g.</td>
<td>.47</td>
</tr>
<tr>
<td>brush my teeth, shower, and eat meals</td>
<td></td>
</tr>
<tr>
<td>7 I put things in the wrong place e.g. milk in the cupboard and</td>
<td>.46</td>
</tr>
<tr>
<td>sugar in the fridge</td>
<td></td>
</tr>
<tr>
<td>66 I forget to turn the stove or iron off</td>
<td>.46</td>
</tr>
<tr>
<td>21 Seeing places or objects can remind me that I need to do something,</td>
<td>.42</td>
</tr>
<tr>
<td>but I can’t remember exactly what it is</td>
<td></td>
</tr>
<tr>
<td><em>65a</em> I forget to take my medication as prescribed</td>
<td>.42</td>
</tr>
<tr>
<td>54 I tell people the same story because I forget that I have already</td>
<td>.41</td>
</tr>
<tr>
<td>told them</td>
<td></td>
</tr>
<tr>
<td>36a I remember things that I need to do even if I am in the middle of</td>
<td>.40</td>
</tr>
<tr>
<td>a busy task</td>
<td></td>
</tr>
<tr>
<td><em>55a</em> I am able to remember to do something if it involves telling</td>
<td>.39</td>
</tr>
<tr>
<td>somebody something e.g. passing on a message</td>
<td></td>
</tr>
<tr>
<td>11a If interrupted while doing something, I remember to finish it</td>
<td>.36</td>
</tr>
<tr>
<td>later</td>
<td></td>
</tr>
<tr>
<td>8 I forget what I was talking about midsentence</td>
<td>.35</td>
</tr>
<tr>
<td>51 I can only remember that I have a message to pass on when I see</td>
<td>.34</td>
</tr>
<tr>
<td>the person the message is for</td>
<td></td>
</tr>
<tr>
<td>18 I forget where I have placed things e.g. keys or money</td>
<td>.32</td>
</tr>
</tbody>
</table>

*Note.* *a* = Items eliminated from 69 item scale. Component 1 = Everyday Memory, Component 2 = Memory Concerns, Component 3 = Cognition, Component 4 = Memory Strategies. 
*a* = negative component loadings.
Table M2 (continued).

Component Loadings in the Principal Component Analysis of the 69-Item Scale

<table>
<thead>
<tr>
<th>Items</th>
<th>Components</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>*9a I am good at remembering dates, phone numbers, and birthdays</td>
<td>.32</td>
</tr>
<tr>
<td>24 I find that I don’t get anything done that I planned to do because I get interrupted all the time</td>
<td>--</td>
</tr>
<tr>
<td>58 I have trouble remembering recent events in my life</td>
<td>.70</td>
</tr>
<tr>
<td>48 I forget important dates, birthdays, or anniversaries</td>
<td>.61</td>
</tr>
<tr>
<td>57 I have trouble remembering the names of people and places</td>
<td>.57</td>
</tr>
<tr>
<td>37 I have trouble remembering directions or instructions</td>
<td>.57</td>
</tr>
<tr>
<td>70 It takes longer to do mental tasks that it used to e.g. crosswords</td>
<td>.57</td>
</tr>
<tr>
<td>29 If I am anxious or worried about something, I forget things that I am supposed to be doing e.g. I forget items on the shopping list</td>
<td>.53</td>
</tr>
<tr>
<td>68 I worry that my memory is getting worse</td>
<td>.50</td>
</tr>
<tr>
<td>34 I have trouble remembering things that I need to do in a few hours’ time</td>
<td>.36</td>
</tr>
<tr>
<td>72 I get frustrated with myself because I forget to do things I was supposed to do</td>
<td>.47</td>
</tr>
<tr>
<td>77 I have trouble thinking of ways to help my memory</td>
<td>.46</td>
</tr>
<tr>
<td>33 I have trouble remembering things that I need to do in 15 minutes time</td>
<td>.31</td>
</tr>
<tr>
<td>5 There are times when I remember that I need to do something but I can’t remember what it is</td>
<td>.39</td>
</tr>
<tr>
<td>*38 If I am given instructions, I will forget at least one step</td>
<td>.43</td>
</tr>
<tr>
<td>26 I forget to do some things I have planned to do</td>
<td>.36</td>
</tr>
<tr>
<td>41 When I am tired, stressed, angry, or upset I forget to do things more often than normal</td>
<td>.40</td>
</tr>
</tbody>
</table>

*Note.* * = Items eliminated from 69 item scale. Component 1 = Everyday Memory, Component 2 = Memory Concerns, Component 3 = Cognition, Component 4 = Memory Strategies. *a* = negative component loadings.
Table M2 (continued).

Component Loadings in the Principal Component Analysis of the 69-Item Scale

<table>
<thead>
<tr>
<th>Items</th>
<th>Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 I walk into a room and forget why I went there</td>
<td>.37</td>
</tr>
<tr>
<td>27 I forget to do things but remember that I was meant to do them</td>
<td>.37</td>
</tr>
<tr>
<td>after it is too late</td>
<td></td>
</tr>
<tr>
<td>39 I have trouble switching my attention between two different</td>
<td>.36</td>
</tr>
<tr>
<td>things e.g. watching TV and talking to someone at the same time</td>
<td></td>
</tr>
<tr>
<td>*59 I have trouble remembering events from my childhood or a long</td>
<td>.32</td>
</tr>
<tr>
<td>time ago</td>
<td></td>
</tr>
<tr>
<td>*35 At the supermarket I can remember at least 5 things that I need</td>
<td>-- -- -- --</td>
</tr>
<tr>
<td>to buy without using a list</td>
<td></td>
</tr>
<tr>
<td>*3 If I lend someone a personal belonging (e.g. a book) I will</td>
<td>-- -- -- --</td>
</tr>
<tr>
<td>remember to ask for it back</td>
<td></td>
</tr>
<tr>
<td>*28 I am more likely to remember to do something if I am anxious or</td>
<td>.63</td>
</tr>
<tr>
<td>worried about it</td>
<td></td>
</tr>
<tr>
<td>20 Seeing places (e.g. a supermarket) or objects (e.g. a teapot) can</td>
<td>.60</td>
</tr>
<tr>
<td>remind me that I need to do something (e.g. buy sugar)</td>
<td></td>
</tr>
<tr>
<td>17 I am more likely to remember to do something if there is</td>
<td>.58</td>
</tr>
<tr>
<td>something to remind me e.g. an object or a person</td>
<td></td>
</tr>
<tr>
<td>*30 I am more likely to remember to do something if I do it often</td>
<td>.56</td>
</tr>
<tr>
<td>*63 I like to keep track in my mind of things that I have done</td>
<td>.54</td>
</tr>
<tr>
<td>*40 Worrying about things that I have to do means that I tend to</td>
<td>.31 .49</td>
</tr>
<tr>
<td>keep thinking about them</td>
<td></td>
</tr>
<tr>
<td>61 I remember to do things by associating them with other things e.g.</td>
<td>.47</td>
</tr>
<tr>
<td>I associate a person who I need to pass a message on to with a</td>
<td></td>
</tr>
<tr>
<td>certain place</td>
<td></td>
</tr>
<tr>
<td>62 I am more likely to remember to do things if I say them over and</td>
<td>.44</td>
</tr>
<tr>
<td>over to myself</td>
<td></td>
</tr>
</tbody>
</table>

Note. * = Items eliminated from 69 item scale. Component 1 = Everyday Memory, Component 2 = Memory Concerns, Component 3 = Cognition, Component 4 = Memory Strategies. 
\(a\) = negative component loadings.
Table M2 (continued).

*Component Loadings in the Principal Component Analysis of the 69-Item Scale*

<table>
<thead>
<tr>
<th>Items</th>
<th>Components</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td><em>45</em> When there is something I must remember to do at a certain time</td>
<td>.38</td>
</tr>
<tr>
<td>I look at the clock more often</td>
<td></td>
</tr>
<tr>
<td><em>31</em> I am more likely to remember to do something if it is related to</td>
<td></td>
</tr>
<tr>
<td>what I am already doing e.g. I remember to get petrol whilst driving</td>
<td>.38</td>
</tr>
<tr>
<td><em>49</em> I am always thinking about things that need to be done</td>
<td></td>
</tr>
<tr>
<td>60* I remember the main parts of instructions (e.g. buy milk) but I</td>
<td>.32</td>
</tr>
<tr>
<td>forget details (e.g. buy two litres of skim milk)</td>
<td></td>
</tr>
<tr>
<td>78 I make lists to help me remember to do things</td>
<td>.81</td>
</tr>
<tr>
<td><em>46</em> I use a diary or calendar to help me remember to do things</td>
<td></td>
</tr>
<tr>
<td><em>76</em> I am more likely to remember things if I make lists or draw</td>
<td></td>
</tr>
<tr>
<td>pictures</td>
<td>.69</td>
</tr>
<tr>
<td><em>47</em> I use an alarm clock or a phone to help me remember to do things</td>
<td></td>
</tr>
<tr>
<td><em>69</em> I know that I am going to need a memory aid such as a note, list,</td>
<td>.46</td>
</tr>
<tr>
<td>or alarm</td>
<td></td>
</tr>
<tr>
<td><em>4</em> If I borrow someone else’s personal belonging (e.g. a book) I will</td>
<td></td>
</tr>
<tr>
<td>remember to give it back</td>
<td>--</td>
</tr>
</tbody>
</table>

*Note.* * = Items eliminated from 69 item scale. Component 1 = Everyday Memory, Component 2 = Memory Concerns, Component 3 = Cognition, Component 4 = Memory Strategies. = negative component loadings.

**Internal consistency reliability.** The overall scale and four components scales were examined for internal consistency reliability using Cronbach’s alpha (see Table M3). As can be seen in the table, the draft PMCQ total scale was found to have good reliability, whilst each component had adequate to excellent internal consistency scores.
Table M3

*Internal Consistency of Items in the Draft PMCQ Total Scale and Four Components*

<table>
<thead>
<tr>
<th>Scale</th>
<th>(\alpha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Draft PMCQ total scale</td>
<td>.81</td>
</tr>
<tr>
<td>Everyday Memory</td>
<td>.90</td>
</tr>
<tr>
<td>Memory Concerns</td>
<td>.87</td>
</tr>
<tr>
<td>Cognition</td>
<td>.77</td>
</tr>
<tr>
<td>Memory Strategies</td>
<td>.79</td>
</tr>
</tbody>
</table>

*Note.* Alpha scores range from 0 to 100 with higher scores indicating better reliability.

This analysis not only demonstrated the internal consistency of the draft PMCQ scale and its components, it also informed the decision of which items to retain or eliminate on the basis of improving scale reliability. The four component alphas were compared to the component alphas if any of the scale items were deleted. If component reliability was improved significantly by the removal of an item, this suggested that the item should be deleted from the scale. Overall, few improvements were found and these alpha changes were small (no greater than .01). On the draft PMCQ total scale, the removal of Item 11 “if interrupted while doing something, I remember to finish it later”, Item 73 “I am the person in our household responsible for remembering appointments, birthdays, or events” and Item 74 “I like to make sure that I am never late if I have to be somewhere” each increased the scale alpha to .82. On the Memory Strategies component, the deletion of Item 47 “I use an alarm clock or a phone to help me remember” enhanced the scale alpha to .80. As these changes to scale alphas were negligible no items were removed from the scale on the basis of this reliability analysis alone.

**Predictive validity.** In addition to determining the scale’s structure and reliability, an analysis of how well the scale and its components discriminated between participants in the
non-referred group from those in the referred group was carried out. Also analysed were the differences between the non-referred group and the subsamples of the referred group, that is, the brain injury and MCI/dementia groups. Before conducting these analyses, component scores for each of the four components were calculated by computing an average score for each item within each component. An average score was used as opposed to a summative score as average scores can be computed where there is missing data without the use of an imputation procedure, whilst summative scores cannot. These component scores and the draft PMCQ total scale score were used in the group comparisons, which involved one-way ANOVAs and a DA.

One-way ANOVAs were conducted on the scales with the brain injury and MCI/dementia samples combined (i.e. referred group). The descriptive statistics for this analysis are provided in Table M4. Levene’s tests revealed that the assumption of homogeneity of variance was violated for the Everyday Memory component (5.56, \( p = .02 \)) and the Memory Concerns component (9.00, \( p = .003 \)). Therefore, the Welch statistic was reported for these analyses.

Table M4

<table>
<thead>
<tr>
<th>Scales</th>
<th>Non-referred (( n = 134 ))</th>
<th>Referred (( n = 19 ))</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( M )</td>
<td>( SD )</td>
</tr>
<tr>
<td>Everyday Memory</td>
<td>.69</td>
<td>.33</td>
</tr>
<tr>
<td>Memory Concerns</td>
<td>.85</td>
<td>.36</td>
</tr>
<tr>
<td>Cognition</td>
<td>1.55</td>
<td>.42</td>
</tr>
<tr>
<td>Memory Strategies</td>
<td>1.51</td>
<td>.74</td>
</tr>
<tr>
<td>Draft PMCQ total scale</td>
<td>1.01</td>
<td>.25</td>
</tr>
</tbody>
</table>

*Note: Mean scores are average scale scores that range from 0 to 3 with high scores indicating more memory concerns. Scores of 0 = Never, 1 = Sometimes, 2 = Often, and 3 = Always.*
The non-referred group were found to have significantly less memory concerns than the referred group on the draft PMCQ total scale, $F(1, 151) = 9.72, p = .002, 95\% \text{ CI } [-.22, -.07]$, $\eta^2_p = .06$, and on the Memory Concerns component, $F(1, 20.46) = 7.29, p = .014, 95\% \text{ CI } [-.59, -.08]$. The non-referred group also reported having a better use of memory strategies on the Memory Strategies component $F(1, 151) = 6.97, p = .009, 95\% \text{ CI } [-.82, -.12]$, $\eta^2_p = .04$. These effect sizes were of a small to medium size. On the Everyday Memory component the non-referred group had less memory concerns than the referred group, however this effect did not reach significance, $F(1, 20.11) = 2.27, p = .147, 95\% \text{ CI } [-.44, .07]$. Together, these findings indicated that the scales were able to distinguish between those with good versus poor PM quite well. The Cognition component on the other hand did not appear to separate the two groups. In fact, the mean score of both groups on this component was identical, $F(1,151) = .002, p = .966, 95\% \text{ CI } [-.22, .20]$, $\eta^2_p = < .001$. This component in particular required further refining in subsequent item analyses.

To assess the differences between the referred and non-referred groups in more detail, one-way ANOVAs were conducted comparing the non-referred group with the brain injury and MCI/dementia subgroups of the referred sample on each component. Means and standard deviations for the three groups on the total scale and four components are presented in Table M5. The assumption of homogeneity was violated on the Memory Concerns component (Levene’s statistic = 4.85, $p = .009$). Therefore, the Welch statistic and Games-Howell post-hoc comparisons were used for this component. Post-hoc analyses for the remaining scales were conducted using the Scheffé test (Scheffé, 1953).
Table M5

**Average Draft PMCQ Scale and Component Scores Across Groups**

<table>
<thead>
<tr>
<th>Scales</th>
<th>Non-referred (n = 134)</th>
<th>Brain injury (n = 12)</th>
<th>MCI/Dementia (n = 7)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
</tr>
<tr>
<td>Everyday Memory</td>
<td>.69</td>
<td>.33</td>
<td>.79</td>
</tr>
<tr>
<td>Memory Concerns</td>
<td>.85</td>
<td>.36</td>
<td>1.19</td>
</tr>
<tr>
<td>Cognition</td>
<td>1.55</td>
<td>.42</td>
<td>1.65</td>
</tr>
<tr>
<td>Memory Strategies</td>
<td>1.51</td>
<td>.74</td>
<td>2.07</td>
</tr>
<tr>
<td>Draft PMCQ total scale</td>
<td>1.01</td>
<td>.25</td>
<td>1.21</td>
</tr>
</tbody>
</table>

*Note: Mean scores are average scale scores that range from 0 to 3 with high scores indicating more memory concerns. Scores of 0 = Never, 1 = Sometimes, 2 = Often, and 3 = Always.*

Significant differences of a medium effect size were found on the draft PMCQ total scale, $F(2, 150) = 4.83, p = .009$, $\eta^2_p = .06$, and post-hoc analyses revealed that the non-referred group had less memory concerns than the brain injury group, $p = .039$, 95% CI [-.39, -.01]. Analysis of the subscales indicated that the three groups did not significantly differ on the Everyday Memory component, $F(2, 150) = 3.16, p = .045$, $\eta^2_p = .04$, on the Memory Concerns component, $F(2, 10.97) = 3.29, p = .076$ or on the Cognition component, $F(2, 150) = .81, p = .446$, $\eta^2_p = .01$. However, a small to medium significant effect was found on the Memory Strategies component, $F(2,150) = 3.69, p = 027$, $\eta^2_p = .05$, whereby post-hoc analyses revealed that the non-referred group reported better use of strategies than the brain injury group, $p = .043$, 95% CI [-1.10, -.01]. On the draft PMCQ total scale and Everyday Memory, Memory Concerns, and Memory Strategies components the non-referred group reported better memory than the MCI/dementia group however these group differences all failed to reach significance.
**Scale dimensionality.** The total draft PMCQ scale and component scales also underwent a Rasch analysis. First, each component was assessed for multidimensionality using a PCAR once the modelled dimension was removed. Of particular interest was the amount the variance explained by the first contrast in the residuals where eigenvalues below 2.0 indicate scale unidimensionality. Table M6 shows the eigenvalues for the first contrast obtained in the PCAR for each scale. These eigenvalues suggest that the items in both the Everyday Memory and Memory Concerns components may be measuring more than one dimension, whereas the Cognition and Memory Strategies are unidimensional.

Table M6

*PCAR Eigenvalues*

<table>
<thead>
<tr>
<th>Scale</th>
<th>Eigenvalues of PCA on residuals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Everyday Memory</td>
<td>2.4</td>
</tr>
<tr>
<td>Memory Concerns</td>
<td>2.0</td>
</tr>
<tr>
<td>Cognition</td>
<td>1.9</td>
</tr>
<tr>
<td>Memory Strategies</td>
<td>1.7</td>
</tr>
<tr>
<td>Draft PM total scale</td>
<td>7.9</td>
</tr>
</tbody>
</table>

**Item fit.** In addition to these analyses that evaluated the overall functioning of the draft PMCQ and components, an assessment of the functioning of individual items within each of the scales was carried out. These analyses assisted in informing decisions of retaining or removing of items from the PMCQ. First, mean square fit statistics were assessed for each item within the four components. Fit statistics for the total draft PMCQ were not assessed, as this would have overlapped with the item fit statistics within each component. Infit scores are weighted mean square statistics that are sensitive to unexpected scores close to a person’s ability level on the scale. Outfit scores on the other hand are unweighted statistics, which are
more sensitive to outlying scores. Mean square scores below 0.7 indicated that items were too predictive as they related to other items loading on the same dimension, and therefore provided little additional information about the dimension. Alternatively, mean square scores above 1.3 suggested that items were too noisy and unpredictable, that is, they did not load consistently onto the measured dimension. Person fit statistics were not analysed in this study as the primary interest was to assess item functioning in developing the PMCQ scale.

On the Everyday Memory component, Item 32 “I remember to do things that I need to do on a daily basis e.g. brush my teeth, shower, and eat meals” (infit = 1.35, outfit = 1.40) and Item 75 “I like to be organised all of the time” (infit = 2.17, outfit = 4.50) demonstrated underfit and unpredictability. Conversely, Item 52 “I do things twice because I forget that I have already done them e.g. take a tablet twice” and Item 53 “I think that I have done things what I actually have not done them” were both found to be slightly overfitting and predictable (infit = .79, outfit = .68 for both items). On the Memory Concerns component, Item 58 “I have trouble remembering recent events in my life” was found to be overfitting and possibly redundant (infit = .67, outfit = .64), whilst Item 59 “I have trouble remembering events from my childhood or a long time ago” was slightly underfitting (infit = 1.30, outfit = 1.30). On the Memory Strategies component, Item 46 “I use a diary or calendar to help me remember to do things” showed some overfit (infit = .72, outfit = .61), whilst item 47 “I use an alarm clock or a mobile phone to help me remember to do things” exhibited some underfit (infit = 1.37, outfit = 1.40). All other items had acceptable fit indices.

**Rating scale functioning.** The functioning of the rating scale response categories for each PMCQ item within the four components was assessed. Just as items should be located at a specific point or difficulty level on a dimension, so should response categories within items. Specifically, a person high in PM ability on any given item should endorse a higher response category than a person with low levels of PM ability. For example, an individual with more
memory concerns should endorse the *Always* category more often than an individual with less memory concerns. Therefore, an examination of item response category average measures for items within each of the four components was carried out. Average measures can be defined as the average ability of persons responding to a particular response category, for example, the average ability of persons that respond to the *Never* category (Linacre, 2009b). The average measures for items within each of the four components are shown in Figures M1-M4.

On the right-hand side of each figure are the component item hierarchies with the most difficult item at the top and the easiest memory item at the bottom. Adjacent to each item (within the box) are the observed average person measures for each rating scale category. Theoretically these ability measures should increase in ascending order from left to right so that more difficult items are endorsed by people with greater ability (i.e. the category should be ordered 0, 1, 2, 3). If these measures are disordered then the response categories are not performing as expected. An example of category disordering is when a person of high ability is more likely to rate an item as 2 *Sometimes*, whilst a person of lower ability is more likely to rate the same item as 3 *Often*. Category disordering such as this may occur because people of higher or lower ability than intended for the response category are endorsing the category unexpectedly, the response category is not being used as predicted, or there is a problem with the item.
Figure M1. Average measures for rating scale categories in the Everyday Memory scale.

Figure M2. Average measures for rating scale categories in the Memory Concerns scale.
Figure M3. Average measures for rating scale categories in the Cognition scale.

Figure M4. Average measures for rating scale categories in the Memory Strategies scale.

Note. Average measures for rating scale categories are listed inside the box with 0 = Never, 1 = Sometimes, 2 = Often, and 3 Always categories. Item numbers are listed on the right-hand side of the figure. The logit measurement scale for the average measures is displayed at the top and bottom of the box.
Figure M1 shows the average measures for the Everyday Memory component. For the majority of items in this component, the average measures increased monotonically from left to right (i.e. they are ordered 0, 1, 2, 3). Items 32 however had some considerable category disordering, as the average measures were almost the opposite of what would be expected (i.e. it is ordered 0, 3, 2, 1). Other items had some disordering but to a lesser extent (e.g. 0, 1, 3, 2). Another issue that can be seen in the figure is that for some items, not every response category was endorsed. For example, in Item 7 “I put things in the wrong place e.g. milk in the cupboard and sugar in the fridge” the Always category was not endorsed at all by the sample. Items that demonstrated disordering or had categories were not endorsed were flagged for further analysis.

Figure M2 shows the observed average measures for items within the Memory Concerns component. Item 6 “I walk into a room and forget why I went there” had considerable category disordering (i.e. 0, 3, 1, 2), while some items showed disordering to a lesser extent with the Often and Always categories ordered incorrectly. On this scale, two items (Item 5 and Item 26) did not have participants endorse the Always category. These items that were not functioning as expected were flagged for further analysis.

Figure M3 depicts the observed average measures for items within the Cognition component. The rating scales for each item within this component function very well with the response categories increasing from left to right as expected. Item 45 “When there is something I must remember to do at a certain time I look at the clock more often” had very marginal category disordering with the Never and Sometimes categories in reverse order. As a result, this item was flagged for further analysis.

Figure M4 displays the observed average measures for the five items on the Memory Strategies component. The response categories for each of these items increased as expected demonstrating that the rating scales on these items were functioning appropriately.
**Item removal.** The findings of the PCA, Reliability Analysis, and Rasch Analysis were used collectively to determine which items were performing poorly and needed to be deleted. Poorly performing items were those on the PCA with low component loadings (around .3) or items that loaded significantly onto multiple components. In the Reliability Analysis, items that were found to improve scale validity if they were deleted were also highlighted as indicating poor functioning. Problematic items in the Rasch analysis were those that demonstrated misfit or poor category functioning. Items were typically eliminated if they met more than one of these criteria, although item content was considered. For example, when multiple items contained similar content, the items with better psychometric properties were retained, whilst the less effective items were eliminated. A total of 23 items were removed from the draft PMCQ scale as a result of these analyses. These items are shown in Table M7. Furthermore, items 32 and 65 were combined. At the conclusion of these analyses, 46 items remained within the draft PMCQ scale.
Table M7

*Items Eliminated from the PMCQ 69-Item Scale*

<table>
<thead>
<tr>
<th>Items</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>If I lend someone a personal belonging (e.g. a book) I will remember to ask for it back</td>
</tr>
<tr>
<td>4</td>
<td>If I borrow someone else’s personal belongings (e.g. a book) I will remember to give it back</td>
</tr>
<tr>
<td>9</td>
<td>I am good at remembering dates, phone numbers, and birthdays</td>
</tr>
<tr>
<td>12</td>
<td>If I miss an appointment, I will remember to reschedule it for a later time</td>
</tr>
<tr>
<td>25</td>
<td>If I have a lot of things to do, I like to plan how and when I will do them</td>
</tr>
<tr>
<td>28</td>
<td>I am more likely to remember to do something if I am anxious or worried about it</td>
</tr>
<tr>
<td>30</td>
<td>I am more likely to remember to do something if I do it often</td>
</tr>
<tr>
<td>31</td>
<td>I am more likely to remember to do something if it is related to what I am already doing e.g. I remember to get petrol whilst driving</td>
</tr>
<tr>
<td>35</td>
<td>At the supermarket I can remember at least 5 things that I need to buy without using a list</td>
</tr>
<tr>
<td>38</td>
<td>If I am giving instructions, I will forget at least one step</td>
</tr>
<tr>
<td>40</td>
<td>Worrying about things that I have to do means that I tend to keep thinking about them</td>
</tr>
<tr>
<td>45</td>
<td>When there is something I must remember to do at a certain time I look at the clock more often</td>
</tr>
<tr>
<td>46</td>
<td>I use a diary or calendar to help me remember to do things</td>
</tr>
<tr>
<td>47</td>
<td>I use an alarm clock or a phone to help me remember to do things</td>
</tr>
<tr>
<td>49</td>
<td>I am always thinking about things that need to be done</td>
</tr>
<tr>
<td>55</td>
<td>I am able to remember to do something if it involves telling somebody something e.g. passing on a message</td>
</tr>
<tr>
<td>59</td>
<td>I have trouble remembering events from my childhood or a long time ago</td>
</tr>
<tr>
<td>63</td>
<td>I like to keep track in my mind of things that I have done</td>
</tr>
<tr>
<td>65</td>
<td>I forget to take my medication as prescribed</td>
</tr>
<tr>
<td>73</td>
<td>I am the person in our household responsible for remembering appointments, birthdays, or events</td>
</tr>
<tr>
<td>74</td>
<td>I like to make sure that I am never late if I have to be somewhere e.g. an appointment</td>
</tr>
<tr>
<td>75</td>
<td>I like to be organised all of the time</td>
</tr>
<tr>
<td>76</td>
<td>I am more likely to remember things if I make lists or draw pictures</td>
</tr>
</tbody>
</table>
Item Analyses of the 46 Item Scale

Construct validity. A PCA was conducted on the remaining 46 items to further reduce the number of items in the PMCQ. Using the MAP test (Velicer, 1976), three components were extracted from the scale. These three components were only weakly correlated (correlations were below .32), therefore a Varimax orthogonal rotation was carried out with Kaiser normalisation. This solution accounted for 33.07% of the variance in the scale, however more than 25 iterations were required to create this solution. Specifically, the first component in this rotated solution accounted for 12.59% of the variance (eigenvalue = 5.79), the second component 11.94% (eigenvalue = 5.49), and the third component 8.54% (eigenvalue = 3.93) of the variance within the data. The component loadings for the 46 items obtained in the orthogonal PCA solution are shown in Table M8.
Table M8

Component Loadings in the Principal Component Analysis of the 46-Item Scale

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Component Loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>When I am given a message to pass on, I forget what the message was</td>
<td>.63</td>
</tr>
<tr>
<td>50</td>
<td>I am good at remembering to do things on time</td>
<td>.62</td>
</tr>
<tr>
<td>1</td>
<td>I forget to do daily tasks such as paying bills, posting letters, or putting the garbage out</td>
<td>.60</td>
</tr>
<tr>
<td>53</td>
<td>I think that I have done things when I actually have not done them</td>
<td>.56</td>
</tr>
<tr>
<td>2</td>
<td>I forget to pass important messages on to family, friends, or colleagues</td>
<td>.54</td>
</tr>
<tr>
<td>22</td>
<td>When I have to do two things at once, I have trouble remembering to do both</td>
<td>.54 .36</td>
</tr>
<tr>
<td>36</td>
<td>I remember things that I need to do even if I am in the middle of a busy task</td>
<td>.53</td>
</tr>
<tr>
<td>10</td>
<td>I forget important appointments</td>
<td>.52</td>
</tr>
<tr>
<td>52</td>
<td>I do things twice because I forget that I have already done them e.g. take a tablet twice</td>
<td>.51</td>
</tr>
<tr>
<td>32</td>
<td>I remember to do everyday tasks such as take medication, brush my teeth, or shower</td>
<td>.50</td>
</tr>
<tr>
<td>16</td>
<td>I forget to do things that can be done in a sequence e.g. buy a stamp, put the stamp on an envelope, and post it</td>
<td>.45 .40</td>
</tr>
<tr>
<td>21</td>
<td>Seeing places or objects can remind me that I need to do something, but I can’t remember exactly what it is</td>
<td>.45 .30</td>
</tr>
<tr>
<td>23</td>
<td>I forget to do things because I get carried away doing something else</td>
<td>.42 .38</td>
</tr>
<tr>
<td>58</td>
<td>I have trouble remembering recent events in my life</td>
<td>.34 .64</td>
</tr>
<tr>
<td>57</td>
<td>I have trouble remembering the names of people and places</td>
<td>.61</td>
</tr>
<tr>
<td>69</td>
<td>I know that I am going to need a memory aid such as a note, list, or alarm</td>
<td>.60</td>
</tr>
<tr>
<td>48</td>
<td>I forget important dates, birthdays, or anniversaries</td>
<td>.55</td>
</tr>
</tbody>
</table>

*Note. Component 1 = Forgetting Behaviours, Component 2 = Memory Concerns, Component 3 = Retrieval Cues.*
Table M8 (continued).

Component Loadings in the Principal Component Analysis of the 46-Item Scale

<table>
<thead>
<tr>
<th>Item</th>
<th>Components</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>70</td>
<td>It takes longer to do mental tasks that it used to e.g. crosswords</td>
<td>.54</td>
<td></td>
<td></td>
</tr>
<tr>
<td>77</td>
<td>I have trouble thinking of ways to help my memory</td>
<td>.54</td>
<td></td>
<td></td>
</tr>
<tr>
<td>68</td>
<td>I worry that my memory is getting worse</td>
<td>.53</td>
<td></td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>I have trouble remembering things that I need to do in a few hours’ time</td>
<td>.45 .48</td>
<td></td>
<td></td>
</tr>
<tr>
<td>37</td>
<td>I have trouble remembering corrections or instructions</td>
<td>.47</td>
<td></td>
<td></td>
</tr>
<tr>
<td>72</td>
<td>I get frustrated with myself because I forget to do things I was supposed to do</td>
<td>.47 .34</td>
<td></td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>If I am anxious or worried about something, I forget things that I am supposed to be doing e.g. I forget items on the shopping list</td>
<td>.46</td>
<td></td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>I have trouble remembering things that I need to do in 15 minutes time</td>
<td>.38 .46</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>There are times when I remember that I need to do something but I can’t remember what it is</td>
<td>.42 .36</td>
<td></td>
<td></td>
</tr>
<tr>
<td>39</td>
<td>I have trouble switching my attention between two different things e.g. watching TV and talking to someone at the same time</td>
<td>.41</td>
<td></td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>I forget to do some things I have planned to do</td>
<td>.40 .31</td>
<td></td>
<td></td>
</tr>
<tr>
<td>41</td>
<td>When I am tired, stressed, angry, or upset I forget to do things more often than normal</td>
<td>.36</td>
<td></td>
<td></td>
</tr>
<tr>
<td>78</td>
<td>I make lists to help me remember to do things</td>
<td>.34 .35 .31</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>If interrupted while doing something, I remember to finish it later</td>
<td>.31 .35</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>I forget what I was talking about midsentence</td>
<td>.35 .35</td>
<td></td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>I forget to do things but remember that I was meant to do them after it is too late</td>
<td>.30 .33</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>I am more likely to remember to do something if there is something to remind me e.g. an object or a person</td>
<td>.66</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note. Component 1 = Forgetting Behaviours, Component 2 = Memory Concerns, Component 3 = Retrieval Cues.*
Table M8 (continued).

Component Loadings in the Principal Component Analysis of the 46-Item Scale

<table>
<thead>
<tr>
<th>Item</th>
<th>Seeing places (e.g. a supermarket) or objects (e.g. a teapot) can remind me that I need to do something (e.g. buy sugar)</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>.65</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>62</td>
<td>I am more likely to remember to do things if I say them over and over to myself</td>
<td>.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>I forget to hang the washing out once the washing machine cycle has finished</td>
<td>.35</td>
<td>.48</td>
<td></td>
</tr>
<tr>
<td>61</td>
<td>I remember to do things by associating them with other things e.g. I associate a person who I need to pass a message on to with a certain place</td>
<td></td>
<td></td>
<td>.46</td>
</tr>
<tr>
<td>18</td>
<td>I forget where I have placed things e.g. keys or money</td>
<td>.43</td>
<td></td>
<td></td>
</tr>
<tr>
<td>54</td>
<td>I tell people the same story because I forget that I have already told them</td>
<td>.42</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>I put things in the wrong place e.g. milk in the cupboard and sugar in the fridge</td>
<td>.37</td>
<td>.42</td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>I remember the main parts of instructions (e.g. buy milk) but I forget details (e.g. by two litres of skim milk)</td>
<td></td>
<td></td>
<td>.42</td>
</tr>
<tr>
<td>51</td>
<td>I can only remember that I have a message to pass on when I see the person the message is for</td>
<td></td>
<td></td>
<td>.39</td>
</tr>
<tr>
<td>66</td>
<td>I forget to turn the stove or iron off</td>
<td>.37</td>
<td>.38</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>I walk into a room and forget why I went there</td>
<td>.31</td>
<td>.35</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>I find that I don’t get anything done that I planned to do because I get interrupted all the time</td>
<td></td>
<td></td>
<td>.34</td>
</tr>
</tbody>
</table>

Note. Component 1 = Forgetting Behaviours, Component 2 = Memory Concerns, Component 3 = Retrieval Cues.

The three components were analysed visually to determine common themes in item content. Component 1 was labelled Forgetting Behaviours as it contained items measuring common PM forgetting behaviours. The highest loading item on this component was Item 15 “When I am given a message to pass on, I forget what the message was”. Component 2 was
named Memory Concerns and consisted of items pertaining to memory worries for example, items related to anxiety, meta-memory, and memory errors. An example of a meta-memory item on this component is Item 69 “I know when I am going to need a memory aid such as a note, list, or alarm”. Conversely, Component 3 was labelled Retrieval Cues as it referred to memory activation, attention, and retrieval cues. Item 54 “I tell people the same story because I forget that I have a ready told them” reflects a failure in distinguishing between retrieval cues of current and previous intentions (i.e. an output monitoring error), and is an example of an item on this component.

**Internal consistency reliability.** An examination of the internal consistency of the draft PMCQ scale and its three components was carried out. The results of these analyses are reported in Table M9. The draft PMCQ total scale had excellent reliability, whilst the component subscales all had good internal consistency reliability.

Table M9

<table>
<thead>
<tr>
<th>Scale</th>
<th>α</th>
</tr>
</thead>
<tbody>
<tr>
<td>Draft PMCQ total scale</td>
<td>.91</td>
</tr>
<tr>
<td>Forgetting Behaviours</td>
<td>.84</td>
</tr>
<tr>
<td>Memory Concerns</td>
<td>.78</td>
</tr>
<tr>
<td>Retrieval Cues</td>
<td>.77</td>
</tr>
</tbody>
</table>

*Note. Alpha scores range from 0 to 100 with higher scores indicating better reliability.*

The Reliability Analysis also assessed whether the deletion of any items would improve each component’s reliability. This was done by comparing each scale’s alpha score with the alpha if items were to be deleted from the scale. These comparisons revealed that neither the Forgetting Behaviours nor Retrieval Cues components would have improved internal consistency reliability if items were deleted from the scales. However, the Memory
Concerns component would be slightly improved with the removal of Item 78 “I make lists to help me remember to do things” whereby the scale’s alpha would increase to .88. The internal consistency of the total scale (containing all 46 items) was also marginally improved if some items were removed from the scale. However, the magnitude of these improvements was minimal, being only .01 or .02. Therefore, no items were removed solely on the basis of the reliability analysis.

**Item removal.** At this stage of the analysis, Item 78 was found to have met multiple criteria for deletion. That is, the PCA revealed that the item loaded significantly onto all three components, each with low loadings. Furthermore, the reliability analysis indicated that the Memory Concerns component would be improved if this item were deleted. As a result, Item 78 was eliminated from the draft PMCQ.

An investigation of the PCA component loadings of the remaining 45 items revealed that many items cross loaded onto multiple components. As discussed in Chapter 5, a series of Rasch analyses were conducted to maximise the psychometric properties of each component. During these analyses, cross loading items were taken from their highest loading component and placed on to components where they loaded to a lesser extent but where item fit and scale dimensionality were best. As a result of these analyses, three items (Items 27, 33, and 34) were removed as they were found to decrease the psychometric properties of all three components. In addition, five items that were cross loading were moved to the component that resulted in the best psychometric properties (see Table 8). Finally, some items were slightly reworded to increase item reliability. However, overall content and phrasing of these items was maintained to preserve the psychometric properties of the items. These changes are shown in Table M10. At the conclusion of these analyses, 42 items were retained for what was to be the final version of the PMCQ.
### Table M10

Changes Made to Items in 46-Item Scale

<table>
<thead>
<tr>
<th>Item</th>
<th>Original item</th>
<th>Reworded item</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>I forget what I was talking about midsentence</td>
<td>In the middle of a sentence I forget what I was going to say</td>
</tr>
<tr>
<td>15</td>
<td>I forget to hang washing out once the washing machine cycle has finished</td>
<td>I forget to do things that I have started e.g. hanging washing out once the washing machine has finished</td>
</tr>
<tr>
<td>24</td>
<td>I find that I don’t get anything done that I planned to do because I get interrupted all the time</td>
<td>I find that I don’t return to planned tasks if I get interrupted</td>
</tr>
<tr>
<td>29</td>
<td>If I am anxious or worried about something, I forget things that I am supposed to be doing e.g. I forget items on the shopping list</td>
<td>I forget things that I am supposed to be doing if I am anxious or worried about something</td>
</tr>
<tr>
<td>32</td>
<td>I remember to do everyday tasks such as take medication, brush my teeth, or shower</td>
<td>I remember to do everyday tasks such as take medication, brush my teeth, or shower</td>
</tr>
<tr>
<td>36</td>
<td>I remember things that I need to do even if I am in the middle of a busy task</td>
<td>I remember to do things I need to do even if I am in the middle of another task</td>
</tr>
<tr>
<td>60</td>
<td>I remember the main part of instructions (e.g. buy milk) but I forget details (e.g. buy two litres of skim milk)</td>
<td>I remember the main part of instructions (e.g. buy milk) but I forget details (e.g. buy two litres of milk)</td>
</tr>
</tbody>
</table>
Appendix N: The Prospective and Retrospective Memory Questionnaire (PRMQ)

In order to understand why people make memory mistakes, we need to find out about the types of mistakes people make, and how often they are made in normal everyday life. We would like you to tell us how often these kinds of things happen to you. **Please respond by circling the number that corresponds to your answer.** Please make sure that you answer all of the questions even if they do not seem applicable to you.

1. Do you decide to do something in a few minutes’ time and then forget to do it?
2. Do you fail to recognise a place you have visited before?
3. Do you fail to do something you were supposed to do a few minutes later even though it’s there in front of you, like take a pill or turn off the kettle?
4. Do you forget something that you were told a few minutes before?
5. Do you forget appointments if you are not prompted by someone else or by a reminder such as a calendar or diary?
6. Do you fail to recognise a character in a radio or television show from scene to scene?
7. Do you forget to buy something you planned to buy, like a birthday card, even when you see the shop?
8. Do you fail to recall things that have happened to you in the last few days?
9. Do you repeat the same story to the same person on different occasions?
10. Do you intend to take something with you, before leaving a room or going out, but minutes later leave it behind, even though it’s there in front of you?
11. Do you mislay something that you have just put down, like a magazine or glasses?
12. Do you fail to mention or give something to a visitor that you were asked to pass on?
13. Do you look at something without realising you have seen it moments before?
14. If you tried to contact a friend or relative who was out, would you forget to try again later?
15. Do you forget what you watched on television the previous day?
16. Do you forget to tell someone something you have meant to mention a few minutes ago?
Appendix O: The Social Desirability Scale-17 (SDS-17)

Below you will find a list of statements. Please read each statement carefully and decide if that statement describes you or not. If it describes you, please circle “True” (T), if it does not describe you, circle “False” (F).

1. I sometimes litter
2. I always admit my mistakes openly and face the potential negative consequences
3. In traffic I am always polite and considerate of others
4. I always accept others’ opinions, even when they don’t agree with my own
5. I take out my bad moods on others now and then
6. There has been an occasion when I took advantage of someone else
7. In conversations I always listen attentively and let others finish their sentences
8. I never hesitate to help someone in case of emergency
9. When I have made a promise, I keep it - no ifs, ands, or buts
10. I occasionally speak badly of others behind their back
11. I would never live off at other people’s expense
12. I always stay friendly and courteous with other people, even when I am stressed out
13. During arguments I always stay objective and matter-of-fact
14. There has been at least one occasion when I failed to return an item that I borrowed
15. I always eat a healthy diet
16. Sometimes I only help because I expect something in return
Appendix P: The Australian Personality Inventory (API)

Please read each statement very carefully and indicate how accurate or inaccurate these statements are about your behaviour and personality by circling the number that best describes your feelings. Please answer honestly as there are no correct or incorrect answers.

1. I often feel blue
2. I feel comfortable around people
3. I do not like art
4. I have a good word for everyone
5. I am always prepared
6. I dislike myself
7. I make friends easily
8. I have a vivid imagination
9. I believe that others have good intentions
10. I pay attention to details
11. I am often down in the dumps
12. I am skilled in handling social situations
13. I have a rich vocabulary
14. I respect others
15. I get chores done right away
16. I have frequent mood swings
17. I am the life of the party
18. I carry the conversation to a higher level
19. I accept people as they are
20. I carry out my plans
21. I panic easily
22. I know how to captivate people
23. I enjoy hearing new ideas
24. I make people feel at ease
25. I make plans and stick to them
26. I seldom feel blue
27. I have little to say
28. I am not interested in abstract ideas
29. I have a sharp tongue
30. I waste my time
31. I feel comfortable with myself
32. I keep in the background
33. I enjoy wild flights of fantasy
34. I cut others to pieces
35. I find it difficult to get down to work
36. I rarely get irritated
37. I would describe my experience as somewhat dull
38. I avoid philosophical discussions
39. I suspect hidden motives in others
40. I do just enough work to get by
41. I am not easily bothered by things
42. I don’t like to draw attention to myself
43. I do not enjoy going to art museums
44. I get back at others
45. I don’t see things through
46. I am very pleased with myself
47. I don’t talk a lot
48. I rarely look for a deeper meaning in things
49. I insult people
50. I shirk my duties
Appendix Q: Addenbrookes Cognitive Exam-Revised (Australian Version A)

**ADDENBROOKE'S COGNITIVE EXAMINATION - ACE-R**
*Final Revised Version A (May 2004) - Australian Version*

<table>
<thead>
<tr>
<th>Name:</th>
<th>Date of testing: ........ / ........ / ........</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date of birth:</td>
<td>Tester's name:</td>
</tr>
<tr>
<td>Hospital no.:</td>
<td>Age at leaving full-time education:</td>
</tr>
<tr>
<td>Addressograph</td>
<td>Occupation:</td>
</tr>
<tr>
<td></td>
<td>Handedness:</td>
</tr>
</tbody>
</table>

### ORIENTATION

- Ask: What is the Day, Date, Month, Year, Season.

### REGISTRATION

- Tell: 'I'm going to give you three words and I'd like you to repeat after me: lemon, key and ball.' After subject repeats, say 'Try to remember them because I'm going to ask you later'. Score only the first trial (repeat 3 times if necessary).

### ATTENTION & CONCENTRATION

- Ask the subject: 'could you take 7 away from a 100? After the subject responds, ask him or her to take away another 7 to a total of 5 subtractions. If subject make a mistake, carry on and check the subsequent answer (i.e. 93, 84, 77, 70, 63 -score 4).
SELF-REPORTED PROSPECTIVE MEMORY

ADDENBROEKE'S COGNITIVE EXAMINATION - ACE-R
Final Revised Version A (May 2004)

VERBAL FLUENCY - Letter 'P' and animals

- Letters
  Say: 'I'm going to give you a letter of the alphabet and I'd like you to generate as many words as you can beginning with that letter, but not names of people or places. Are you ready? You've got a minute and the letter is P.'

  [Score 0 - 7]

- Animals
  Say: 'Now can you name as many animals as possible, beginning with any letter?'

  [Score 0 - 7]

LANGUAGE - Comprehension

- Show written instruction:

  Close your eyes

LANGUAGE - Writing

- Ask the subject to make up a sentence and write it in the space below.
  Score 1 if sentence contains a subject and a verb (see guide for examples)

  [Score 0-3]
### ADDENBROOKE'S COGNITIVE EXAMINATION - ACE-R

**Language - Repetition**

- Ask the subject to repeat: *hippopotamus; eccentricity; unintelligible; statistician*
  
  Score 2 if all correct; 1 if 3 correct; 0 if 2 or less.

- Ask the subject to repeat: *Above, beyond and below*

- Ask the subject to repeat: *No ifs, ands or buts*

**Language - Naming**

- Ask the subject to name the following pictures:

  ![Pencil](image1)
  ![Watch](image2)
  ![Kangaroo](image3)
  ![Anchor](image4)
  ![Camel](image5)
  ![Barrel](image6)
  ![Parrot](image7)
  ![Harpa](image8)
  ![Snake](image9)
  ![Accordion](image10)

**Language - Comprehension**

- Using the pictures above, ask the subject to:
  - Point to the one which is associated with the monarchy
  - Point to the one which is a marsupial
  - Point to the one which is found in the Antarctic
  - Point to the one which has a nautical connection

[Score 0-4]
### Addenbrooke's Cognitive Examination - ACE-R

**Language - Reading**

- Ask the subject to read the following words: [Score 0-1 only if all correct]
  - sew
  - pint
  - soot
  - dough
  - height

**Visuospatial Abilities**

- Overlapping pentagons: Ask the subject to copy this diagram:

![Overlapping Pentagons Diagram]

- Wire cube: Ask the subject to copy this drawing (for scoring, see instructions guide)

![Wire Cube Diagram]

- Clock: Ask the subject to draw a clock face with numbers and the hands at ten past five. (For scoring see instruction guide: circle = 1, numbers = 2, hands = 2 if all correct)

![Clock Diagram]
PERCEPTUAL ABILITIES

- Ask the subject to count the dots without pointing them

Score 0-4

Visual spatial abilities
### ADDENBROOKE'S COGNITIVE EXAMINATION - ACE-R

#### PERCEPTUAL ABILITIES

- Ask the subject to identify the letters

#### RECALL

- Ask "Now tell me what you remember of that name and address we were repeating at the beginning"

<table>
<thead>
<tr>
<th>Harry Barnes</th>
<th>73 Market Street</th>
<th>Rockhampton</th>
<th>Queensland</th>
</tr>
</thead>
</table>

#### RECOGNITION

- This test should be done if subject failed to recall one or more items. If all items were recalled, skip the test and score 5. If only part is recalled start by ticking items recalled in the shadowed column on the right hand side. Then test not recalled items by telling "Ok, I'll give you some hints: was the name X, Y or Z?" and so on. Each recognised item scores one point which is added to the point gained by recalling.

<table>
<thead>
<tr>
<th>Jerry Barnes</th>
<th>Harry Barnes</th>
<th>73</th>
<th>Harry Bradford</th>
<th>76</th>
<th>recalled</th>
<th>recalled</th>
</tr>
</thead>
<tbody>
<tr>
<td>37 Market Road</td>
<td>Martin Street</td>
<td>Rockhampton</td>
<td>Coffs</td>
<td>New South Wales</td>
<td>Victoria</td>
<td></td>
</tr>
<tr>
<td>Queensland</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### General Scores

| MMSE | /30 |
| ACE-R | /100 |

#### Subscores

| Attention and Orientation | /18 |
| Memory | /26 |
| Fluency | /14 |
| Language | /26 |
| Visuospatial | /16 |
Research Participants Needed

I am currently seeking research participants to complete a questionnaire and an assessment on memory processes and cognitive functioning in normal ageing.

This research is being conducted by a Ph.D. candidate through Charles Sturt University.

I am looking for males and females aged over 18 years with various degrees of memory ability.

Participation will involve attending a one-hour assessment session where you will be asked to complete a questionnaire and some cognitive tasks e.g. naming objects and drawing.

Participants will go in the draw to win one of 20 gift vouchers valued at $20 from Coles/Myer, Big W, BCF or Bunnings.

If you would like to participate in this research or would like further information please contact Nicole Sugden on (mobile number) or at (email)
Appendix S: Study 3 Participant Invitation Letter

Note. This invitation letter is the version distributed to the brain injury sample. The MCI/dementia invitation letter is identical except that the MCI/dementia letter refers to retrieving information from the Aged Care Assessment Team Database. The non-referred group invitation letter did not refer to obtaining consent for information retrieval. Furthermore, researchers’ contact details and signatures have been removed from these letters.
Appendix T: Study 3 Information Sheet

Note. This information sheet is the version distributed to the brain injury sample. The MCI/dementia information sheet is identical except that the MCI/dementia letter refers to retrieving information from the Aged Care Assessment Team Database. The non-referred group information sheet did not refer to obtaining consent for information retrieval. Furthermore, researchers’ contact details and signatures have been removed from these letters.
Appendix U: Study 3 Participant Consent Form

PROSPECTIVE MEMORY: A THEORETICAL EVALUATION AND DEVELOPMENT OF A STANDARDISED QUESTIONNAIRE

PARTICIPANT CONSENT FORM

I agree to participate in the research project "Prospective memory: A theoretical evaluation and development of a standardised questionnaire" which is being conducted by Nicole Suellen at Charles Sturt University under the supervision of Associate Professor Michael Kerman and Doctor Matthew Thomas.

I have read and understood the information sheet given to me and have been given the opportunity to ask questions about my participation in this research.

The purpose of this research project has been explained to me and I am aware of potential risks and discomforts that are associated with this research.

I agree that personal information about my brain injury may be collected from the NSW brain injury clinic data set by the research team. I am aware that this information will be kept confidential by the researchers and that no identifying information about me will be used or published without my written permission.

I understand that my participation is voluntary and I am free to withdraw my participation in this research project at any time. I also understand that if I choose to withdraw that my non-identifiable questionnaire will not be able to be retrieved or withdrawn from the study once submitted. I am aware that if I choose to withdraw from this research I may do so without any negative consequences to myself or my health care.

I have read and understood the information on this form:

Name: ______________________

Signed: ____________________

Date: ______________________

The ethical aspects of this project have been approved by the Human Research Ethics Committee (HREC) of the Greater Western Area Health Service. If you have any concerns or complaints please contact:

The Executive Officer
P.O. Box 143
Bathurst, NSW 2795
Phone (02) 6339 5601

www.csu.edu.au
Charles Sturt University, Bathurst Campus, NSW, Australia, Phone: 1300 27 56 01

Note. This consent form is the version distributed to the brain injury sample. The MCI/dementia consent form is identical except that the MCI/dementia form refers to retrieving information from the Aged Care Assessment Team Database. The non-referred group consent form did not refer to retrieving clinical information.
Appendix V: Study 3 Guardian Consent Form

Prospective Memory: A Theoretical Evaluation and Development of a Standardised Questionnaire

GUARDIAN CONSENT FORM

I give consent on the behalf of_________________________ to participate in the research project “Prospective memory: A theoretical evaluation and development of a standardised questionnaire” which is being conducted by Nicole Sugdon at Charles Sturt University under the supervision of Associate Professor Michael Kieman and Doctor Matthew Thomas.

I have read and understood the information sheet given to me and have been given the opportunity to ask questions on behalf of this person about participation in this research.

The purpose of this research project has been explained to me and I am aware of potential risks and discomforts that are associated with this research.

I agree that personal information about this person’s brain injury may be collected from the NSW brain injury clinical data set by the research team. I am aware that this information will be kept confidential by the researchers and that no identifying information about this person will be used or published without my written permission.

I understand that participation in this research project is voluntary and that the participant, or myself, are free to withdraw their participation at any time. I also understand that if the participant or myself choose to withdraw that this person’s non-identifiable questionnaire will not be able to be retrieved or withdrawn once submitted. I understand that choosing to withdraw from the research will not result in any negative consequences for the person or myself, or affect the person’s health care in any way.

I have read and understood the information on this form:

Participant name: __________________________

Guardian name (print): __________________________

Guardian signature: __________________________

Date: __________________________

The ethical aspects of this project have been approved by the Human Research Ethics Committee (HREC) of the Greater Western Area Health Service. If you have any concerns or complaints please contact:

The Executive Officer
P.O. Box 143
Bathurst, NSW 2795
Phone: (02) 6339 5601

Note. This consent form is the version distributed to the brain injury sample. The MCI/dementia consent form is identical except that the MCI/dementia form refers to retrieving information from the Aged Care Assessment Team Database. This form was not applicable to the non-referred sample.
Appendix W: Naturalistic Task Scoresheet

<table>
<thead>
<tr>
<th>Switch Pens:</th>
<th>early</th>
<th>Part 2</th>
<th>late</th>
<th>prompt 1</th>
<th>prompt 2</th>
<th>no recall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time task:</td>
<td>due time</td>
<td>recall time</td>
<td>prompt 1</td>
<td>prompt 2</td>
<td>no recall</td>
<td></td>
</tr>
<tr>
<td>24-hour task:</td>
<td>call time</td>
<td>early</td>
<td>late</td>
<td>no recall</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Appendix X: The Prospective Memory Questionnaire (PMQ)

*Note.* Thank you to Roseann Hannon for the use of the PMQ in this study.

Rating scale:

| --- | --- | --- | --- | --- | --- | --- | --- | NA |
| (never) | (2 times/week) | (4 or more times/week) |

1. I missed appointments I had scheduled
2. I forgot to follow a change in my usual routine
3. I forgot to send a card for a birthday or anniversary
4. I forgot to make an important phone call
5. I told someone something that I did not mean to tell
6. I forgot to return something I borrowed
7. I forgot to pick up items I needed when shopping
8. I forgot to meet a friend on time
9. I forgot to pass on a message to someone
10. I forgot to run an errand I meant to do
11. I forgot to return a phone call
12. I forgot to make an appointment I needed to make (e.g., doctor or dentist)
13. I forgot to write an important letter
14. I forgot to return books to the library by the due date
15. I forgot to tip when I finished dinner at a restaurant
16. I forgot to turn my alarm clock off when I got up in the morning
17. I forgot to lock the door when leaving my apartment or house
18. I forgot to take my keys out of my car before locking the doors
19. I forgot to button or zip some part of my clothing as I was dressing
20. I forgot to pay the bill when finishing a meal at a restaurant
21. I forgot to put a stamp on a letter before mailing it
22. I forgot to comb my hair in the morning
23. I forgot to put on deodorant after showering or bathing
24. I forgot to flush the toilet
25. I forgot to get the groceries out of the car when I got home from the grocery store
26. I forgot to lock up my house, bike, or car
27. I forgot to shower or bathe
28. I forgot to cash or deposit my paycheck before my account ran out of money
29. I forgot what I wanted to say in the middle of a sentence
30. I forgot to say something important I had in mind at the beginning of a conversation
31. I forgot what I came into a room to get
32. I started to do something, and then forgot what it was I wanted to do
33. I forgot to bring something I meant to take with me when leaving the house
34. I got part way through a chore and forgot to finish it
35. I was driving and temporarily forgot where I was going
36. I dialled someone on the phone and forgot who I had called by the time they answered
37. I started writing a note or letter and forgot what I wanted to say
38. I started to write a check and forgot to whom it was to be paid
39. I make lists of things I need to do
40. I write myself reminder notes
41. I make a grocery list whenever I go shopping for food
42. I plan my daily schedule in advance so I will not forget things
43. I repeat things I need to do several times to myself in order to remember
44. I use external reminders like tying a string around my finger to help me remember to do things
45. I rehearse things in my mind so I will not forget to do them
46. I lay things I need to take with me by the door so I will not forget them
47. I make Post-It (sticky notes) reminders and place them in obvious places
48. I create mental pictures to help me remember to do something
49. I put things in piles so I know which ones to do first and which can wait
50. I lay in bed at night and think of things I need to do the next day so I won’t forget to do them
51. I try to do things at a regular time so I will remember to do them
52. I keep an appointment book updated in order to remember to do things
Appendix Y: The Comprehensive Assessment of Prospective Memory (CAPM)

Note. Thank you to Jennifer Fleming for permission to use the CAPM in this study.

Section A and B

Section A rating scale:

1 = never, 2 = rarely (once/month), 3 = occasionally (2-3 times/month), 4 = often (once/week), 5 = very often (daily), NA = not applicable.

Section B rating scale:

1 = not a problem at all, 2 = a slight problem, 3 = a moderate problem, 4 = a serious problem, 5 = a very serious problem, NA = not applicable.

Items

1. Forgetting to buy an item at the grocery store
2. Forgetting an appointment with your doctor or therapist
3. Leaving the iron on
4. Forgetting to put the garbage bin out
5. Forgetting a change in your daily routine (e.g. turning up to a regular meeting when the regular meeting day has been changed)
6. Not locking the door when leaving home
7. Walking into a room and forgetting why you went there
8. Mistakenly following your old routine, when it has been changed (e.g. putting out rubbish at the wrong time when the collection day has been changed)
9. Forgetting to water pot plants or the garden
10. Forgetting to pass on a message
11. Forgetting to take tablets at the prescribed time
12. Forgetting to take clothes off the line
13. Forgetting to have a shower or bath
14. Performing a routine activity twice by mistake (e.g. putting two lots of coffee in a cup)
15. Forgetting to eat a meal
16. Forgetting to get money from the bank
17. Accidentally forgetting to put an article of clothing on when you get dressed (e.g. forgetting to put your socks on)
18. Forgetting to take your wallet or purse with you when you leave the house
19. Problems remembering future personal dates, such as birthdays
20. Accidentally forgetting a grooming activity (e.g. brushing your hair, shaving)
21. Forgetting to make a telephone call you intended to make
22. Forgetting to do cleaning chores
23. Leaving water taps on
24. Not remembering to bank a cheque
25. Leaving out an ingredient you planned to use while cooking or preparing a meal
26. Accidentally forgetting to brush your teeth
27. Arriving at a shop and forgetting what you planned to buy
28. Forgetting to mention a point you intended to make during a conversation
29. Forgetting to put petrol in your car
30. Not remembering to pay bills
31. Having to check whether you have done something you have planned to do
32. Forgetting to do the laundry
33. Forgetting to meet a friend at the pre-arranged time
34. Leaving the stove on
35. Forgetting to post a letter
36. Not remembering to check the water levels/tyre pressure of your car
37. Forgetting to check your calendar or diary
38. Forgetting to turn the heater off
39. Forgetting to take your diary
Section C

Section C rating scale:

1 = *strongly disagree*, 2 = *disagree*, 3 = *agree*, 4 = *strongly agree*.

Items

1. When I forget to do something I had planned to do, it is usually not because I forgot what I had to do but because I forgot when I had to do it
2. When I forget to do something I had planned to do, it is usually because I forgot what I actually had to do
3. I frequently forget to do things that other people have asked me to do
4. I frequently forget to do things that I have planned to do
5. If something is very important to me I usually remember to do it
6. If something is very important for other people, I usually remember to do it
7. The more things (say two or three) I have to do, the more likely I will forget to do them
8. I rely on other people to remind me when I have to remember to do things
9. I do not need to rely on aids such as a diary or to-do list when I have to remember to do things
10. If I have to do one thing in the immediate future (within the next half hour), I usually remember to do it
11. I tend to forget to do things if there is a long delay before they need to be done (e.g. if I plan to do a task in three weeks’ time)
12. I tend to forget to do things if a lot of other activities take place before they need to be done
13. If I am engrossed in another task, I find it difficult to remember to do things
14. Sometimes even though I remember that something has to be done, I forget to do it if I am interrupted (e.g., by a telephone call or by a person)
15. I do not usually need to check whether I have done something because I am confident of my own memory